Nutritional Status of Children with Attention Deficit Hyperactivity Disorder

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Abstract:

Background: *Attention Deficit Hyperactivity Disorder (ADHD) is one of the most common neurobiological disorders affecting children in different parts of the globe. It is not only deficient attention or excessive activity but also a cluster of behaviors or a syndrome comprising of several connected symptoms.* ***Objective:*** *to assess the nutritional status of children with ADHD.* ***Settings:*** *The study was conducted at the Pediatric Neurological Disorder Outpatient Clinic of Specialized University Hospital at Smouha and Child and Adolescent Psychiatric Outpatient Clinic at El-Hadara University Hospital in Alexandria.* ***Subjects:*** *A convenient sample of 120 children with ADHD and their mothers.* ***Tools:*** *Four tools were used namely; sociodemograghic characteristics of children and their mothers as well as medical history of children structured interview schedule, anthropometric measurements of the children sheet, health assessment observational sheet, and dietary pattern of children questionnaire sheet.* ***Results:*** *The study revealed that 41.7% of children were obese, 21.7% were overweight, while 36.6% of them were considered normal regarding to body mass index for age. It was also noticed that only 5.8% of children were underweight regarding to their weight for age and 4.2% had short stature regarding to their height for age.* ***Conclusion:*** *it can be concluded that the highest percent of children were obese regarding to their body mass index, most of children received proteins during the day and nearly two thirds of them received food rich in iron and Zinc. Unfortunately, all children consumed food contains preservatives or food colors and three quarters of them received sweets.* ***Recommendations:*** *Nutritional screening should be formulated periodically for all children with ADHD for early detection and monitoring of their growth*

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Key wards: Nutritional Status, Attention Deficit Hyperactivity Disorder, Children.

Introduction

Attention-Deficit Hyperactivity Disorder (ADHD) is a neurodevelopmental disorder that is characterized by heterogeneous combinations of inattention, impulsivity, and hyperactivity symptoms (Kliegman et al.,2020).

There is not an exact cause for ADHD, while there are many theories that explain the pathogenesis of the disease. A neurochemical etiology is suggested by some children may have an absence or insufficiency of norepinephrine, dopamine, and serotonin. These neurotransmitters normally occur in high concentrations in the brain and affect activity level, mood, and awareness (Paul et al., 2019; Holton et al.,2019; Dulcan et al., 2018). Some believe that the observed behavioral patterns are related to an innate sensitivity to food items such as sucrose or food

additives as aspartame (Konikowska et al., 2012).

A wide variety of treatments have been used for ADHD management. One of these treatment strategies is a psychostimulant medication that maintains children' focus, reduce distractibility and facilitates learning and memory through increasing the availability of dopamine and norepinephrine levels in the brain. Additionally, psychosocial treatment and behavioral modification are directed to modify the children's physical and social environment (Berkowitz, 2020).

Optimal nutrition is essential for brain development and its function as well as normal growth of children. Currently, there are many evidences that support the vital role of nutrition in ADHD. Some children have improvement when certain foods are eliminated from their diet, particularly artificial food colors or flavors, food preservative or additives. Moreover, restriction of food that causes hyperactivity such as chocolate, cow's milk, nuts and eggs can help in controlling the symptoms (Lange et al., 2017). It was documented that there are a significant reduction of iron, zinc, magnesium, vitamin D, omega-3 fatty acids among those children. Some studies have reported that micronutrient supplementation was significantly helpful in reducing symptoms, improving attention and behavior for many children with ADHD (Croft, 2015; Lange, 2020).

Pediatric nurses are an integral part in the process of delivering assessment of nutritional status of those children. This assessment gives an idea of pre-existing condition, information about the type of consumed food and practices. Furthermore, it provides detailed information about dietary history to know whether the child's intake of macro-and micro-nutrients is adequate or not. Assessment of nutritional status can also provide a guide for meal planning and nutritional counseling by health care provider (Sharma, 2013). Hence the present study concerned with the study of nutritional status of children with Attention Deficit Hyperactivity Disorder.

Aim of the study

Assess the nutritional status of children with Attention Deficit Hyperactivity Disorder.

Research question:

What is the nutritional status of children with Attention Deficit Hyperactivity Disorder?

Materials and Method

Materials:

Design:

A descriptive research design was utilized for this study.

Settings:

This study was carried out in two settings. The Pediatric Neurological Disorder Outpatient Clinic of Specialized University Hospital at Smouha in Alexandria and Child and Adolescent Psychiatric Outpatient Clinic at El-Hadara University Hospital in Alexandria.

