

Research Article**Is Attention Deficit Hyperactivity Disorder more Prevalent in Children with Functional Constipation?****Parsa Yousefichaijan¹, Bahman Salehi², Hamid Shekholeslami³, Mojtaba Hashemi⁴, Mojtaba Sharafkhan^{5*}, Mohammad Amiri⁶, Mohammad Rafiei⁷**¹Associate Professor in Pediatric Nephrology, Department of Pediatrics, School of Medicine, Arak University of Medical Sciences, Arak, Iran²Associate Professor in Psychiatry, Department of Psychiatry, School of Medicine, Arak University of Medical Sciences, Arak, Iran³Assistant Professor in Pediatric, Department of Pediatrics, School of Medicine, Arak University of Medical Sciences, Arak, Iran⁴Assistant Professor in Pediatric Gastroenterology, Department of Pediatrics, School of Medicine, Arak University of Medical Sciences, Arak, Iran⁵Medical student, Students Research Committee, School of Medicine, Arak University of Medical Sciences, Arak, Iran⁶Assistant Professor of emergency medicine, Department of Emergency Medicine, School of Medicine, Arak University of Medical Sciences, Arak, Iran⁷Associate professor of Biostatistics, Department of Biostatistics and Epidemiology Arak university of Medical Sciences, Arak, Iran***Corresponding author**

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Abstract: Attention Deficit Hyperactivity Disorder (ADHD) is the most common childhood neurological disorder which is more prevalent in some chronic diseases. The aim of this study was to investigate ADHD in children with functional constipation and compare it with healthy children. 100, 5-16-year-old children with functional constipation and 100 healthy children without constipation were included in this case – control study as case and control groups, respectively. Subjects were selected from children who were referred to the pediatric clinic of Amir Kabir Hospital of Arak, Iran, in the form of simple probability and based on inclusion and exclusion criteria. ADHD was diagnosed by Conner's Parent Rating Scale – 48 (CPRS-48) and DSM-IV criteria and was confirmed by psychologist consult. Data were analyzed by Binomial test in SPSS18. ADHD inattentive type was observed in 9 cases (9%) with functional constipation and 4 controls (4%) (P=0.05). Moreover, in the case and control groups, 15 (15%) and 10 (10%) children were affected by ADHD hyperactive-impulsive type (p = 0.28), and 15 (15%) and 16 (16%) children were affected by ADHD mixed type (p = 0.84), respectively. There were no differences between prevalence of ADHD in the children with functional constipation and the control group. However, due to the importance of relationships between different types of psychiatric disorders such as ADHD and constipation and lack of enough evidence concerning the relationship between these two disorders, conducting further studies in this field is recommended.**Keywords:** Attention deficit hyperactivity disorder, Child, Constipation.**INTRODUCTION**

ADHD is the most common neurobehavioral disorder of childhood period. As per DSM-IV (statistical manual of mental disorders, fourth edition) criteria, it includes ADHD inattentive type, ADHD hyperactive-impulsive type, and ADHD mixed type [1]. ADHD affects 5-10% of children in school age. The causes of ADHD in children are not clearly known; however, some evidence recognizes underlying genetic defect and CNS dysfunction as its main causes [2, 3]. Based on the studies, ADHD can be significantly associated with a variety of chronic disease [4-6],

depression [6], behavioral, emotional, language, and hearing disorders [7-8] and even illnesses such as epilepsy [4-5] and abnormal electroencephalogram (EEG) in children [9].

As the evidence suggests, in addition to the aforementioned disorders, urinary and bowel disorders can be also associated with ADHD in children [10-13]. In this regard, Burgu B [11], McKeown C [12], and Duel BP [13] showed that the prevalence of different types of urinary disorders and constipation is

significantly higher in children with ADHD than in healthy ones.

Constipation is a chronic and common disorder during childhood, which is defined as bowel movement twice or less than twice a week, or stool in hard and round ball shapes that lasts at least 2 weeks [14]. Constipation has many causes such as functional constipation and Hirschsprung's disease (HD) [14]. Functional or habitual constipation is a bowel disorder seen in children above 2 years of age, which is defined as voluntary withholding of stool – in which the child makes a special gesture (such as pressing the feet together) – and non-involvement of organic causes [1]. As the evidence suggests, in addition to constipation devastating impact on children's quality of life (QOL) [15], functional constipation and fecal incontinence can be also associated with behavioral problems in children [12].

Given the importance and prevalence of ADHD [11-13] and digestive disorders such as constipation [15-16] in children, and since relationship between these two disorders may be effective in clinical encounters with each of them [13], the aim of this study was to investigate ADHD in children with functional constipation and compare it with healthy children.

MATERIALS AND METHODS

This case-control study was performed on 200 children in the age bracket of 5-16 years old who were referred to the pediatric clinic of Amir Kabir Hospital in Arak, Iran, in 2013. Of the 200 children under study, 100 children with functional constipation as the case group, and 100 healthy children without constipation as the control group, were included in the study based on the inclusion and exclusion criteria.

