

## Nutritional status and dietary patterns of children with attention deficit hyperactivity disorder in Bangladesh

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### ABSTRACT

A descriptive cross-sectional study was conducted purposively among 45 children who took regular health and nutritional care facilities in the Savoy Autism Rehabilitation Center at Narayanganj, Bangladesh with the aimed to observe the nutritional status and dietary patterns of the selected attention deficit hyperactivity disorder (ADHD) child. About 24% of the respondents were well nourished, while 18% of respondents were overweight and 58% of the children were underweight. Dietary patterns were monotonous, cereals (rice/bread) consumption were higher, whereas daily fish and meat consumption were very poor such as 4.4% (small fish), 13.3% (large fish), and 2.2% (meat) respectively daily. Fruits and vegetables consumption were also found as poor among the children. It can be concluded that more emphasis should be given to the incorporation of meat, fish, fruits and vegetables daily into the diet of children with providing nutritional care guidelines to the caregivers of these children so that their diet gets more diversified to ensure macro and micronutrient adequacy. Diet rich with adequate nutrients and proper behavioral and psychiatric therapy should be provided in order to control hyperactive-related disorders.

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## 1. INTRODUCTION

Since the 1970s, attention deficit hyperactivity disorder (ADHD) has been recognized as a distinct illness that affects school-age children and adolescents [1], [2]. It is divided into three types: one where hyperactivity and impulsivity predominate, one where attention deficit type predominates, and a complex type where both symptoms are present [3], [4]. Despite being distinct clinical diagnoses, autism spectrum disorder (ASD) and ADHD have a number of things in common, such as male predominance, early childhood onset, connections to perinatal and prenatal causes, common comorbidity for one another, and frequently persistence into adulthood [5]. ADHD and ASD symptoms commonly co-occur. While ASD and ADHD have some phenotypic overlap, they are each diagnosed according to different standards [6]. Boys are

much more likely than girls to experience with ADHD [7]. The reported prevalence of ADHD varies and is based on age and the diagnostic instruments used, but is estimated to range between 6.7% and 15.5% [8]–[11] and 5-10% of the population of children in school-age [7]. According to epidemiological research and meta-analyses, 5-12% of school-age children and adolescents suffer from ADHD [12], [13]. In a prior comprehensive review, the prevalence of ADHD was determined to be 5.6% worldwide.

There are numerous genetic and environmental factors that contribute to the development of ADHD [10], [14]. Although nutrition deficiencies and unhealthful diets may have a part in the pathophysiology of ADHD, it is still thought to be a hereditary illness [10], [14], [15]. While asymmetrical nutrition decreases growth and brain function and lowers learning and memory capacities in children, adequate nutrition positively affects a child's growth and development [16].

Unfortunately, it is unknown how many children or people in many underdeveloped nations are affected by this crippling developmental neurological disorder that lasts a lifetime. The necessity to rapidly address the needs of persons with ADHD through appropriate epidemiological survey programs is of the utmost importance. Children with ADHD symptoms can be significantly reduced by adopting healthy eating habits and a diet rich in minerals and nutrients. Short-term symptom reduction in ADHD patients may be achieved with both medication and behavioral treatment. Additionally, nutrition treatment can be employed to support these management strategies.

Study stated that poor eating patterns and frequent consumption of processed foods may be linked to a higher risk of ADHD in primary school pupils [16]. According to a research, individuals who skip breakfast more frequently than the normal group had higher levels of ADHD and had poorer dietary habits. Children who consume more processed foods less frequently than they do vegetables have greater rates of ADHD [4]. Evidence suggested that deficiencies in long-chain polyunsaturated fatty acids and a number of minerals, including zinc, iron, magnesium, and iodine, may have a major effect on how severe a child's ADHD symptoms become. The authors of various research also showed how eliminating foods containing artificial food additives, such as food colors and preservatives, had a good effect on the behavior of ADHD-affected kids. During a child's rapid growth and development, it is especially crucial to provide an adequate amount of nutrients and minerals and remove certain dietary items from the diet [4]. Micronutrients, such as vitamins and minerals, and polyunsaturated fatty acids are two of the main dietary components that have been shown to be beneficial in the treatment of ADHA. In patients with ADHD both medication and behavioral therapy reduce symptoms temporarily [17].

Considering the fact, it is important to understand the food habits and nutritional status of children with ADHD. This study will assist us in controlling ADHD symptoms after we have looked into nutritional status and food habits. To assess the potential efficacy of the diet in treating the symptoms of ADHD, additional research in this area is required.