Subjects:

- A convenient sample of 120 children with ADHD and their mothers was included in the study.
- ***Inclusion criteria:***
  - School age children (5-12 yrs).
  - Free from other chronic condition that affect the children's nutritional status such as diabetes, renal failure, hyperthyroidism and psychiatric disorder such as depression, schizophrenia, bipolar disorder

Tools: Four tools were used in order to collect the necessary data.

Tool (I): Socio-demograghic Characteristics of Children and their Mothers Structured Interview Schedule: This tool was developed by the researcher after thorough review of relevant and

recent literature (Brown et al., 2017; Arruda et al., 2015). It was used to assess the characteristics of children and their mothers as well as medical history. It included three parts:

Part one: Characteristics of Children:

It included age, gender, level of education and birth order.

Part two: Characteristics of Mothers

It involved age, level of education, occupation, marital status, and risk factors for the disease such as consanguinity with husband, mother's age during pregnancy, exposure to radiation, intake of medication during pregnancy and having any health problems during pregnancy. Moreover, it included the characteristics of family composed of family size, type of family, type of residence, family income and family history of the disease.

Part three: Medical History of the Child:

It involved onset of diagnosis, duration of disease, manifestations of the disease, social and learning problems, time of starting treatment, type of treatment and follow up visit and its frequency.

Tool (II): Children's Anthropometric Measurements sheets: It involved weight, height; body Mass Index (BMI), mid-arm circumference and skin fold thickness. These were compared with standard growth charts. These charts were adopted from Centers for Disease Control and Prevention to monitor growth of the children and forming an overall clinical impression for the child being measured. They included stature-for-age, weight-for-age, BMI-for-age and weight for stature (CDC, 2021).

Tool (III): Children's Health Assessment Observational Sheet: This tool was developed by the researcher after review of relevant and current literature (Nowak et al., 2018; Duderstadt, 2017). It was used to assess the health status of the children. Health assessment involved observing feeling of tiring or fainting or headache, face as skin discoloration and conjuctival pallor, hair as brittle or dry hair and loss of brittleness, mouth condition as dry lips, tooth decay, skin and nail condition as clubbing fingers, brittle nails.

Tool (IV): Dietary Pattern of Children Questionnaire Sheet: It was developed by the researcher after review of relevant and recent literature (Hunsberger et al., 2015). This tool was used to assess dietary pattern of the children. It included habit of taking breakfast, dinner and lunch, number of meals, type of food taken, snack-eating habits, type of preferred and non-preferred food, dietary received information, any changing in appetite, food allergy and dietary pattern that increasing and alleviating symptoms of the disease.

Method:

- Official approval was obtained from research ethics committee, Faculty of Nursing, Alexandria University to carry out the study. Official permission was obtained from Faculty of Nursing and was sent to the director of the hospital to take the permission and facilitate the research implementation after explaining the aim of the study.
- Tool II was adopted from Centers for Disease Control and Prevention. Tools I, tool III and IV were developed by the researcher based on review of relevant and recent literature.
- Tools I, III and IV were validated by 5 experts in the pediatric nursing field and no modifications were done.
- A pilot study was carried out on 10 % of sample size (12 children) with ADHD to test the clarity and feasibility of the tool and no modifications were

done. Those children were excluded from the study subjects.

- Reliability of the tools was ascertained using the Cronbach's coefficient alpha test which was 0.896 for tool I, 0.703 for tool III, and 825 for tool IV.
- Every mother and her child were interviewed in the examination room to collect data.
- Sociodemographic characteristics and medical history of children were collected from mothers using tool I.
- Anthropometric parameters of every child were measured using tool II.
- Every child was inspected to assess his nutritional status using tool III.
- The mothers were asked about their children dietary pattern using tool IV.
- The duration of each interview lasted from 15-20 minutes.
- Data was collected by the researcher over a period of four months extending from the beginning of November 2019 to the end of February 2020.

- ***Statistical analysis:***

The statistical package for social sciences (SPSS version 20) was utilized for both data presentation and statistical analysis of the results. The level of significance selected for this study was P equal to or less than 0.05. The used tests were Chi square, student t test and paired t test.

- ***Ethical considerations*:**
  - Written informed consent was obtained from child's mothers after explaining the aim of the study .
  - Mothers were ascertained for their data confidentiality& privacy and anonymity of their children were considered.
  - Mothers had the right to withdraw from the study at any time.

Results

Table (1): **Percentage Distribution of Anthropometric Measurements of Children.** This table shows that 45% of children had normal weight for their age. Nearly one quarter of them (26.7%) were overweight. While, 22.5% of children were obese and 5.8% of them were underweight. It was also observed that 82.5% of children had normal height for their age. Whereas, 4.2% of them had short stature, and 13.3% were tall. The same table also illustrates that 41.7% of children were obese, and 21.7% of them were overweight regarding to their body mass index for age. Thirty six point six percent of children had normal BMI for their age.

