

# Food Insecurity and Some Associated Socioeconomic Factors Among Children with Attention Deficit Hyperactivity Disorder in Tehran: A Case Control Study

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## ABSTRACT

### Article History

Received:  
23/07/2018

Revised:  
14/08/2018

Accepted:  
28/08/2018

### Keywords:

Food insecurity;  
ADHD;  
Socio-economic  
status;  
Tehran

**Background:** Food insecurity is defined as the limited or uncertain availability of enough food for permanent active and healthy life. Attention Deficit and Hyperactive Disorder (ADHD) is the most common neurobehavioral disorder of childhood, presenting with pervasive and impairing symptoms of inattention, hyperactivity, impulsivity, or a combination. There is scientific evidence that some dietary strategies and socioeconomic factors may be useful to improve the symptoms of ADHD and benefit the social, cognitive and academic performance of children and adolescents with ADHD. This Study is aimed at determining the association between food insecurity and ADHD in newly diagnosed patients.

**Methods:** This case-control Study was conducted in Iran in 2017 among 146 patients with ADHD as cases and 146 healthy children as controls, who referred to health and medical centers under the supervision of Tehran universities of medical sciences, while, age, sex and location of living had matched. The general and United States Department of Agriculture household food security questionnaires were completed. A structured questionnaire was used with a wide range of questions for the evaluation of Socioeconomic Status (SES) and the presence of ADHD was diagnosed using the questionnaire of the Diagnostic and Statistical Manual of Mental Disorders, fifth edition.

**Results:** The food insecurity prevalence was 68.5% and 40.4% in cases and controls, respectively. Food insecurity, low economic level and ethnicity were significantly associated with this disorder ( $P < 0.05$ ).

**Conclusion:** Food insecurity was one of the important risk factors for Children with ADHD that health care providers should consider it.

## Introduction

Food is one of the essential needs of human and the ability to have healthy and enough food described as food security [1]. The concept of food security was attended in the early years of 1970s over the food crisis and several studies evaluated its various perspectives [2]. According to the 1996 World Food Summit (WFS), food security exists when all people, at all times, have physical and financial access to adequate, safe and nutritious food to achieve their dietary essentials and food inclinations for a dynamic and healthy life [3]. Food secure peoples do not live in hunger

or dread of starvation [3]. Then again, food insecurity as indicated by USDA is a circumstance of constrained or unverifiable availability of nutritionally satisfactory and safe foods or restricted or indeterminate ability to obtain acceptable foods in socially worthy ways [4].

The WHO expresses that food availability, access, and use are three columns that determine food security [5]. The Food and Agriculture Organization (FAO) includes a fourth column: the stability of the initial three distances of food security over time [3]. The World Summit on Food Security in 2009 expressed that the “four

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columns of food security are: availability, access, utilization, and stability” [6].

Food insecurity with inadequate intakes of essential nutrients may prompt mental and behavioral dysfunction in children and adults and reduce resistance in diseases. Inability to purchase nutritious and adequate food and its mental and emotional stresses affect human health detrimentally and even result in aggravation of other underlying diseases caused by other risk factors. Food insecurity is indirectly in relationship with poor health status, certain chronic diseases, childhood obesity, hypertension, abnormal blood glucose levels, mental disorders, depression, decreasing ability in daily activities, heart failures, asthma and cognitive decay [7-16]. The food insecurity and poor health status can prompt each other. Continuous and periodic food deficiencies may more effectively trigger health challenges, that can, in turn; augment food insecurity [17]. Increasing of food insecurity over the past decade particularly in developing countries was as a result of economic levels decline that raise fuel and food costs [18]. The food insecurity prevalence was about 14.7% in America, 10% in Canada, 50% in Malaysia, 11% in Indonesia, 35% in Philippines, 70% in Bolivia, 73% in Burkina Faso, 5.7% in Finland, 43% in Pakistan, and nearly 50% in Iran [4, 19-25].

