



ASSOCIATION BETWEEN MEALTIME BEHAVIOR PROBLEMS AND SOMATIC STATUS AMONG INDIAN CHILDREN WITH AUTISM SPECTRUM DISORDER

Paediatrics

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ABSTRACT

Research information on the mealtime behavior issues and somatic measurements of Indian ASD children is quite scarce. Therefore, a cross-sectional observational study was planned to investigate the associations between mealtime behavior problems and somatic measurements of Indian children with Autism Spectrum Disorder. ASD children (n=104) aged 2-15 years attending special centers of Mysuru, India, were enrolled for the study to measure their somatic status (height, weight, BMI) and food behavior issues using a validated questionnaire (CEBI and BAMBI). Demographic profile, gastrointestinal problems and nutrient intakes through 3 day recall method and FFQ were also obtained. The mean BMI was 24.5 ± 10.3 . Almost $1/3^{rd}$ of the children were categorized as overweight (85-95th percentile BMI) and $1/4^{th}$ were obese (>95th percentile BMI). 59.61% of the children had food refusal as dominant issue reported by their parents followed by 47.11% children facing abdominal cramps. Limited food variety and inadequacy of micronutrient intakes were observed. The Odd Ratios (OR) for selected micronutrients (Ca, Fe, Zn, Folate, Vitamin C) were 3.57, 2.17, 3.06, 2.92, 1.87 respectively indicating a higher risk for failing to meet recommended levels. Continuous nutrition counseling programs and awareness on health education are essential to improve parent's knowledge on nutritional aspects in addition to detect nutritional related problems at an early stage and design a systematic assessment and planned screening programs for the target populations.

KEYWORDS

Body measures, Food behavior issues, Nutrient inadequacies, GI Issues

INTRODUCTION

ASD is emerging as one of the most common developmental disabilities exponentially rising and affecting the future generation of India.^[1,2] There is no single cause for ASD, but it is likely that multiple genetic, environmental and immunological factors play a significant role in its pathogenesis. Recent prevalence rates in India estimates a pooled percentage of 0.11 among rural children (1-18 years) and 0.09 among urban children (0-15 years)^[3]. The drastic increase in the incidences could be probably attributed to the recent advances in diagnostic techniques and early recognition, parent's attitude towards acceptance of ASD, better intervention therapies, etc.^[4]

Besides the socio-behavioral problems, diet related issues are common recurrent concerns experienced by ASD children. They are nutritionally vulnerable as they exhibit a selective or picky eating pattern and sensory sensitivities that predisposes them to nutritional related issues. They self-select and restrict foods based on temperature, color, texture and even packaging of prepared foods and they also prefer monotonous routine in dietary habits, predominantly in the form of strong preferences towards starches, snack items and processed foods and a bias against proteins, fruits and vegetables^[5] which can end up in vital nutrient deficiencies. Parents also report feeding problems and challenging mealtime behavior issues which occur as high as 90% among this population. As a result of all these factors; the nutritional vulnerability has direct effect on the normal growth and development of ASD populations^[6, 7]. Majority of ASD children display gastrointestinal symptoms (GI) such as constipation, diarrhea, bloating and cramping, which could impact the absorption and utilization of nutrients and an increased intestinal permeability often referred to as leaky gut syndrome.^[8-10] It has also been postulated that dietary aspects like micro-biota composition, GI problems, foods such as gluten and casein could aggravate the symptoms of ASD. Together, these factors can influence a child's willingness and ability to consume an adequate number and variety of nutrients to meet their daily needs. Therefore, nutrition-related factors have been hypothesized to play a causal role in the etiology of ASD and its symptoms^[11,12,13,14].

Research on ASD children in India is largely restricted to the clinical profiles, language improvement protocols and diagnostic procedures with no or minimal research work focusing on nutritional and somatic parameters. Studies primarily targeting on the somatic status and dietary intakes of ASD children in India are not reported. However, our pilot work (n=53) mainly focused on the dietary patterns and its impact on the somatic status of the children with ASD.^[2] As an extension to this work, the current study was planned with a larger sample size (n=104), to examine the association between mealtime behavior issues and somatic parameters. The results of the study will direct the need of addressing these important issues among the target population of the region which is often overlooked.