Functional constipation was diagnosed by expert pediatric gastroenterologist based on the following:

- History of bowel movement twice or less than twice a week, or stool in hard and round ball shapes that lasts at least for 2 weeks as a definition for constipation [14].
- Following items in history and physical examination in order to diagnose functional constipation: Voluntary withholding of stool in which the child makes a special gesture (such as pressing the feet together), thick stool, painful defecation, leakage of stool from the anal, loose anal sphincter in rectal examination, and rectal ampoules containing stool [14].
- Rejection of organic causes of constipation and its other differential diagnoses (in order to diagnose functional constipation) including congenital anomalies of digestive system such as anorectal anomalies and Hirschsprung's disease, hypothyroidism, hypocalcemia, lead poisoning, celiac disease, malnutrition, and drug side effects.

Clinical interviews were carried out with the children and their parents to study the inclusion/exclusion criteria.

Inclusion criteria

- Children of both genders in the age bracket of 5-16
- Children with functional constipation according to its diagnostic criteria
- Written consent from patients' parents or guardians

Exclusion criteria

- History of major depressive disorder (MDD), anxiety disorders (ADs), schizophrenia, autistic disorders (ASD), Tourette's disorder, ADHD (in the case group, before developing constipation) and other considerable psychiatric disorders or nervous system disorders
- Congenital and chromosomal abnormalities such as Down syndrome and Fetal alcohol syndrome, birth weight less than 1,500 gr or very low birth weight (VLBW), (1 and 2 due to confounding factors that - based on the studies - may contribute to ADHD in children [1, 17, 18])
- Substance abuse, mental retardation (MR) and history of sleep apnea or other sleeping disorders which can cause ADHD-like symptoms
- History of considerable or chronic medical disorders such as epilepsy, asthma, diabetes, immune deficiency, malignancy etc.
- Chronic medication use, low socioeconomic status, parental consanguinity and separation or death
- Family history (first-degree relatives (parents and siblings)) of major psychiatric diseases such as ADs, schizophrenia, depression, ADHD, etc.

Schizophrenia, different types of ADs (post-traumatic stress disorder (PTSD), panic attacks and etc.), MDD, ASD, Tourette's disorder and other considerable psychiatric disorders were defined according to DSM-IV criteria as a history of each [19-23]. MR was defined as the intelligence quotient (IQ) of 70 or less [24, 25]; epilepsy was defined as a history of recurrent seizures for which no cause can be identified in clinical studies [5] and chronic drug use was defined as a history of at least 6 months to one year of continuous use of one or more types of medications. Moreover, the low socioeconomic status was considered as family income less than 5,000,000 Rials (the equivalent of America \$ 400) (for a family of 3 to 5 members) and parental education lower than diploma.

According to the diagnostic workup of functional constipation and its definition [14], the children with functional constipation were entered the study as the case group and control group members were selected from children who had referred to hospital for common

cold, minor and limited trauma, etc. as an outpatient. Matching method was used for selecting the control group and children were matched in two groups regarding age, gender, developmental level, economic status, number of family members, place of residence (in terms of floor and area) with a standard deviation of ± 2 . After primary evaluation regarding exclusion/inclusion criteria and receipt of informed consent from children's parents for participating in the study, basic information (age, sex) was recorded.

ADHD was defined according to DSM-IV criteria as the presence of disease symptoms for at least 6 months continuously and in two separate environments (both at home and at school) without any organic causes [7], and it was diagnosed by Conner's Parent Rating Scale - 48 (CPRS-48). After CPRS-48 completed by the parents and the children identified with any form of ADHD, the children were referred to an expert psychiatrist as the project administrator in order to confirm ADHD diagnosis by clinical interview and based on DSM-IV diagnostic criteria [1].

Conner's Parent Rating Scale (CPRS) was standardized by Conners *et al.* [31] in 1999. It has two 93-item and 48-item versions. The present research uses the 48-item version. This version of Conners Questionnaire evaluates 5 factors of conduct, psychosomatic - impulsivity, hyperactivity, anxiety and learning problems and has 4 choices scored from 0 (never) to 3 (very high). The score of each article is converted into t scores with the average of 50 and standard deviation of 10. If the t scores of 12 standard deviations are higher than the average, the individual has a problem [26]. Abdekhodaie Z *et al.* [27] reported the sensitivity and specificity of this form of Conner Questionnaire for the diagnosis of children with ADHD at 90.3% and 81.2%, respectively.

It should be mentioned that ADHD diagnosis for children with this disorder was confirmed by

evaluating its differential diagnoses such as hyperthyroidism (by measuring TSH and FT4) and lead poisoning (Blood Lead Level (BLL) > 5-10 $\mu\text{g/dl}$) [28].

The collected data were analyzed with SPSS software (Statistical Package for the Social Sciences, version 18.0, SPSS Inc, Chicago, Ill, USA) and descriptive statistics methods for frequency determination. Moreover, student t and chi-square tests were used for data analysis. P values less than .05 were considered significant. This study was confirmed by ethics committee of Arak University of medical sciences and in all stages of this study, we were loyal to Helsinki declaration principles and a written consent was obtained from all of participants and they were free to exit the study by their will.