## 2. METHOD

### 2.1. Sampling technique and sample size

A cross-sectional study was conducted among 45 children who were receiving regular health and nutritional care at a rehabilitation center named Savoy Autism Rehabilitation Center located at Narayanganj district, Bangladesh. Respondents were selected from the study population by purposive sampling method. The sample size was calculated with 95% confidence interval and 5% margin of error.

### 2.2. Data collection

A total of 45 participants were recruited for the study and were each asked individually after verbal agreement of the aim and nature of the investigation was obtained. To gather pertinent data regarding general information, a standard questionnaire was created; it also asked about socioeconomic status, personal characteristics, and food preferences. The questionnaire included demographic information like age, sex, educational qualifications of mothers and fathers, and monthly income. To assess the questionnaire's validity, the length of the interview, and some of the items' substance, a pre-test was conducted. To ensure content coverage, the reliability, and the validity of the study, the questionnaires were modified and revised after the pre-test.

The guardian of subject provided the majority of the necessary information regarding the socioeconomic status of the respondents, including family size, monthly income, monthly expenses, respondents' level of education, marital status, occupation, employment patterns, and sources of income. Other household members who were present during the interview also contributed. Individual measurements of height and weight were taken, with each measurement being recorded in kilograms using a common weighing machine. Subjects were asked to stand on the platform without shoes, with their heads erect and looking straight ahead, to be measured for height using a conventional height measurement scale. The closest 0.1 cm was used to measure height. For the purpose of collecting dietary data, a seven days food frequency

questionnaire was used. The respondents were questioned about their eating habits in this part. Five categories of consumption frequency were established: 7 days, 6 to 5 days, 4 to 3 days, 2 to 1 days, and never. All of the data were entered into the appropriate spaces on the questionnaire.

### 2.3. Statistical analysis

The Statistical Package for Social Sciences (SPSS) was used to examine the data (version 20.0). The majority of the statistics were descriptive. The frequency distribution and percentage were examined. Body mass index (BMI) is measured by calculating weight in kilograms/height in meter square and classified according to WHO classification of BMI, nutritional status was categorized into three groups, namely undernutrition: <20, Normal: 20.0-24.9 and overnutrition: 25 and above.

## 3. RESULTS AND DISCUSSION

Table 1 shows the percent distribution of the respondents' socioeconomic information. About 20% of them were four to six years of age and about 31% were seven to nine years of age. Almost half of the respondents (about 49%) were between ten to twelve years of age. About 60% of children were male and 40% were female. Majority of the mothers of the respondents were housewives, while majority of the fathers were day laborers or mill workers. It was observed that about 45% of the respondents' monthly household income were below fifteen thousand BDT (1 USD= 107.27 BDT BDT (Bangladeshi Taka)), while about 22% of respondents' income were between fifteen thousand BDT to twenty thousand BDT. About 76% of respondents replied that their main caregiver was mother and in case of living place of the respondents, about 87% of them had lived with their family.

Table 1. Percent distribution of the respondents' socioeconomic information

Socioeconomic variables		Frequency (n=45)	Percentage (%)
Age of children (in years)	4-6	9	20
	7-9	14	31.1
	10-12	22	48.9
Sex of children	Male	27	60.0
	Female	18	40.0
Occupation of the mothers	Garments worker	6	13.3
	Housewife	34	75.6
	Tailor	3	6.7
	Weaving	2	4.4
Occupation of the fathers	Labor/mill worker	18	40
	Garments worker	6	13.3
	Auto-rickshaw driver	9	20
	Shopkeeper/grocers/small businessman	5	11.1
	Farmer	2	4.4
	Weaving	1	2.2
	Unemployed	4	8.9
Monthly household income (in BDT)	<10,000	3	6.
	10,000-14,999	20	44.4
	15,000-19,999	10	22.2
	20,000-24,999	10	22.2
	≥25,000	2	4.4
Main care provider in family	Mother	34	75.5
	Father	3	6.7
	Grandmother	3	6.7
	Grandfather	1	2.2
	Grandmother plus sister	4	8.9
Child living place	With family	39	86.7
	Others	6	13.3

Figure 1 depicts the nutritional status of the children. The average height of the children was  $125 \pm 6$  cm and their average weight was found  $28 \pm 4.5$  kg. It can be seen from the above table that about 24% of the respondents were in normal status measured by BMI-for-age, while 18% of respondents were overweight.