Methods Employed

Study Design and Participants

The current work was a cross sectional study (September 2017-October 2019) comprising 104 children (82boys and 22girls) in the age group of 2-15years attending 2 special schools set up for ASD children and All India Institute for Speech and Hearing (AIISH) at Mysuru, India. The subjects recruited were diagnosed after a series of structured interviews conducted by a psychologist and developmental pediatrician defined in Indian Scale for Assessment of Autism (ISAA) which is based on the DSM (IV) criteria for autism spectrum disorders. The study protocol was conducted according to the guidelines stated in the Declaration of Helsinki (2000) and was approved by Institutional Human Ethics Committee, University of Mysore (IHECUOM No.51/Res/2016-17) prior to the initiation of the study. Permission was also obtained from the respective Institutes and Block education officer before the commencement of the study. As the children fall under the vulnerable group, parents or guardians permission was also taken through written informed consent in both English and local regional languages.

Anthropometric measurements

A general questionnaire was developed by the authors to collect the background information regarding demographic profile (age and gender) physical assessments (standing height and weight measurements) which reflects their general health and dietary adequacies. Using height and weight measurements, BMI (kg/m²) was calculated and converted to percentile ranking and based on these percentiles, children were categorized according to one of the following groups : normal (5-84th percentile), overweight (85th - 95th percentile) and obese (> 95th percentile). All the measurements were recorded using standard anthropometric techniques^[15] and recorded as per the guidelines suggested by Jelliffe.^[16] All the instruments were calibrated to the accurate levels before use. Additionally, clinical manifestations associated with GI problems (nausea, abdominal cramps, vomiting, constipation, diarrhea, etc.) were also recorded.

Eating and mealtime behavior issues

Children's Eating Behavior Inventory (CEBI), a valid tool developed by^[17] which comprises of 40 items in total; 28 regarding assessment of food preferences, motor skills and behavioral compliance; 12 items assess the parental child behavior controls, cognitions and feelings about feeding their child and relations between family members was used. For the convenience of our study; the psychometric properties of this questionnaire were further sub-categorized into seven factors, such as Satiety Responsiveness (SR), Slowness in Eating (SE), Fussiness (F), Food Responsiveness (FR), Enjoyment of Food (EF), Emotional Under eating/Over eating (EUO) and Family Care (FC). The responses (never, seldom, sometimes, often and always) given by

the parents/caretakers were scored using a 5-point Likert scale based on the frequency of occurrence of problem. The responses of the items are then summed up for the total scores, converted into percentages and a cut-off value of >16% are indicative of presence of eating problems.

Brief Autism Mealtime Behavior Inventory (BAMBI) a structured and validated questionnaire^[18] comprising of questions related to eating problems (food aversion/food refusal of new foods) was used. The questionnaire utilizes a Likert scale for reporting the frequency of behaviors. The parents were asked to report their responses based on the frequencies of mealtime behavioral issues by rating them according to the subsequent scoring method: 1 = Never / rarely, 2 = Seldom, 3 = Occasionally, 4 = Often and 5 = At almost every meal. The questionnaire also had an option of circling 'Yes' or 'No' if the parents think it's a problem or not a problem for them. Thus, the parents selected one of these options to depict the severity of each problem.

Dietary assessments

Dietary intakes were recorded using 24hour recall method for three non-consecutive days (two weekdays and one weekend) and food frequency questionnaire (FFQ) was used to measure the consumption pattern of different food groups on daily, weekly, monthly or occasional basis by the children. Standardized measuring cups and visual guides were shown to the parents in order to accurately measure the portion size of the foods given to their children.