Table (2): Percentage Distribution of Health Assessment of Children. This table presents that less than one third of children (30%) had feeling of tiring, headache and fainting. It was observed that 90.8% of children had dry, brittle hair and loss of hair brightness. All children's face had skin discoloration, periorbital darkness and conjunctival pallor. Nearly half of children (49.2%) had dry, cracked lips. It was found that, less than two thirds of children (61.7%) had dry skin, skin paleness and cold extremities.

Table (3): Percentage Distribution of Food that Trigger Hyperactivity Manifestations in Children. This table illustrates that 74.2% of children their mothers reported that they consumed sweats, while 60% got salty food, 38.3% spicy food, 45.8% fatty food, 60.8% canned food, 100% food contains preservatives/ food colors, and 90.8% for milk and milk products.

Table (4): Percentage Distribution of Drinks that Trigger Hyperactivity Manifestations in Children with ADHD. This table reveals that 79.2% of children received caffeine beverages as tea or coffee. Less than two thirds of children (60.8%) drink caffeine beverages once per day. Sixty percent of children drink caffeine beverages after meal and 16.7% consumed it two hours after meals and 2.5% of them got it before meal. Almost all children (98.3%) received carbonated beverage.

Table (5): Percentage Distribution of Children's Food Intake that Decrease the Manifestations of ADHD. This table illustrates that 62.5% children ate food rich in iron. In addition, 69.2% of children consumed food rich in zinc. Thirty eight point three percent of children received raw vegetables or fruit once per day. Most of children (92.5%) received proteins in their meal once per day.

Table (6) :Relationship between the Mothers' Sociodemographic Characteristics and their Children's Weight for Age. This table shows that there was no statistical significance difference between the mothers' age, occupation and their children's weight for age. While, there was statistical significant difference between mothers' level of education and their children's weight for age (P=0.026).

Table (7): Relationship between Children's Sociodemographic Characteristics and their Body Mass Index for Age. This table shows that there were no statistical significant differences between children' age, gender, birth order and their body mass index for age. Whereas, there were statistical significant difference between children' level of education and their body mass index for age (P= 0.020).

Discussion

Numerous studies documented that insufficient nutrition or unbalanced diet during fetal life may trigger adverse behavioral patterns and hyperactivity in children later on. Childhood malnutrition is considered one of the health problems that contribute to the development of ADHD among children. Thus, assessment of nutritional status and support for children with ADHD is an important task of the pediatric nurse's role (Energin et al., 2015).

Health assessment is a vital component for determining nutritional status of children. The findings of the current study revealed that about one third of children had feeling of tiring, headache and fainting, and the majority of them had dry, brittle hair. Additionally, all children had skin discoloration of their face. This could be due to bad dietary habits as more than half of children preferred eating food outside their homes especially when they buy food from street vendors. Those are often uneducated and have a lack of knowledge about essential dietary elements, safe food handling, environmental sanitation, and universal precautions that must be followed during preparation of food such as hand washing. Juneja et al., (2010) findings were in harmony with findings of the present study as they found that most of children with ADHD had fatigue, nervousness, mood swings and lack of concentration due to nutrients deficiency.

It was revealed in the current study that three quarters of children preferred sweets and mothers observed that children hyperactivity manifest especially after receiving sweets. It was justified by the attractive colors of sweets and artificial flavors impose the children to increase their consumption of sweets. Furthermore, excess consumption of sweets leads to desensitization of dopaminergic receptors that are responsible for inhibition of the control mechanisms in the frontal cortex.

Del-Ponte et al., (2019) results were consistent with the present study findings who found that sweet intake by children significantly increased hyperactivity manifestations. On the other hand, Kim and Chang, (2011) did not find any association between sweaty food consumption and hyperactivity manifestations among children with ADHD.

The American Academy of Pediatrics recommended that caffeine consumption must be limited in children because of its negative effect on brain development (Temple, 2019). The present study highlighted that more than three quarters of children received caffeine as tea. It could be due to that caffeine drinks are the daily drink for the majority of the Egyptians and curiosity of children as well as the attractive flavors imposes them to testing new drinks. Namanjeet et al. (2014) results were in agreement with the present study findings who stated that the majority of children consumed caffeine drinks. While, the findings of Kahathuduwa et al. (2020) were incongruent with the present study as they suggest that caffeine can be useful stimulant to improve concentration for older children. In addition, they found that high doses of caffeine (600 milligrams) every day helps control hyperactivity symptoms in children.