Attention deficit and hyperactivity disorder (ADHD) is one of the most common psychiatric disorders in early childhood and adolescence with a prevalence rate exceeding 5% [26]. Some of the most common symptoms associated with ADHD are hyperactivity, attention deficit, cognitive deficit and poor impulse control [27]. The etiology of ADHD is still unknown, although there are several factors which may have a certain influence in the symptomatology, including diet, complications during pregnancy, at birth or shortly after birth, head injury, toxic chemicals in the environment, a decreased prefrontal cortex, and decreased medial temporal and inferior parietal lobes [27-28]. It has been reported that 5% to 8% of school-age children worldwide have this syndrome [29]. Based on criteria of the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV), 8.7% of U.S. children 8 to 15 y old are affected [30]. In Iran, ADHD has been estimated to affect 25% of preschool children [31] and 15.2% of elementary schoolboys [32]. Others have reported a prevalence of 11.3% in Hamadan, an Iranian city [33].

Attention to effects of food insecurity on health and social and psychological consequences, evaluation of its perspectives is essential [34]. The relationship between food insecurity and some diseases including obesity/overweight, cardiovascular disease, diabetes, depression, and other mental and physical illnesses has been demonstrated [7-17, 23, 25].

Attention to the increasing food insecurity and ADHD in young Iranian population, possibility of relationship, and no previous studies, our Study was designed to determine the association of food insecurity and some associated socioeconomic factors among Children with newly diagnosed patients suffering from ADHD.

### Subjects and methods

This case-control Study was conducted at health and medical centers under the supervision of Tehran universities of medical sciences in Iran between Jul 2016 and Mar 2017. The case group included 146 newly patients who were examined by a psychiatrist and two psychologists and proved to suffer from ADHD. The presence of ADHD was assessed using the DSM-V [35]. According to the DSM-V, a person with ADHD must have at least six of the listed symptoms of inattention or symptoms of hyperactivity-impulsivity that have persisted for at least 6 mo to a degree that is maladaptive and inconsistent with the person's developmental level. The reliability and validity of this questionnaire has been shown previously [35]. According to this questionnaire, the subtypes of this disorder were also identified. Therefore, the children were categorized as having ADHD and ADHD inattentive subtype, combined subtype, or hyperactive-impulsive subtype.

The control group included 146 non-ADHD children referred to health centers. The age, sex and residential status (namely, Tehran and its suburbs) were matched between two groups. The protocol carried out according to the declaration of Helsinki of 1975 as revised in 1983 and was approved by Tehran University of Medical Sciences, Ethics Committee Board under number IR.TUMS.VCR.REC.1395.371. Before the data collection, a written informed consent form was taken from mother's children.

All of participants completed the general and USDA household food security of status questionnaires by interviewing. The USDA food security questionnaire had been validated over the previous studies in Iran [36-37]. Before beginning, a pilot study was conducted among 35

newly diagnosed ADHD patients to clarify the research perspectives.

The inclusion criteria were patients with ADHD diagnosis duration less than 1 month, and age between 2 to 12 y. The exclusion criteria were refusal or inability to provide informed consent.

A structured questionnaire for the SES evaluation was used to collect data. Questionnaire included a wide range of questions including age, sex, parent's jobs and level of education, house-ownership, family size, child death, number of children under age 18, abortion status, ethnicity, food aid and family history of ADHD. The economic status was determined based on nine items: personal home, personal car, washing machine, LCD TV, dishwasher, side-by-side refrigerator, hand-woven carpets, computers/laptops, and micro-wave oven. The three economic levels were low/poor (< 3 items), moderate (4-6 items) and high/wealthy (>7 items).

According to the 18-item USDA food security questionnaire, food security is classified into four groups: food secure, food insecure without hunger, food insecure with moderate hunger, and food insecure with severe hunger. In this study, participants were divided into two food secure and food insecure groups [4].

Weight was measured in minimally clothed subjects and without shoes using digital scales and recorded to the nearest 100 g. Height was measured using a tape measure while the children were standing in a normal position and were not wearing shoes. To assess children's growth Z-Scores related to height for age and Body Mass Index (BMI) for age were calculated by WHO Anthro Plus v.1.0.4 software according to the WHO reference. If height for age was rated less than -2 SD, the child was considered as stunted (short stature); and if the BMI for age less than -2 SD, the child was considered as under-weighted and over-weighted if greater than +2 SD and obese if exceeding +3 SD [38].

Data were analyzed using the SPSS version 22.0

(SPSS Inc., Chicago, IL, USA) statistical software. Normality of the data was evaluated by using Kolmogorov-Smirnov test. Chi-square test, univariate, and multivariate conditional logistic regression models were used to identify the risk factors of ADHD. A P value <0.05 was considered significant statistically.