Nutrient Intake Analysis

The records of foods consumed were analyzed using Diet Cal software^[19] to calculate nutrient intake and an individual report was generated for each participant. The software is a tool for dietary assessment and planning of commonly consumed foods and is based on Indian Data (National Institute of Nutrition, Indian Council of Medical Research). It has an editable central repository classified by food groups and their nutritive values and also had the facility to create custom recipes and allowed calculation of nutritive values of food items and recipes. The adequacy of diets can be assessed using several analytical approaches such as cut-off method, which estimates the percentage of the population having usual intakes below a given value; and probability method, which assesses the percentage of the population whose usual intakes are below their individual requirements.^[20] In the present study, Estimated Average Requirements (EAR) cut-off method (Indian Council of Medical Research 2020) was used to assess the adequacy or deficiency of nutrient intakes.

Statistical analysis of the data

The data was subjected to descriptive statistics using Statistical Package for the Social Sciences SPSS 16 Version program (SPSS, IBM). The data are expressed in mean, range and standard deviation (SD) for anthropometric measurements. Parent's responses on feeding behavior of autistic children during mealtime were evaluated in frequencies and percentages. The mean of nutrient intakes according to age of the subjects were calculated. For significant difference, one sample t-test was employed at 95% CI between the actual nutrient intake and Estimated Average Requirements (EAR) of the subjects to evaluate the adequacy or deficiency of nutrients. Odds ratios were calculated for selected micronutrients to evaluate the relative risk of nutrient deficits.

RESULTS

Somatic measures and autism status results are presented in Table 1. A total of 104 children, comprising 82 boys and 22 girls were enrolled, thereby constituting gender ratio of 3.7:1 (males: females). 36 belonged to 2-5-years of age, while rest 68 to 5.1-15years. On an average, children were almost 111 cm tall and weighed nearly 52 kgs. Mean BMI was 24.5±10.3. None of the children were found to have protein energy malnutrition according to their BMI for age percentile distribution. However, almost one-third of children were categorized as overweight (85-95th percentile BMI) while one-fourth of them were obese (>95th percentile BMI). Children were assessed for characteristics of ASD and are mainly grouped into mild, moderate and severe cases - degree of autism; (20.19%, 63.46% and 16.34% respectively). Symptoms associated with GI problems are also presented in table 1. Majority (almost 60%) of children had food refusal as dominant issue. As evident, 49 children reported to "often" have abdominal cramps; 6 subjects faced reflux/indigestion problems. In addition, most of the parents also complained of dental issues, selective food eating habits among their children.

Table 1: Somatic measures and associated GI problems in ASD children (n=104)

Characteristics	Mean	SD	Range
Height (cms)	111.42	33.23	109-178
Weight (kgs)	52.25	22.62	18.5- 65
BMI	24.5	10.3	13.9-38.6
BMI for age	n	%	
Normal (5-84 th percentile)	38	36.53	
Overweight (85-94 th percentile)	40	38.46	
Obese (>95 th percentile)	26	25	
Degree of ASD (%)			
Mild	20.19		
Moderate	63.46		
Severe	16.34		
GI problems	n	%	
Food refusal	62	59.61	
Abdominal cramps	49	47.11	
Reflux/Indigestion	6	5.76	
Nausea	5	4.80	
Vomiting	9	8.65	
Constipation	16	15.38	

Eating problems: Results of CEBI are shown in figure 1. Only 4.80% of ASD children fed themselves and were dependent on their parents during meal times. About 10.50% finished their meals on time and 22.11% parents gave response as 'never' when asked if their child finishes meal quickly. 28.88% ASD subjects told that they felt hungry. Around 20.19%'always' took more than half an hour to finish their meals and 33.65% responded that subjects 'always' gags at mealtime. ASD children also reported higher (50.96%) stressful meals. 35.57% subjects asked food 'sometimes' which they should not eat because of their issues related to food behavior. Around 43.26% children gave responses as 'seldom' when asked to eat foods that taste different, 29.80% gave responses as 'never' when asked if they eat chunkier foods and only a handful 6.73% preferred chunkier foods 'always'. 19.23% responses were 'sometimes' when asked if child vomits at mealtimes. 23.07% parents complained the response as 'sometimes' for food choking at mealtimes. 72.11% responses were 'never' when asked if child uses cutlery as expected for age. 22.11% children gave 'always' as responses for enjoyment of food while eating. Only 7.69% parents were confident that their children eat sufficient and 45.19% parents reported that their ASD children never had snacks between meals. Maximum responses were reported as 'never' when asked if child eats their meals when getting upset or they'll get fat or will they eat or hide food and demands for books or toys during eating or mealtimes.