The frequency of obesity was reported to be 18.0% in a study with 279 children and adolescents who were mentally retarded [18]. A study stated that about 2.6% of the children were underweight, 17.1% were overweight, and 14.5% were obese [19]. A scoping review showed that overweight is more prone to younger children with neurodevelopmental condition compared to normal developing children [19]. A study of overweight children in Italy found that they had worse gross motor abilities than their normal-weight peers

[20], while other systematic reviews found that overweight children had less executive control and more trouble with inhibition than children of healthy weight [21]. A study carried out on nutritional status and dietary patterns of children with autism and it was discovered that 11.9%, 19.7%, and 23.3% of the individuals were underweight, overweight, and obese, respectively [22]. About 58% of the children were underweight. According to a Chinese study, children with ASD have a higher risk of nutrient deficiencies and have geographical variations in their nutritional condition [23]. The ratio of stunting was reported to be 33.5% among all children in a study that investigated the nutritional condition of children with impairments. It was also stated that the ratio of stunting increased with age, with females being more likely to become stunted than boys [24].

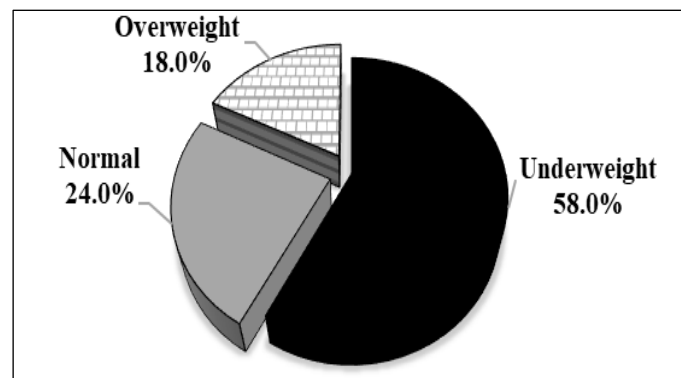


Figure 1. Nutritional status of the respondents by BMI-for-age

On the other hand, Figure 2 shows the scenario of different types of therapies received by the respondents in the center. It is evident that about 43% of respondents had received physical therapy, about 10% respondents had received behavioral therapy, about 30% had received speech therapy, and occupational therapy was received by about 13% respondents, while only about 3% of respondents were found to receive no therapies. There is evidence that children with neurodevelopmental condition who receive physical therapy may have considerable improvements in their motor skills [25]. Children with autism spectrum disorders benefit from speech and language therapy by improving their vocabulary, verbal and nonverbal communication, sentence construction, and speech [26]. A study showed that the cognitive behavioral therapy (CBT) group dramatically improved on tests of ADHD knowledge, self-efficacy, and self-esteem than the control group [27]. About 43 persons with ADHD participated in an open study that found that receiving combination treatment is linked to significant improvements on all clinical metrics [28].

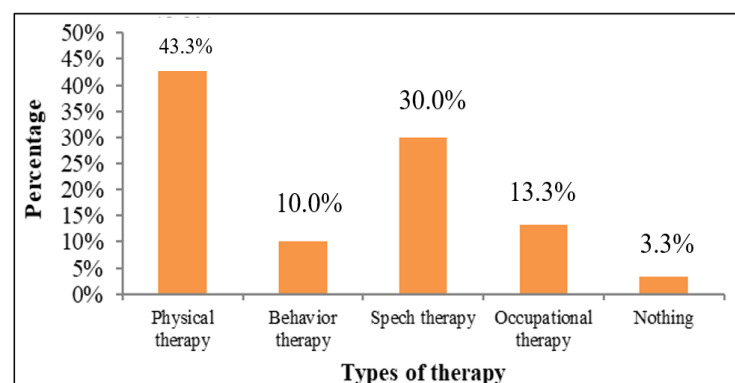


Figure 2. Respondents by different types of therapies they received in the center

According to a study, many management strategies are used to treat ASD in order to improve quality of life. Some examples of these are counseling, speech therapy, occupational therapy, music and movement therapy, special education, art therapy and animal therapy. The five top-rated reviews and the

ADHD literature have combined their findings to demonstrate that psychosocial treatments help to improve behavioral and social outcomes [29]. A long-term use of stimulants like methylphenidate, dexamphetamine, and its derivatives is frequently linked to the standard treatment, which combines behavioral and psychiatric therapy with medicine [30]. It appears that supplement use helps lessen some children's hyperactive behavior [31], [32] CBT is a successful treatment for people with ADHD, according to one study. Combining CBT with medication led to greater gains in executive functions than CBT alone, but not in clinical symptoms [33].

