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Nutrient Consumption among the Bangladeshi Children with Autism

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Abstract

Background: The prevalence of Autism in South Asia is 1 in 93 children, where, prevalence is much higher, 3% in Dhaka city of Bangladesh. Consumption of daily required nutrient is essential for these children like normal ones but sometimes may be neglected. Objectives: This study was undertaken to assess the macro and micronutrient consumption among the children with autism in Dhaka city and compared to the requirement. **Material & Methods:** In this cross-sectional study, 100 subjects where male-female ratio was 3:2, were studied from urban autism centers Dhaka, Bangladesh. Anthropometric parameters height, weight, BMI and 24-hour dietary recall (individual 3days) were collected following predesigned questionnaire. Data was collected from face to face interview from both parents and center's teacher as appropriate. Nutritive value of food was calculated using Food Composition Table for Bangladesh, 2014 using a food software. For statistical analysis, SPSS 20 was used. **Results:** The average age and BMI of subjects were 11 yrs and 21 kg/m2 respectively. The mean ±SDvalues (g/day) of protein, fat and carbohydrate intake were 38±15, 47±12 and 116±38 respectively. The average intake of (mg/day) thiamine, riboflavin, vitamin C, calcium, magnesium, iron, niacin, and zinc was 0.68±0.32, 0.46±0.23, 33±24, 144±87, 137±55, 6.5±2, 11±4 and 5.2±2 respectively. About 94% children consumed only 33% of the required calcium. Nearly 42% children took 67% of the required magnesium. Similarly, half of the children failed to consume 33% thiamine and zinc of the requirement. **Conclusions:** Consumption of calcium, thiamine, folic acid, and zinc are seemed to be lower than their requirement.

Keywords:- Autism; micronutrients, 24-hour dietary recall; Food Composition Table; BMI.

INTRODUCTION

Autism Spectrum Disorder (ASD) a neurodevelopment disorder,[1] characterized by stereotyped and repetitive behaviorsand lack of social interactions, verbal and non-verbal communication.[2] Most commonly autism appears at 2 to 3 years of life.[3] ASD is approximately 4.5 times more prevalent in boys (1 in 42) than in girls (1 in 189) and has a prevalence incidence of 1 in 68 youngsters.[1] In

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South Asia, the prevalence of ASD is 1 in 93 children where prevalence is much higher (3%) in Dhaka city of Bangladesh.[4] Micronutrients are most important for developing neuro-network and neurogenesis.[5] It has been reported that children with ASD have lower levels of magnesium,[6] zinc, selenium, vitamin A, vitamin B complex, vitamin D, vitamin E,[7] and carnitine,[8] in blood, hair, or other tissue. Micronutrients deficiency during pregnancy, such as folic acid,[9] and vitamin D,[10] is also associated with developing ASD. Limiting dietary intake, refusing food, behavior problems etc are common feeding problems that are reported by parents of ASD affected children.[11,12] As a result, children with ASD were not meeting Dietary Reference Intakes (DRIs) of various micronutrients like vitamin A, vitamin D,[13] vitamin C, niacin, folic acid,[14] iron, zinc, vitamin B6.[15] A relationship is found between thiamine status and autism development. Thiamine may be involved in autism by apoptotic factors, neurotransmitter systems and oxidative stress.[16,17,18]

Thiamine plays a central role in cerebral metabolism.[16] It is an essential vitamin for brain development in infants.[17] Infantile thiamine deficiency may affect language development, and that thiamine is apparently an essential nutritional component for language development in infants.[18] Calcium appears to be involved in each phase of brain cell development during the early stages of life.[19] Calcium has the ability to regulate neuronal development and can direct both structural and functional adaptations in specific brain cells. When the calcium-dependent network of brain development does not work properly the risk of the fetus developing diseases such as autism is resulting from a calcium deficient pregnant mother.[19] Children with low Zn status may present with lowered immunity, poor muscle development, decreased range of foods.[20] The frequency of Zn deficiency is high in children diagnosed with an ASD. This is a bad thing because the Folate Vitamin is not working and cannot get into the brain where it is needed.[21] It has been documented that Folate Receptor Antibodies were present in 75% of the 93 autistic children studied.[21] Vitamin D also playing important role in brain development.Serotonin, oxytocin, and vasopressin, three brain hormones that affect social behavior related to autism, are all activated by vitamin D. Supplementation with vitamin D and tryptophan would be a practical and affordable solution to help prevent autism.[22]