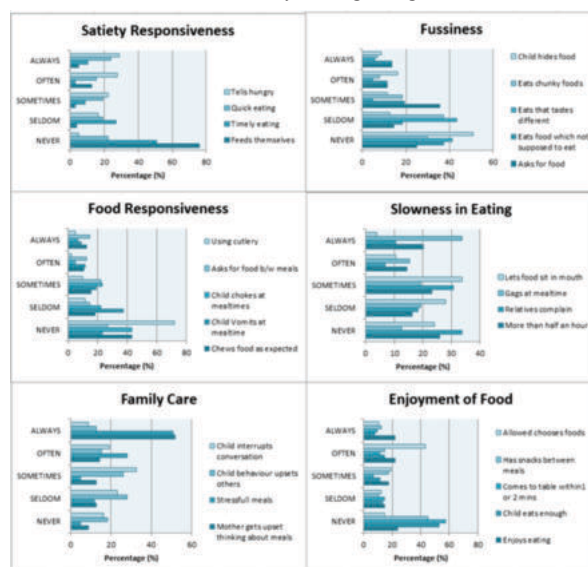


Figure 1: Graphical Representation of CEBI (Eating problems) among ASD children (n=104)

Results of BAMBI are presented in Table 2. None of the parents responded to last two options ("often" and "at almost every meal") on the five point scale; their responses were either "never/rarely", "seldom" or "occasionally". Salient findings, revealed that majority

(96.15%) of children “never/rarely” aggressive and never exhibited self-injurious behavior (94.23%) or (83.65%) cried while eating their meals. However; (68.26%) of parents reported that “occasionally” their child remained seated at table till meal is finished. Though (71.15%) parents reported that “occasionally” their children were flexible about mealtimes; majority (85.57%) of them “never/rarely” liked or wanted to try new foods. About (47.11%) parents reported that their children were “occasionally” disruptive during mealtimes.

Table 2: Mealtime behavioral problems in children with ASD (n=104) [Brief Autism Mealtime Behavior Inventory (BAMBI)]

Variable	Never/rarely n (%)	Seldom n (%)	Occasionally n (%)
My child cries or screams during mealtimes	87(83.65)	12(11.53)	5(4.80)
My child turns his/her face or body away from food	68(65.38)	11(10.57)	25(24.03)
My child remains seated at the table until the meal is finished	19(18.26)	14(13.46)	71(68.26)
My child expels (spits out) food that he/she has eaten	32(30.76)	45(43.26)	27(25.96)
My child is aggressive during mealtimes (hitting, kicking, scratching others)	100(96.15)	1(0.96)	3(2.88)
My child displays self-injurious behavior during mealtimes (hitting self, biting self)	98(94.23)	2(1.92)	4(3.84)
My child is disruptive during mealtimes (pushing/throwing utensils, food)	20(19.23)	35(33.65)	49(47.11)
My child closes his/her mouth tightly when food is presented	34(32.69)	14(13.46)	56(53.84)
My child is flexible about mealtime routines (e.g., times for meals, seating arrangement, place settings)	18(17.30)	12(11.53)	74(71.15)
My child is willing to try new foods	89(85.57)	9(8.65)	6(5.76)

(Figures in the bracket indicates percentages)