Table 2 shows the picture of dietary patterns provided to the neurodevelopmental disorder children attending the rehabilitation center taken by seven days food frequency questionnaire. It was found that about 78% of respondents said that they had rice during the past seven days, while only 4% of them denied to have rice during past seven days. In case of bread consumption, about 36% replied to have bread for four to three days, while about 13% did not take any bread during the past week. Regarding the consumption of animal protein sources by the respondents, only 4% said that they had eaten small fish daily, while about 34% did not have small fish during past week. About 13% of respondents have large fish daily, whereas, 11% of them replied that they had not eaten any kind of large fish during past week. About 42% respondents said that they took meat for four to three days, and 20% said that they did not have any meat during past week. In comparison with other protein sources, (both animal and protein), milk consumption was found to be higher.

Table 2. Dietary patterns of the respondents by seven-day food frequency questionnaire

Food groups			7D	6D to 5D	4D to 3D	2D to 1D	Never
Cereals	Rice	n	35	3	5	0	2
		%	77.8	6.7	11.1	0	4.4
	Bread	n	11	3	16	9	6
		%	24.4	6.7	35.6	20	13.3
Animal protein	Fish (small)	n	2	13	9	6	15
		%	4.4	28.9	20	13.3	33.3
	Fish (large)	n	6	3	18	13	5
		%	13.3	6.7	40	28.9	11.1
	Meat	n	1	3	19	13	9
		%	2.2	6.7	42.2	28.9	20
	Milk	n	28	0	5	8	4
		%	63.3	0	10	16.7	10
	Eggs	n	27	4	9	3	2
		%	60	10	20	6.7	3.3
Plant protein	Pulses	n	18	12	9	3	3
		%	40	26.7	20	6.7	6.7
Fruits	Fruits	n	3	3	21	9	9
		%	6.7	6.7	46.7	20	20
Vegetables	Leafy	n	20	8	6	6	5
		%	43.3	16.7	13.3	13.3	11.1
	Others	n	14	9	9	4	9
		%	30	20	20	10	20

About 63% respondents replied that they had taken milk daily during past week, while only 10% did not take milk and about 60% said that they had eaten eggs daily on past week while only 3% of respondents replied to have no eggs. About half of the respondents (47%) were found to have fruits for three to four days. In case of vegetables consumption, it was found that about 43% of respondents had eaten leafy vegetables daily and 30% respondents had eaten other type of vegetables daily. Simple sugars, processed and ultra-processed carbs, both low- and high-fat animal proteins, and considerably less servings of vegetables and fruits were ingested by children with neurodevelopmental disorder [34]. Results from a study stated that the severity of neurodevelopmental conditions and associated atypical behaviors may be lessened by customizing a balanced diet with the right micronutrient supplements [35]. According to a research, children with ADHD consumed significantly more simple sweets, tea, and prepared foods than children in the control group, but significantly less protein, vitamin B1, vitamin B2, vitamin C, zinc, and calcium [36]. Children with ADHD had a decreased intake of dairy and vitamin B2 compared to the control group, and a greater intake of refined carbohydrates. It was also found that patients with ADHD may be significantly separated from healthy controls by their composite dietary and nutritional scores [37].

Children with ASD were found to eat significantly more daily servings of sweetened beverages and snack foods than typically developing kids, as well as significantly fewer daily servings of fruits and vegetables [38]. Healthy controls and children with ADHD seem to have distinct eating habits [10], [14], [37]. Growing evidence points to the potential significance of nutrition, lifestyle, and nutrients in the

pathogenesis and treatment of mental illnesses [39], including ADHD [40]. Children with ADHD had lower intakes of dairy, calcium, and vitamin B-2 and greater intakes of refined carbohydrates [37]. The interaction between diet and lifestyle should be more prominently included in studies on treatment strategies for ADHD because diet and nutrition interact with other lifestyle factors, such as physical activity [41]. In addition, a survey found that 93.06%, 90.28%, 80.56%, and 62.50% of ASD children did not consume enough fruit, fish, vegetables, or water on a regular basis [42].