## Results

Participants were totally 292 patients (220 boys, 72 girls) aged  $6.22 \pm 2.50$ . ADHD Patients with inattentive subtype were 26 (17 boys and 9 girls), 116 (90 boys and 26 girls) patients with combined subtype and hyperactive-impulsive subtype were 3 (3 boys), respectively.

Variables related with ADHD in the chi-square test and simple logistic regression analysis are presented in the (Table 1).

According to the obtained results food security status (OR = 3.206; 95% CI: 1.982-5.185), economic level, ethnicity (OR = 2.38; 95% CI: 1.475-3.850), abortion status (OR = 2.21; 95% CI: 1.090-4.509) and house ownership status (OR = 2.33; 95% CI: 1.368-3.974) differed significantly between two groups. The other factors including parent's job and level of education, job status, BMI-for-age and height-for-age situation, family size, child death and abortion status and having children under 18 y, did not have significant differences between the two groups (Table 1).

Food security was significantly associated with economic status, parent's job and level of education, ethnicity and house ownership status (Table 2).

Ultimately, risk factors of ADHD were food insecurity (OR = 2.65; 95% CI: 1.07-6.55), low economic level (OR = 1.86; 95% CI: 1.04-3.12) and ethnicity (OR = 1.97; 95% CI: 1.19-3.27) (Table 3).

**Table1. Comparing various factors between ADHD patients and non-ADHD controls**

Factors	Cases		Controls		P value ( $\chi^2$ )	OR (CI 95%)	P value for OR
	N	%	N	%			
Food Security Status							
-Food-secure	46	31.5	87	59.6	<0.0001	1.00	<0.0001
-Food-insecure	100	68.5	59	40.4		3.20	
Economic Level							
-High	19	13.0	22	15.1	<0.0001	1.00	<0.0001
-Medium	23	15.8	57	39.0		1.79	
-Low	104	71.2	67	45.9		3.84	
Ethnicity							

-Persian	44	30.1	74	50.7	<0.0001	1.00	<0.0001																																																																														
-Non-Persian	102	69.9	72	49.3		2.38																																																																															
Level of Education Father																																																																																					
-Less than a diploma	60	41.1	45	30.8	0.151	1.00	0.154																																																																														
-Diploma to licentiate	82	56.2	94	64.4		1.52																																																																															
-Masters and more	4	2.7	7	4.8		2.33																																																																															
Level of Education Mother																																																																																					
-Less than a diploma	50	34.2	37	25.3	0.096	1.00	0.097																																																																														
-Diploma and more	96	65.8	109	74.7		1.53																																																																															
Father's Job Status																																																																																					
-Unemployed & Retired & Worker	43	29.5	33	22.6	0.073	1.00	0.075																																																																														
-Self-employed	64	43.8	56	38.4		1.14																																																																															
-Manager and Administrative Officer	39	26.7	57	39.0		1.90																																																																															
Mother's Job Status																																																																																					
-Householder	128	87.7	88.4	129.0	0.230	1.00	0.251																																																																														
-Worker & Self-employed	8	5.5	2	3.0		0.372																																																																															
-Manager and Administrative Officer	10	6.8	9.6	14		1.38																																																																															
BMI-for-Age Situation																																																																																					
-Under weight	18	12.3	11	7.5	0.134	1.00	0.149																																																																														
-Normal weight	111	76.0	108	74.0		1.59																																																																															
-Over weight	8	5.5	18	12.3		3.68																																																																															
-Obese	9	6.2	9	6.2		1.63																																																																															
Height-for-Age Situation																																																																																					
-Normal	139	95.2	135	92.5	0.330	1.00	0.334																																																																														
-Stunting	7	4.8	11	7.5		0.618																																																																															
Family Size																																																																																					
-1-3 Persons	57	39.0	42	28.8	0.100	1.00	0.101																																																																														
-4-5 Persons	78	53.4	96	65.8		1.67																																																																															
->6 Persons	11	7.5	8	5.4		0.987																																																																															
Child Death																																																																																					
-No	133	91.1	136	93.2	0.515	1.00	0.516																																																																														
-Yes	13	8.9	10	6.8		0.752																																																																															
<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2">Factors</th> <th colspan="2">Cases</th> <th colspan="2">Controls</th> <th rowspan="2">p-value (χ<sup>2</sup>)</th> <th rowspan="2">OR (CI 95%)</th> <th rowspan="2">p-value for OR</th> </tr> <tr> <th>N</th> <th>%</th> <th>N</th> <th>%</th> </tr> </thead> <tbody> <tr> <td colspan="8">Abortion</td> </tr> <tr> <td>-No</td> <td>120</td> <td>82.2</td> <td>133</td> <td>91.1</td> <td rowspan="2">0.025</td> <td>1.00</td> <td rowspan="2">0.028</td> </tr> <tr> <td>-Yes</td> <td>26</td> <td>17.8</td> <td>13</td> <td>8.9</td> <td>2.21</td> </tr> <tr> <td colspan="8">Child of &lt;18years</td> </tr> <tr> <td>-&lt;2 Persons</td> <td>131</td> <td>89.7</td> <td>133</td> <td>91.1</td> <td rowspan="2">0.691</td> <td>1.00</td> <td rowspan="2">0.691</td> </tr> <tr> <td>-&gt;2 Persons</td> <td>15</td> <td>10.3</td> <td>13</td> <td>8.9</td> <td>0.854</td> </tr> <tr> <td colspan="8">House Ownership</td> </tr> <tr> <td>-Owner/free</td> <td>94</td> <td>64.4</td> <td>118</td> <td>80.8</td> <td rowspan="2">0.002</td> <td>1.00</td> <td rowspan="2">0.002</td> </tr> <tr> <td>-Rent/Mortgage</td> <td>52</td> <td>35.6</td> <td>28</td> <td>19.2</td> <td>2.331</td> </tr> </tbody> </table>								Factors	Cases		Controls		p-value (χ <sup>2</sup> )	OR (CI 95%)	p-value for OR	N	%	N	%	Abortion								-No	120	82.2	133	91.1	0.025	1.00	0.028	-Yes	26	17.8	13	8.9	2.21	Child of <18years								-<2 Persons	131	89.7	133	91.1	0.691	1.00	0.691	->2 Persons	15	10.3	13	8.9	0.854	House Ownership								-Owner/free	94	64.4	118	80.8	0.002	1.00	0.002	-Rent/Mortgage	52	35.6	28	19.2	2.331
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**Table2. Factors associated with food security status**