Dietetic factors can play a significant role in the origin of ADHD and that magnesium deficiency can result in disruptive behaviors. There is much overlap between ADH/hyperactivity and autism, for autistic children who show signs of hyperactivity, improving blood sugar balance is a must,[23] Supplements of oral magnesium and vitamin B6 led improving in social interactions, stereotyped restricted behavior, communication and abnormal/delayed functioning in ASD affected children (age 1–10 years).[16] Serotonin, dopamine and norepinephrine are the brain neurotransmitters and folate is essential for synthesized them. In autism, folate vitamin is not working and can't get into brain where it is needed because of auto-antibodies.[17] A relationship is found between thiamine status and autism

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development. Thiamine may be involved in autism by apoptotic factors, neurotransmitter systems and oxidative stress.[18] Therefore, in this study we have attempted to estimate the consumption of nutrients regard to their requirements.

MATERIAL AND METHODS

In this study we have recruited one hundred Autistic children (4 to 19 years of age) from different Autistic schools in Dhaka city of Bangladesh. This cross-sectional study was conducted at the Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders (BIRDEM). The study was conducted with a total of 100 (one hundred) Autistic children of 4 to 19 years of age, from different Autistic schools in Dhaka, Bangladesh. Data were collected by a predesigned questionnaire that included Anthropometric, and 24 hours dietary recalls.In this study the Dietary Diversity Questionnaire was used for collecting and calculating (Women dietary diversity score) WDDS data. It has been adapted from the Guidelines for measuring household and individual dietary diversity (FAO, 2011). The two schools were visited and after having permission from the school authority and the guardians of the children, the data were collected. The questionnaire was given to the participants to document the 24-hour dietary recall. The food intake patterns of the subjects were recorded by 24 hours recall method for three days and used nine groups for WDDS information. The 4-19 years of age autistic children were the respondent. The interview included a detailed description of the foods eaten, the cooking methods and outside foods. In this method, the children's parents were asked by our group members, who has been trained in interviewing techniques, to recall the subject's exact food intake during the previous twenty-four-hour period or preceding day. Detailed description of all foods and beverages consumed, including cooking methods and brand names (if possible), were recorded. Vitamins and mineral supplement was also noted. Quantities of foods consumed were usually estimated in household measures and entered on the data sheet. Food models of various types were used as memory aids to assist the respondent in assessing portion size of food items consumed. (Gibson, 1990).Data editing was carried out by checking and verifying the complete questionnaire at the end of the interview and also at the end of the whole survey before analysis.Statistical analysis was performed using SPSS (Statistical Package for Social Science) Software for windows version 16.0 (SPSS INC.Chicago, Illinois, USA). All the data were expressed as M±SD (Standard Deviation), student's t test, multiple comparisons (Bonferroni) as appropriate. Correlation was also among the parameters. P<0.05 was considered as a level of significance.

RESULTS

In this study, we assess all the children in two ways – total average assessment and age groups average assessment.

Table 1: Anthropometric (M ± SD) parameters among the study autism subjects (n=100)

Variables	All participants	Group 1	Group 2	Group 3	Group 4
Age (Yrs)	11±4	5±0.8	9±0.9	12±0.9	16±1.4

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Height (m)	2±1	1.13±0.2	1.21±0.2	1.4±0.2	1.54±0.2
Weight (Kg)	36±13	27±9.6	29±6.87	39±11.2	35±12.7
BMI (Kg/m^2)	21±6	20.45±4.1	20.36±6.8	19.9±3.9	22.39±3.7

Group 1, <6yrs,; group 2, 7-10yrs; group 3, 11-14yrs; group 4, >14yrs

Mean ± SD age, height, weight, BMI among all the study subjects were 11 ± 4, 2±1, 58±9, 36±13, 21±6 respectively.BMI was increasing according to age in participants over 14 years of age.