ADHD risk has decreased by up to 37% with a "healthy" diet high in fruits, vegetables, legumes, and fish. Adherence to the "Western" dietary pattern, which includes red meat, refined grains, processed meats, and hydrogenated fat, as well as the "junk food" pattern, which includes sweetened beverages and desserts, increased it [43]. The research revealed that unhealthy eating habits had a negative correlation with ADHD whereas good ones had a favorable correlation. Regarding dietary supplements, only vitamin D and vitamin D + magnesium seemed to lessen the symptoms of ADHD [44]. Micronutrients, such as vitamins and minerals, and polyunsaturated fatty acids are two of the main dietary components that have been shown to be beneficial in the treatment of ADHD. According to a number of studies conducted on a group level, individuals with ADHD have lower blood plasma levels of several minerals, such as magnesium, iron, and zinc and their treatment may lessen ADHD symptoms in people with the corresponding deficiencies [45]. It is debatable how omega-3 polyunsaturated fatty acids (PUFAs) affect the pathogenesis and treatment of ADHD [40]. The effectiveness of omega-3 polyunsaturated fatty acid (PUFA) supplementation on the primary symptoms of ADHD is presently not well established.

A systematic review displayed that two dietary therapies that appear to have the greatest potential for reducing the symptoms of ADHD in children are elimination diets and fish oil supplements [46]. Recent studies have looked at dietary patterns, complete diets, and other lifestyle-related factors instead of evaluating the impact of individual micronutrients in children with ADHD. According to the results of these studies, the overall diet should be taken into account rather than concentrating on certain micronutrients [45]. A poor nutritional biochemistry status that affects ADHD behaviors may be preceded by unhealthy eating habits, therefore managing one's food and nutrition should always be taken into account as a means to reduce the symptoms of ADHD.

Figure 3 depicts the percent distribution of respondents under special diet. It was observed that respondents were having different types of specially modified nutritional care such as about 27% was receiving gluten-free diet, 20% was receiving casein-free diet, only 10% was receiving yeast-free diet, whereas, about 44% of the respondents was receiving high-protein diet. Majority of them (about 82%) was receiving sugar-free diet. About 33% of them was receiving supplements. It is investigated whether nutrition (gluten-free/casein-free diet and special carbohydrate diet) is a component of current ASD treatment and whether it has any positive impacts [47]. It is well known fact that ADHD and the symptoms of ASD usually co-occur. But there is minimal proof that a gluten-free and casein-free (GFCF) diet is helpful for a child's ASD symptoms [48]. Food colorants and preservatives should be avoided as well as sugar and sweeteners in order to improve behavior and attention in ADHD youngsters. Despite the prevalence of the gluten-free diet, children with a documented food allergy, such as celiac disease, a wheat allergy, or a non-celiac gluten sensitivity (NCGS), should only follow these diets. Elimination diets are generally only recommended for usage with kids who have known sensitivities to the food being avoided [49].

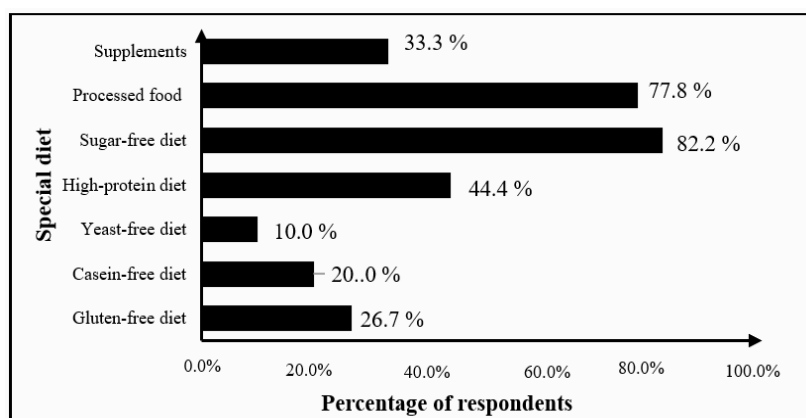


Figure 3. Percent distribution of respondents under special diet

#### 4. CONCLUSION

Therefore, it is recommended that the rehabilitation centers of Bangladesh along with the principal care giver of the patient should be concern about ensuring the proper nutritional care of these children so that their diet get more diversified to ensure macro and micronutrient adequacy. The dietary habits of children with ADHD are distinctive, and nutritional factors may play a role in the pathophysiology of ADHD. When evaluating children with ADHD routinely, clinicians should take into account dietary practices and particular nutrients.

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