RESULTS

The mean age of children in the case and control groups was calculated at 7.8 ± 1 and 7.9 ± 2.1 , respectively ($p > 0.05$). There were 62 (62%) boys and 38 (38%) girls in the case group and 51 (51%) boys and 49 (49%) girls in the control group ($p = 0.11$).

Of the 200 (100%) children under study in both groups, 13 (6.5%), 25 (12.5%) and 31 (15.5%) children were affected by ADHD inattentive type, ADHD hyperactive-impulsive type, and ADHD mixed type, respectively.

Between the prevalence of ADHD inattentive type ($p = 0.05$), ADHD hyperactive-impulsive type ($p = 0.28$) and ADHD mixed type ($p = 0.84$) there were no significant difference between the two groups (Table 1).

The results showed that there is no significant relationship between ADHD inattentive type ($p = 0.34$), ADHD hyperactive-impulsive type ($p = 0.99$) and ADHD mixed type ($p = 0.18$) and gender distribution of the children under study in both groups (Table 2).

Table 1: Frequency of children with any form of ADHD in the study groups

ADHD ^a inattentive type		p-value ^d	ADHD hyperactive-impulsive type		p-value	ADHD mixed type		p-value
Case ^b (n=100) N (%)	Control ^c (n=100) N (%)	0.05	Case (n=100) N (%)	Control (n=100) N (%)	0.28	Case (n=100) N (%)	Control (n=100) N (%)	0.84
9(9)	4(4)		15(15)	10(10)		15(15)	16(16)	

^aAttention deficit hyperactivity disorder, ^bchildren group with functional constipation, ^c healthy children group, ^d p-values less than .05 were considered significant

Table 2: Gender distribution of the children with ADHD in the study groups

Gender	ADHD inattentive type (n=13) N (%)	ADHD hyperactive-impulsive type (n=25) N (%)	ADHD mixed type (n=31) N (%)
Male	9 (69.2)	12 (48)	10 (32.2)
Female	4 (30.7)	13 (52)	21 (67.7)
p-value	0.34	0.99	0.18

DISCUSSION

Our study showed that there is no significant relationship between the disorders - including ADHD inattentive type, ADHD hyperactive-impulsive type, and ADHD mixed type – and functional constipation in the children and prevalence of ADHD in the children with constipation does not exceed the control group.

In a case-control study in 2010, Almong M *et al.* [29] investigated 62 children with ADHD and 57 healthy children in terms of the prevalence of digestive disorder symptoms, including abdominal pain, diarrhea, constipation and food allergies. The results showed that although food allergies were more common in the children with ADHD than in the control group, there was no significant difference between the two groups in terms of frequency of food allergies and other digestive symptoms.

However, contrary to the opinions of Almong M *et al.* [29] and the results of our study, Duel BP *et al.* [13] in 2003, completed the Dysfunctional Voiding Symptom Survey (DVSS) for 28 children with ADHD and 22 children without ADHD. The survey consisted of 10 questions on daytime incontinence, nocturnal enuresis, constipation, urgency, voiding frequency and dysuria. They showed that the DVSS scores were significantly higher in boys and girls with ADHD than in the control group. Also, in a retrospective cohort study by using the military health system database from October 2005 to September 2007 on 742,939 children aged 4-12 (with and without ADHD), McKeown C *et al.* [12] reported a significant difference in terms of prevalence of constipation among the children in the two groups. According to these results, 4.1% and 1.5% of the children with and without ADHD suffered from constipation, respectively.

As the previous studies show, the prevalence of ADHD in male children is higher than in female ones [1, 17, 30]. According to the results of our study, although – unlike other studies – the prevalence of ADHD was higher in girls than in boys. However, there was no significant difference between the two genders in terms of the prevalence of ADHD. So far, very few studies on the relationship between constipation (not functional constipation) and ADHD have been conducted [12, 13, 29]. Although – according to some authors in this field [12, 29] and the results of our study – the hypothesis about the relationship between ADHD and functional constipation is rejected, further studies – due to lack of studies in this field – are recommended to be conducted in future by considering intervening factors such as the role of medical treatment for ADHD in constipation in children.

In finally, it should be mentioned that among the limitations of our study, we may suggest to non-cooperation of some parents to fill in ADHD questionnaire and the psychiatric examination of the

child performed by the psychiatrist. Though this criterion caused to exclude some children eligible for the study, we attempted to remove such limitation by encouraging the parents for possible usefulness of the study and help them fill in the said questionnaire.

CONCLUSION

There were no differences between prevalence of ADHD in the children with functional constipation and the control group. However, due to the importance of relationships between different types of psychiatric disorders such as ADHD and constipation and lack of enough evidence concerning the relationship between these two disorders, conducting further studies in this field is recommended.

ACKNOWLEDGMENTS

The research team wishes to thank Vice Chancellor of research for the financial support and also the children and their parents who have contributed in this research.

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