Anthropometric measurements are essential indicators that reflect the nutritional status of children with ADHD. It was revealed that the highest percentage of children in the present study were obese regarding to their BMI for age. These findings may be explained in the light of the fact that most of children eat unhealthy food that includes higher frequency of consuming sweets, and canned food. Moreover, based on literature dysregulation of dopamine may mediate consumption of high caloric foods. Besides, impulsivity of ADHD may contribute to obesity as it will impose the child to eat a large quantity of high caloric food. Nigg et al., (2016) agree with the current study as they elaborated that there is a predisposition to obesity in children with ADHD.

Weight is the most worthy tool to assess children nutritional status. Based on the present study findings, it was concluded that mother's level of education had a significant relation with children's weight for age. It was found that nearly half of illiterate or read and write mothers had overweight children. This can be explained that education may increase mothers' awareness about the appropriate quantities and qualities of food that was suitable for their children. Kunto et al., (2021) & Feng et al. (2019) findings were in harmony with findings of the present study as they found that there was a significant positive association between maternal education and their children's weight.

Conclusion

According to the findings of the current study, it can be concluded that most of children received proteins during the day. Unfortunately, all children consumed food contains preservatives or food colors and three quarters of them received sweets. The highest percent of children were obese regarding to their BMI and nearly half of them were overweight. It was observed that, all children had dry skin, skin paleness and the highest percentage of them had brittle nails and hair which reflect that they have a nutritional disturbance.

Recommendations

In line with the findings of the study, the following recommendations are made:

1- Mass media should raise the society awareness regarding nutritional needs of children with ADHD.
2- Nutritional screening should be formulated periodically for all children with ADHD for early

detection and monitoring of their growth.

3- Illustrated booklet about nutritional management of children with ADHD should be available and distributed to parents during follow up visits.

Table 1: Percentage Distribution of Anthropometric Measurements of Children (n =120)

Anthropometric measurements	NO	%
Weight for age		
- obese (≥ 95th percentile)	27	22.5
- Overweight (≥ 85th - <95th percentile)	32	26.7
- Normal (≥5th - <85th percentile)	54	45.0
- Underweight (< 5th percentile)	7	5.8
Height for age		
- Tall stature(≥ 95th percentile)	16	13.3
- Normal(≥ 5th- <95th percentile)	99	82.5
- short stature (< 5th percentile)	5	4.2
Body Mass Index for age		
- obese (≥ 95th percentile)	50	41.7
- Overweight (≥ 85th - <95th percentile)	26	21.7
- Normal (≥5th - <85th percentile)	44	36.6
- Underweight (< 5th percentile)	0	0.0

Table 2: Percentage Distribution of Children's Health Assessment (n =120)

Health Assessment	NO	%
General condition		
- Feeling of tiring, Headache, and Fainting	36	30.0
- Feeling of tiring and Fainting	21	17.5
- Feeling of tiring	11	9.2
- Fainting	9	7.5
- Feeling of tiring and Headache	5	4.2
- Feeling of tiring, Headache, Feeling of dizziness, and Fainting	5	4.2
- Feeling of tiring, Headache, and Feeling of dizziness	4	3.3
- No change in general condition	29	24.1
Hair condition		
- Loss of brightness, Brittle, and Dry hair	109	90.8
- No change in hair condition	11	9.2
Face condition		
- Skin discoloration as darkness, Periorbital darkness, and Conjunctival pallor	120	100.0
Mouth condition		
- Dry lips, and Cracked lips	59	49.2
- Dry lips, Tooth decay, and Cracked lips	32	26.7
- Dry lips, Tooth decay, Cracked lips, and Tongue inflammation	16	13.3
- Dry lips, and Tooth decay	4	3.3
- Dry lips, Cracked lips, and Tongue inflammation	4	3.3
- Dry lips, Tooth decay, and Tongue inflammation	3	2.5
- Dry lips	2	1.7
Skin condition		
- Dry skin, Skin paleness, and Cold extremities	74	61.7
- Dry skin, and Skin paleness	46	38.3

Table 3: Percentage Distribution of Food that Trigger Hyperactivity Manifestations in Children

Food that trigger hyperactivity manifestations in Children with ADHD	Total n=120	
	NO	%
Sweets:		
- Yes	89	74.2
- No	31	25.8
Salty food:		
- Yes	72	60.0
- No	48	40.0
Spicy food:		
- Yes	46	38.3
- No	74	61.7
Fatty diet:		
- Yes	55	45.8
- No	65	54.2
Intake of canned food:		
- Yes	73	60.8
- No	47	39.2
Food rich in food preservatives/ food colors:		
- Yes	120	100.0
- No	0	0.0
Milk and milk products:		
- Yes	109	90.8
- No	11	9.2