Table 3: Actual Nutrient Intakes (ANI) of ASD children in comparison with EAR

Nutrients	Age group (2-5years) EAR	Subject's intake** (n= 36)	p- value	Age group (5- 15years) EAR	Subject's intake** (n= 68)	p- value
Energy (Kcals)	1110 - 1360	1458±192.93	0.089	1360-2860	2243±212.12	0.076
Carbohydrates (g)	-	168.31±5.44	-	-	197.57±62.05	-
Protein(g)	10-13	19.65±11.67	0.276	19-36	33.49±10.26	0.04
Fat(g)	30-40	32.41±11.10	0.002	25-35	52.99±18.18	0.89
Calcium (mg)	450	343.48±121.01	0.00	800	250±101.65	0.00
Iron(mg)	6-8	3.55±2.00	0.001	8-15	6.23±3.14	0.001
Zinc(mg)	2.8-3.7	1.96±1.40	0.00	3.7-11.9	2.02±2.10	0.00
Magnesium (mg)	73-104	79.57±51.07	0.351	104-287	132.79±85.47	0.232
Thiamine (mg)	0.6-0.8	0.30±0.20	0.029	0.8-1.6	0.38±0.19	0.001
Riboflavin (mg)	0.8-1.1	0.22±0.14	0.001	1.1-2.2	0.24±0.16	0.040
Niacin (mg)	6-8	2.97±1.86	0.002	8-16	3.82±2.66	0.036
Folates (µg)	97-111	50.67±41.08	0.001	111-238	99.48±66.75	0.024
Vitamin B6 (mg)	0.8-1.0	0.39±0.23	0.001	1.0-2.2	0.49±0.32	0.001
Ascorbic acid (mg)	24-27	19.88±10.98	0.001	27-60	21.57±21.32	0.031

****Values are mean±SD of ANI computed using EAR recommendations for the selected age group of children. Bold values indicate statistically significant at (p≤0.05)**

Data on actual nutrient intakes is summarized in Table 3. Results show that there was a considerable level of nutrient inadequacy in diets of children. None of them consumed adequate amounts of selected nutrients in their diets. Almost all children have nutrient inadequacy (statistically significant at p≤0.05) in terms of micronutrients; especially B-complex vitamins, calcium, zinc and iron intakes. Further analysis of frequency distribution of children (table 4) revealed that 50% of them were found to consume diets that were inadequate in entire nutrients selected; 18 children had inadequacy in consumption of 12 out of 14 nutrients selected; 12 and 14 children had inadequacy in 10 and 8 nutrients, respectively.

DISCUSSION

The study focused on association between mealtime behavior issues on somatic status of Indian ASD children. A strong gender bias in ASD prevalence has been observed with striking consistency, but no mechanism has yet been found to account for this difference.^[21] Deviation of body weight from normal to overweight and obese categories as evident in the study is consistent with previous published studies^[22,23] representing higher prevalence of overweight and obesity among these children. Many studies researching on nutritional status of ASD children reports inconsistent findings either undernourished and/or overly fed children. Under-nutrition and/or over-nutrition both negatively influence child health and development and have a long-term impact on their overall health.^[6] It has been proposed that hyperactivity in children with ASD could partially mediate differences in anthropometric characteristics. Apart from activity, abnormal behaviors can also result in higher levels of stress, which may lead to increased energy expenditure.^[24,25]

Table 4: Frequency of nutrient inadequacies among ASD children (n=104)

Number of inadequate nutrients	n	Percentages (%)
All nutrients	52	50
12 nutrients	18	17.30
10 nutrients	12	11.53
8 nutrients	14	13.46
6 nutrients	5	4.80
5 nutrients	3	2.88

Eating styles and mealtime behaviors of ASD children has profound effect on their nutrient intakes. Overall, in our study ASD subjects had higher mealtime issues related to food and eating styles. Mealtime behavior problems along with feeding issues are frequently reported concerns that may occur in rampant nature among ASD.^[26, 12, 13] Relatively, parents reported similar occurrence of mealtime behavior with issues such as frequent avoidance of food by turning his/her face and body away from food, food neo-phobia, spitting out food. Among all these mentioned issues; most common problem observed about eating behavior was consumption of limited variety of foods (food selectivity) followed by food refusals, skipping of meals, gaging at mealtimes, eating slowly and demanding parents/caretakers attention during mealtimes. Similar problems such as limited consumption of variety of foods, unwillingness to try new foods, dislike for certain foods and rejection to eat them has been reported.^[6,10,12,14] However, one positive outcome of study was that almost all subjects neither exhibited any aggressive nor self-injurious behavior during mealtimes, as against reported^[8] that autistic children were comparatively more aggressive during mealtimes and had problem to remain seated until meal was finished.