Table 2: Key food intake among the study autism subjects (n=100)

	All participants	**Group 1**	**Group 2**	**Group 3**	**Group 4**
Food groups					
Cereals	381±152	465±179	353±132	377±151	392±168
Vegetables	184±154	145±135	193±191	178±132	212±138
Spices, condiments, beverages	60±62	44±75	53±51	68±64	65±67
White tubers and roots	21±25	9±10	17±22	25±21	30±38
Milk and milk products	59±71	64±67	69±78	55±68	34±55
Fruits	62±67	127±128	52±44	52±48	53±54
Fish and other sea foods	46±30	43±26	41±26	50±32	44±35
Oils and fats	39±11	37±11	37±11	38±11	41±06
Legumes, nuts and seeds	82±50	102±52	66±54	87±44	86±48
Eggs	33± 18	43±18	28±17	32±18	34±11
Meat	79±130	94±68	91±200	74±72	48±42
Sweet	36±36	60±76	26±13	36±30	34±24

Group 1, <6yrs,; group 2, 7-10yrs; group 3, 11-14yrs; group 4, >14yrs

M ± SD cereals consumed by study subjects was 381±152; vegetables were 184±154; spices, condiments and beverages were 60±62. M±SD value of average intake of white tubers and roots, milk and milk products and fruits were 21±25, 59±±71and 62±67 respectively. The value of M ± SD fish and other sea foods consumed was 46±30; oils and fats was 39±11; legumes, nuts and seeds was 82±50; eggs was33± 18; meat was 79±130; sweets was 36±36. Veg and roots, spices and oil consumption were lower and milk, sweet, egg and meat consumption were higher in group I in comparison with other 3 groups.

Table 3: M±SD intake of macronutrients (g/day) of study autism subjects (n=100)

Macronutrients	**All**	**G1**	**G2**	**G3**	**G4**
Carbohydrate (g/day)	38±15	138±52	105±33	118±37	118±37
Protein (g/day)	47±12	51±18	33±16	38±12	35±11
Fat (g/day)	116±38	48±11	46±13	46±11	49±7
G					

Group 1, <6yrs,; group 2, 7-10yrs; group 3, 11-14yrs; group 4, >14yrs

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M ± SD protein, fat, carbohydrate among the study subjects were 38±15, 47±12 and 116±38 respectively. Carbohydrate, fat and protein consumption were higher in group 1 than other 3 groups.

Table 4: M±SD intake of micronutrients (g/day) of study autism subjects n=100

Brain nutrients	**All**	**G1**	**G2**	**G3**	**G4**
Thiamin (mg/day)	0.68±0.32	1.0±0.4	0.7±0.4	0.7±0.3	0.7±0.3
Magnesium (mg/day)	137.8±55.14	162.2±60	130.3±61	138.2±54	134±35
Calcium (mg/day)	144.6±87.24	135.5±67	168.3±12	135.5±67	117.2±53
Folic acid (mcg/day)	79.10±35.48	88±24	76.4±42	77±32	85±32

Group 1, <6yrs,; group 2, 7-10yrs; group 3, 11-14yrs; group 4, >14yrs

M ± SD value of average intake of thiamin, riboflavin, zinc and niacin were 0.68±0.32, 0.46±0.23, 5.28±2.40 and 11.06±4.57 respectively. M±SD vitamin C consumed by study subjects was 32.90±23.89, iron was 6.54±2.60, sodium was 149±64.87 and magnesium was 137.8±55.14. M ± SD value of average intake of calcium, phosphorus, potassium were 144.6±87.24, 441.6±168.2, 970.7±367.4 respectively. M±SD folic acid consumed by study subjects was 79.10±35.48 and retinol was 111.43±90.41. Thiamin, Magnesium and Folic acid consumption g/day were higher in group1 who were most younger in age in this study.

Table 5: Comparison of daily vitamin intakes with recommended dietary allowances among the study subjects (n=100)

Vitamins	**All subject**	**Group-1, n=12**		**Group-2, n=35**		**Group-3, n= 40**		**Group-4, n= 13**	
	Daily Intake	**RDA**	**Daily Intake**	**RDA**	**Daily Intake**	**RDA**	**Daily Intake**	**RDA**	**Daily Intake**
Riboflavin (mg/day)	0.46±0.23	0.6	0.5±0.2	0.9	0.5±0.3	1.3	0.4±0.2	1.3	0.4±0.2
Niacin (mg/day)	11.06±4.57	8	15±6.7	12	10±4.4	16	11±3.6	16	10±4
Vitamin C (mg/day)	32.90±23.89	30	42±39	35	32±24	40	29±18	40	39±22
Folic acid (mcg/day)	79.10±35.48	200	88±24	300	76.4±42	400	77±32	400	85±32
Retinol (mcg/day)	111.43±90.41	450	105±54	500	130±121	600	93±64	600	125±85

Group 1, <6yrs,; group 2, 7-10yrs; group 3, 11-14yrs; group 4, >14yrs

Folic acid retinol and ribo were lower consumption. All most all nutrients were found lower consumption in all groups.