Factors	Food-secure		Food-insecure		P value
	N (%)	N (%)	N (%)	N (%)	
Economic Level					
-High	41(30.8)	0(0.0)			<0.0001
-Medium	77(57.9)	3(1.9)			
-Low	15(11.3)	156(98.1)			
Level of Education Father					
-Less than a diploma	17(12.8)	88(55.3)			<0.0001
-Diploma to licentiate	105(78.9)	71(44.7)			
-Masters and more	11(8.3)	0(0.0)			
Level of Education Mother					
-Less than a diploma	17(12.8)	70(56.0)			<0.0001
-Diploma and more	116(87.2)	89(44.0)			

<b>Father's Job Status</b>			
-Unemployed & Retired & Worker	8(6.0)	68(42.8)	
-Self-employed	64(48.1)	56(35.2)	<0.0001
-Manager and Administrative Officer	61(45.9)	35(22.0)	
<b>Mother's Job Status</b>			
-Householder	111(83.5)	146(91.8)	
-Worker & Self-employed	2(1.5)	9(5.7)	<0.0001
-Manager and Administrative Officer	20(15.0)	4(2.5)	
<b>BMI-for-Age Situation</b>			
-Under weight	11(8.3)	18(11.3)	
-Normal weight	104(78.2)	115(72.3)	0.552
-Over weight	12(9.0)	14(8.8)	
-Obese	6(4.5)	12(7.5)	
<b>Height-for-Age Situation</b>			
-Normal	127(95.5)	147(92.5)	0.283
-Stunting	6(4.5)	12(7.5)	
<b>Family Size</b>			
-1-3 Persons	47(35.3)	52(32.7)	
-4-5 Persons	82(61.7)	92(57.9)	0.085
->6 Persons	4(3.0)	15(9.4)	
<b>Ethnicity</b>			
-Persian	67(50.4)	51(32.1)	0.002
-Non-Persian	66(49.6)	108(67.9)	
<b>House Ownership</b>			
-Owner/free	122(91.7)	90(56.6)	<0.0001
-Rent/Mortgage	11(8.3)	69(43.4)	
<b>Child of &lt;18years</b>			
-<2 Persons	119(89.5)	145(91.2)	0.619
->2 Persons	14(10.5)	14(8.8)	
<b>Food Aid</b>			
-No	133(100.0)	155(97.5)	0.065
-Yes	0(0.00)	4(2.5)	