Many studies reports that gastrointestinal problems(diarrhea, unformed stools, constipation, bloating, flatulence, etc.) are frequently associated with ASD and presumed to have a correlation with autism severity. Similar GI symptoms related to food were observed in our study. Almost half subjects (47.11%) had abdominal cramps, followed by constipation (15.38%). Our findings are in consistent with research work reported by published studies.^[27,28]

Research findings regarding nutrient adequacy and/or nutrient intake status in ASD children have been erratic and similar trend was observed in our study. A higher rejection towards specific food groups such as proteins (derived mainly from non-veg foods), wheat, milk and

its products; fruits and vegetables (indicated as “rarely/never” and “seldom used” from FFQ respectively) and preference for certain food groups (starchy rich foods) was well supported by many studies.^[24, 29] Selective eating practices, picky eating habits, preference for similar foods, rejection or avoidance for certain foods, limited variety in diet patterns are all characteristic features among ASD children, as a result they are vulnerable to acquire increased risk of deficiency and/or medical issues affecting their normal health patterns.^[23,30,31,32]

As evident from findings on nutrient intakes, children are at risk of developing micronutrient deficiencies (calcium, iron, zinc, B-complex). Odd Ratios (table 5) show that children had a 3.57-fold higher risk of failing to meet recommendations for calcium, their risk being 2.17-fold higher for iron, 3.06-fold higher for zinc, 2.92-fold higher for folates and 1.87-fold higher for vitamin C. Each of these nutrients plays a significant role in growth and development and may aggravate the child's health or symptoms associated with ASD. Their dietary patterns clearly indicated that >70% were identified with erratic mealtime issues and food behavior problems. Nutritional factors plays major role in ASD recovery as diet therapies may be complementary to treatments employed.

Table 5: OR of selected micronutrients among ASD children

Nutrients	OR	IC 95%
Calcium(mg/day)	3.57	1.9-28.20
Iron(mg/day)	2.17	1.2-21.32
Zinc(mg/day)	3.06	0.97-96.0
Magnesium(mg/day)	0.55	0.331-0.96
Thiamine (mg/day)	0.32	0.13-0.74
Niacin (mg/day)	1.16	0.072-18.86
Folates (µg/day)	2.92	0.16-51.1
Vitamin B6 (mg/day)	1.82	1.6-21.39
Ascorbic acid (mg/day)	1.87	0.7-23.03

Hence it is recommended that ASD children receive a comprehensive nutrition and dietary evaluation to establish baseline nutritional status in order to track down their health. Our study has some limitations. First; we focused on only ASD children, comparison with typically growing children as controls would have been much helpful in better understanding of the mealtime behavior problems. Second, this work being region based, results cannot be generalized to other regions of the country mainly because of difference in dietary patterns. Moreover, future research work to validate food behavior issues as an indicator of risk for adequate or deficient intakes of nutrients is required.

CONCLUSION:

The study is the first of its kind focusing on the impact of mealtime behavior problems on the somatic status of ASD children from Mysore region, India. Findings clearly indicate characteristic features of ASD children with mealtime concerns viz., limited variety, food refusal and picky eating habits through their specific food preferences which has marked a negative influence on their health and growth. Therefore, routine screening for feeding and mealtime behavior problems among ASD children is critical to avert dietary inadequacies that may be associated with eating habits and hence, continuous nutrition counseling programs and awareness on health education are essential to improve parent's knowledge on nutritional aspects in addition to detect nutritional related problems at an early stage and design a systematic assessment and planned screening programs for the target populations of this region.

Funding

This work was financially supported by UGC DRS-II, No.F.25-1/2014-15 (BSR) New Delhi, India.

Acknowledgments

Authors express their deep gratitude to the children and their parents who participated in the study and staff members of all ASD units for their co-operation and support.

Competing interests - Authors declare that there is no conflict of interest to be disclosed and also declare that the present research work is original and has not been submitted for possible publication to another journal neither has it been published elsewhere.

Author's Contributions details

SS and AU conceptualized and designed the study; SS collected the data, drafted manuscript, performed statistical analysis of data and

consolidated the manuscript. AU critically evaluated the manuscript. Both the authors gave the final approval of the manuscript.

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