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Page no- 122-129 | Section- Research Article (Nutritionology)

Table 6: Comparison of daily mineral intakes with recommended dietary allowances among the study subjects (n=100)

Minerals	All subject	Group-1, n=12		Group-2, n=35		Group-3, n= 40		Group-4, n= 13	
	Daily Intake	RDA	Daily Intake	RDA	Daily Intake	RDA	Daily Intake	RDA	Daily Intake
Iron (mg/day)	6.54±2.60	4.2	8±3	5.9	6±3	9.7	7±2	12.5	7±2
Magnesium (mg/day)	137.8±55.14	76	162.2±60	100	130.3±61	230	138.2±54	230	134±35
Calcium (mg/day)	144.6±87.24	600	135.5±67	700	168.3±12	1300	135.5±67	1300	117.2±53
Zinc (mg/day)	5.28±2.40	4.8	7.4±3.4	5.6	4.5±2.4	8.6	5.4±2	8.6	5±2
Phosphorus (mg/day)	441.6±168.2	500	585±224	500	403±179	1250	441±127	1250	415±135
Potassium (mg/day)	970.7±367.4	1500	1254±459	1550	862±407	1550	990±278	15500+	939±289

Group 1, <6yrs,; group 2, 7-10yrs; group 3, 11-14yrs; group 4, >14yrs

Calcium intake were lower in comparison with RNI values.

DISCUSSION

Autism spectrum disorder (ASD) is a complex as well as a frequent neuro developmental disorder that usually begins at or before the children are 3 years old.[24] As expected, children with autism had poorer food intake. According to [Table 1], the average BMI of subject groups is 21, which is normal. From [Table 2], Macronutrients (protein, fat, carbohydrate) intake were 38±15, 47±12 and 116±38 respectively.One of the major objectives of the study was to compare their micronutrient intake with their requirement. We found that Autistic children took major micronutrient less than their requirement. ⅓ and ⅔ calcium of the requirement were consumed by 94% and 5% children respectively. According to Lohmann,[25] calcium has the ability to regulate neuronal development and can direct both structural and functional adaptations in specific brain cells. Only 1% children filled up their requirement. 26% children consumed Mg more than their requirement. 26% children filled up their requirement. 42% and 6% children consumed ⅔ and ⅓ of their requirement respectively.Gómez-Pinilla, Fernando stated autistic children and children with other spectrum disorders had significantly lower plasma concentrations of Mg than normal.[26] 19% children consumed thiamine more than their requirement. 10% children filled up their requirement. 52% and19% children consumed ⅔ and ⅓ of their requirement respectively.

Current study suggested that more than 50% of a preschool children cohort,[27] who were exposed to a thiamine-deficient diet for more than 1 month during the first 24 months of life, developed movement and motor skills difficulties compared to less than 10% among

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Page no- 122-129 | Section- Research Article (Nutritionology)

children with appropriate thiamine intake. A more recent study has shown decreased TPP levels in plasma from ASD children compared to healthy controls,[28] suggesting either lower consumption or an impaired absorption from the gastrointestinal tract, providing a link between thiamine metabolism and the gut microbiome, which has been considered in the context of ASD.[29] The result of the study was as follows: 53% of the studied cases had insufficient nutrient intakes in terms of the nutrients vitamin C, iron, vitamin D, niacin, ribo-flavin, vitamin B6, calcium, and zinc. Also, the intake of food types was extremely narrow.[21] Folic acid was consumed 2/3 of the required quantity by 78% children and ⅓ was consumed by 22% children of their requirement. Folate deficiency is associated with neuropsychiatric disorders. About 41% children consumed niacin more than their requirement. 37% children filled up their requirement. 21% and 1% children consumed ⅔ and ⅓ of their requirement respectively.niacin deficiency manifest dementia, loss of memory, nervousness, distractibility and schizophrenia.[21] ⅓ and ⅔ Zn of the requirement were consumed by 8% and 57% children respectively. Nearly 35% children filled up their requirement. The frequency of Zn deficiency is high in children diagnosed with an ASD.[30] In this study, it was also seen that 45% children drank milk but not regularly. Most of the children with ASD become more hyper after taking coke and chocolate.

CONCLUSIONS

From the above results it may concluded that Consumption of calcium, thiamine, folic acid, and zinc are seemed to be lower than their requirement among the study Autism subjects.

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