There were significant differences between groups by Chi square test

**Table 3. Logistic regressions enter method (only significant associations are shown)**

Factors	OR (Confidence interval of 95%)	p-value
Food Security Status	2.65 (1.07-6.55)	0.034
Economic Level	1.86 (1.04-3.12)	0.041
Ethnicity	1.97 (1.19-3.27)	0.008

## Discussion

68.5% of the patients with ADHD and 40.4% of the controls had mild to severe food insecurity. The current study was the first on the food security status of ADHD patients in Iran. The average food insecurity prevalence in the past studies on general population in Iran and in children were about 50% and 67%, respectively [1, 36-37, 39-41]. Moreover, food insecurity prevalence in the United States between 1995 and 2012 varied from 10.1% to 14.7% [22]. The food insecurity prevalence in other studies on general peoples by using USDA household food security questionnaire was reported less than this study [3, 19, 42]. These differences may be the result of the different methods and participants.

The risk of ADHD is increased with low socioeconomic level according to previous studies [43-44]. In a recent systematic review noted that symptoms of ADHD are more common

among those from a low economic status background [45]. Food security was negatively associated with the economic status, too [1, 3, 19, 22, 24, 42, 46].

Suggested that the effect of poverty on mental health in children occurs both directly (via environmental resource constraints) and indirectly (through psychological influence). Children from high-SES families benefit from an array of services, goods, parental actions, and social connections, whereas children living in low-SES families lack access, putting them at risk for developmental problems [47].

The income level is an important factor to access to adequate food in the society and peoples with good economic status have more choices of food [48]. The mild food insecurity includes concern about adequate food and reducing the size and number of meals, moderate food insecurity includes decreasing the size and

number of meals, weight losing and feeling hunger and severe food insecurity include reducing size or number of the children's meals, too. Food insecure individuals often have poor financial resources and consume cheaper and nutritionally insufficient foods (e.g., higher calorie and fat with low micronutrients) that lead to poor health status [49]. Insecure food accessibility creates anxiety and worry, because of the social and biological importance of food that increases the probability of growing usual mental disorders. Besides, anxiety and worry can provoke encountering food insecurity and using nutritionally inadequate and high-calorie foods (i.e., comfort meals and poor quality diet) [16, 49]. So, food insecurity may increase risk of nutrients deficiency and consequently the risk of ADHD.

Actually, food insecurity is resulted from the reduced households' ability to supply adequate and safe food. Consequently in order to meet their hunger needs, the households tend to select low nutritious, high-fat and high-calorie foods, such as carbohydrates, refined grains and sugars, fats (particularly trans fats), snacks and junk foods that contain large amounts of sugar, preservatives, food additives and artificial colorants, that proved in previous studies to be effective in ADHD suffering. [50-53].

Due to the scarcity of previous studies in the field of food security and Socioeconomic Status on newly diagnosed ADHD patients, more accurate comparison requires further studies. Direct assessment of food insecurity status and some of associated factors in ADHD patients was performed first time in Iran that is strong point of this study.

### Conclusion

Food insecurity and poor economic status, as well as ethnicity status were risk factors for ADHD. Further research in this regard is required. Obviously, current food insecurity is a major public health problem and food security is considered as an indicator of the families and individuals health. Food insecurity and hunger may also have physical, social and psychological consequences. No study had been conducted until now in Iran regarding the relationship between food insecurity and ADHD. Taking into account the significance of the relationship between the food insecurity and ADHD, planning to reduce food insecurity in the society, particularly among children, through improving the economic status and family dietary patterns is considered as

necessary.

### Acknowledgment

International Campus, Tehran University of Medical Sciences (IR.TUMS.VCR.REC.1395.371) supported this master's thesis. We thank the mothers and children for their participation in this study. The authors declare that there is no conflict of interest.

### Disclosure statement

There are no competing financial interests.

### Conflict of interest

None of authors have conflict of interests.

### Funding

None.

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