International Journal of Medical and Health Research
www.medicalsciencejournal.com
ISSN: 2454-9142
Received: 19-08-2024, Accepted: 18-09-2024, Published: 03-10-2024
Volume 10, Issue 5, 2024, Page No. 51-57

Nutritional assessment of children with autism spectrum disorder in Baghdad

Tasneem Faiq Jawad[1], Besmah Mohammed Ali Ibrahim[1], Osama Zuhair Salman[2]
[1] Department of Clinical Nutrition, Ghazi Al-Hariri Teaching Hospital, Medical City Complex, College of Medicine, Baghdad, Iraq
[2] Department of Clinical Nutrition, Baghdad Teaching Hospital, Medical City Complex, College of Medicine, Baghdad, Iraq

Abstract
Background: Typical autism characteristics of rigid thinking, resistance to change and sensory processing difficulties make feeding problems common. Food selectivity can be one of the biggest challenges in caring for a patient with autism; selectivity with foods can lead to potential alterations in micronutrient intake.
Aim: To assess nutritional status, deficiencies and feeding behavior problems in children with autism spectrum disorder.
Patients and methods: A cross-sectional study carried out from 1st of September 2023 to 31st of December 2023 in autism center in children welfare teaching hospital in Baghdad. The study was carried on 80 participants their age group ranges from (>3year to <11 year). All participants underwent anthropometric measurements, dietary and biochemical assessment, and detailed questionnaire about feeding and mealtime behavior problems
Results: Fifty percent of children had normal BMI, 17.5% were classified as underweight, 27.5%, 5% were classified as overweight, obese respectively. Vitamin D deficiency was observed in (91.25%), there is significant association between vitamin D level and nutritional status (p-value 0.022). There is significant correlation between behavioral problems when introducing new food items, position during feeding, food refusal, selection of food type and texture with nutritional status.
Conclusion: This study highlights the importance of assessment of nutritional status, biochemical indices and feeding problems in children with ASD. Our study demonstrates high rates of vitamin D deficiency in autistic children with significant association with nutritional status. Current study also found association between mealtime/ feeding behavioral problems and nutritional status. These results indicate that early identification and management of feeding difficulties, coupled with consistent growth monitoring, are essential.

Keywords: Autism, vitamin D, mealtime behavior

Introduction

Autism spectrum disorder (ASD) refers to a neurodevelopmental condition defined by a number of behavioral features. According to DSM-5, the core clinical characteristics of ASD include impairments in two areas of functioning (social communication and social interaction), as well as restricted, repetitive patterns of behavior, interests or activities. These symptoms are present in the early developmental period, but may not be fully manifest until social demands exceed the child's limited capacities, or may be masked by learned strategies in later life [1].

Recently attention has focused on the relationship between metabolic, nutritional disturbances and developmental disorders as ASD [2].

Therefore, targeted, individualized nutritional therapy is crucial to managing the complexity of patients with autism as May influences the severity, presentation or dynamics of disease [3].

Typical autism characteristics of rigid thinking, resistance to change and sensory processing difficulties make feeding problems common [4]. Food selectivity can be one of the biggest challenges in caring for a patient with autism [5]; selectivity with foods can lead to potential alterations in micronutrient intake. Some research has shown an increased risk of inadequate intake of calcium, vitamin D, zinc, and vitamin B12 in patients with autism who are selective eaters [5].

Compared with typically developing controls, autistic children have more severe eating problems that include not staying seated, not eating with their families, 'food jags' (persistently wanting the same foods), narrower food repertoires, restrictions by food category, texture and the way they are presented [6].

There is no evidence that autistic children and young people have different nutrient requirements to the general population. In the main, dietary and nutritional management of coexisting conditions, GI conditions and nutritional problems should be as per the general population, taking an individualized approach to each child [6].

Aim of the study

To assess nutritional status, deficiencies and feeding behavior problems in children with autism spectrum disorder.

Patients and methods

This is a cross sectional study carried out from 1st of September 2023 to 31st of December 2023 in autism center in children welfare teaching hospital in Baghdad.

The study was carried on 80 participants: (62) male and (18) female their age group ranges from (>3year to <11 year) who are assessed through distribution of detailed questionnaires. The participant was selected by communicating with their parents and caregivers. The questionnaire divided into several parts: It contained questions about demographic and socioeconomic data, mealtime behaviors of autism, gastrointestinal symptoms, food intake, biochemical investigation, and anthropometric measurements.

Anthropometric parameters used in this study include weight, height and body mass index (BMI). Weight measurements were taken on a manual scale, with the child standing on the scale with arms extended along the side of the body and wearing light clothes, weight was measured in (kilogram) with an accepted error of 0.1 kg. Height measurement by using well calibrated stadiometer by which height was measured (in meter) using a fixed board measures to the nearest 0.5 cm with the participant standing barefoot, heals together and the head in the horizontal plane. Body mass index (BMI) was calculated by dividing weight in kilograms by the square of height in meters.