Table 4: Percentage Distribution of Drinks that Trigger Hyperactivity Manifestations in Children with ADHD

Drinks that trigger Hyperactivity manifestations in Children with ADHD	Total n=120	
	NO	%
Caffeine beverages as tea or coffee:		
- Yes	95	79.2
- No	25	20.8
Frequency of having caffeine beverages:		
- One	73	60.8
- Two	17	14.2
- Three and more	5	4.2
-Not receiving caffeine	25	20.8
Time of having caffeine beverages:		
- Before meal	3	2.5
- After meal	72	60.0
- Two hours after meal	20	16.7
-Not receiving caffeine	25	20.8
Receiving carbonated beverage :		
- Yes	118	98.3
- No	2	1.7

Table 5: Percentage Distribution of Children's Food Intake that Decrease the Manifestations of ADHD

Food that decrease the manifestations of ADHD	Total n=120	
	NO	%
Food rich in iron as liver, eggplant, spinach:		
- Yes	75	62.5
- No	45	37.5
Food rich in zinc as liver, fish, apricot:		
- Yes	83	69.2
- No	37	30.8
Frequency of raw vegetables/ fruit received / day:		
- One	46	38.3
- Two	26	21.7
- Three and more	35	29.2
- Did not receive	13	10.8
Number of proteins containing meal received / day:		
- Once	111	92.5
- Twice	7	5.8
- Three times and more	2	1.7

Table 6: Relationship between the Mothers' Sociodemographic Characteristics and their Children's Weight for Age

Mothers' characteristics	Children weight for Age								Total		Test of Significance
	Obese ≥ 95th percentile		Over weight ≥ 85th - <95th percentile		Normal ≥5th - <85th percentile		Underweight < 5th percentile				
	n = 27		n = 32		n = 54		n = 7		n = 120		
	NO	%	NO	%	NO	%	NO	%	NO	%	
Age /years											
-25-	24	27.0	21	23.6	39	43.8	5	5.6	89	74.2	X^2= 8.228
-35-	0	0.0	2	50.0	1	25.0	1	25.0	4	3.3	P= 0.222
-45 and above	3	11.1	9	33.3	14	51.9	1	3.7	27	22.5	
Level of education											
-Illiterate/ Read and write	6	30.0	9	45.0	2	10.0	3	15.0	20	16.7	X^2= 18.929 P=0 .026*
-Primary education	6	33.3	2	11.1	9	50.0	1	5.6	18	15.0	
-Secondary / technical education	1	16.7	2	33.3	2	33.3	1	16.7	6	5.0	
-University education	14	18.4	19	25.0	41	53.9	2	2.6	76	63.3	
Occupation:											
-Working	2	8.7	7	30.4	13	56.5	1	4.3	23	80.8	X^2=3.508
-Not working	25	25.8	25	25.8	41	42.3	6	6.2	97	19.2	P=0 .320

* Statistically significant at $p \leq 0.05$

Table 7: Relationship between Children's Sociodemographic Characteristics and their Body Mass Index for Age

Children's characteristics	Children BMI for Age								Total		Test of Significance
	Obese ≥ 95th percentile		Over weight ≥ 85th - <95th percentile		Normal ≥5th - <85th percentile		Underweight < 5th percentile				
	n = 50		n = 26		n = 44		n = 0		n = 120		
	NO	%	NO	%	NO	%	NO	%	NO	%	
Age /years											
- 5-	30	37.0	17	21.0	34	42.0	0	0.0	81	67.5	X^2=3.251
- 9-12	20	51.3	9	23.1	10	25.6	0	0.0	39	32.5	P= 0.197
Gender:											
- Male	29	34.9	20	24.1	34	41.0	0	0.0	83	69.2	X^2= 5.013
- Female	21	56.8	6	16.2	10	27.0	0	0.0	37	30.8	P= .082
Level of education											
- Kindergarten	7	21.2	10	30.3	16	48.5	0	0.0	33	27.5	X^2=7.871
- Primary school	43	49.4	16	18.4	28	32.2	0	0.0	87	72.5	P= 0.020*
Birth order:											
- First	27	45.8	11	18.6	21	35.6	0	0.0	59	49.2	X^2=3.045
- Second	13	44.8	5	17.2	11	37.9	0	0.0	29	24.2	P=0 .550
- Third and more	10	31.3	10	31.3	12	37.5	0	0.0	32	26.6	

* Statistically significant at $p \leq 0.05$

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