In assessing anthropometrics in this study we used WHO age and sex appropriate growth charts (3rd – 97th percentile). Calculated BMI compared by using BMI for age percentile according to these charts to determine the nutritional status of children. Underweight was defined as BMI percentile below the 5th percentile, normal weight was defined as BMI percentile at or above the 5th percentile and below the 85th percentile, Overweight was defined as a BMI percentile at or above the 85th percentile, obesity was defined as BMI percentile at or above the 95th percentile [7, 8].

Assessment of autism severity was completed by the psychologist in the autism centre using The Childhood Autism Rating Scale (CARS), which is a well-established scale for the screening and classification of childhood autism [9]. Total scores were calculated for each child with ASD, Scores between 15-29.5 points suggest non-autistic, 30-36.5 points suggest mild to moderate autism, and 37-60 points suggest severe autism [11].

The laboratory tests were obtained from participants includes testing of complete blood count, serum ferritin, Calcium, and vitamin D. We used ferritin cutoff < 10 ng/mL for preschool children and < 12 ng/mL for school aged children [11]. Low hemoglobin was defined as < 11.0 g/dL for preschool children and < 12.0 g/dL for school-aged children [11]. The following value (8.4- 10.2) mg/dl for calcium was used based on our hospital laboratory values.

Normal level of vitamin D is defined as a 25-OHD concentration >30 ng/ml, vitamin D insufficiency (20–30 ng/ml), and vitamin D deficiency (<20 ng/ml)[10].

Selection (Inclusion) criteria:

- All autistic children diagnosed by psychiatrists attending autism center during research period that their parents accept to participate in the study.
- Age more than three years and less than eleven years

Exclusion criteria

- Patient's parents refuse to participate in the study.
- Children who are difficult to deal and to take measurement for them.
- Children who are difficult to draw blood sample for them.
- Children who has chronic illness

Statistical analysis

The collected data were coded, entered, presented, and analyzed by computer using the available data base software program statistical package of IBM SPSS-29 (IBM Statistical Packages for Social Sciences- version 29, Chicago, IL, USA). Data were presented in simple measures of frequency, percentage, mean, standard deviation, and range (minimum-maximum values).

The significance of difference of different percentages (qualitative data) were tested using Pearson Chi-square test (χ^2-test) with application of Yate's correction or Fisher Exact test whenever applicable. Statistical significance was considered whenever the P value was equal or less than 0.05.

Results

Eighty children with ASD were enrolled in this study between 1st of September 2023 to 31st of December 2023. The Mean age and SD of the study sample was 5.7±2.0. Demographic, social and disease characteristics were shown in table 1.

Table 1: Demographic, social and disease characteristics

		No.	%
Age	3-6 years	54	67.5
	7-11 years	26	32.5
	Mean±SD (Range)	5.7±2.0 (3-11)	
Gender	Male	62	77.5
	Female	18	22.5
Residence	Urban	68	85.0
	Rural	12	15.0
Education level of father	Illiterate	2	2.5
	Primary	36	45.0
	Secondary	22	27.5
	Higher education	20	25.0
Education level of mother	Illiterate	2	2.5
	Primary	38	47.5
	Secondary	17	21.3
	Higher education	23	28.7
Occupation of the father	Employee	74	92.5
	Not employee	6	7.5
Occupation of the mother	Employee	15	18.8
	Not employee (housewife)	65	81.2
Family history of autism	Yes	3	3.8
	No	77	96.2

Follow up of autism center	Regular	29	36.2
	Irregular	27	33.8
	1st time visit	24	30.0
Autism severity (according to CARS score)	Mild to Moderate	62	77.5
	Severe	18	22.5
Drug intake (risperidone & clonidine)	Yes	29	36.3
	No	51	63.7
Supplement intake (iron, calcium, vitamin d3, omega 3)	Yes	31	38.7
	No	49	61.3

Fifty percent of children had normal BMI, 17.5% were classified as underweight, 27.5%, 5% were classified as overweight, obese respectively. Gastrointestinal, feeding and mealtime behavioral problems were shown in table 2.

Table 2: Nutritional status, feeding and mealtime behavioral problems

		No.	**%**
BMI	Underweight	14	17.5
	Normal	40	50.0
	Overweight	22	27.5
	Obese	4	5.0
GIT problems	Constipation	15	18.8
	Vomiting	5	6.2
	Abdominal pain	2	2.5
	No	58	72.5
Special diet	Casein free diet	17	21.2
	Gluten free diet	13	16.3
	Ordinary diet	50	62.5
Select food type	Yes	38	47.5
	No	42	52.5
Preferred food texture	Solid	9	11.3
	Liquid	20	25.0
	Both	51	63.7
Preferred food color	Red	5	6.3
	White	11	13.7
	Both	64	80.0
Food refusal	Yes	33	41.25
	No	47	58.75
Behavioral problems when introducing new food items	Close mouth tightly	8	22.2
	Throwing food	17	47.2
	Head turning	6	16.7
	Aggression	2	5.6
	Self injury	3	8.3
Position during feeding	Sitting	40	50
	Moving	40	50

Among the 80 children in the study, 97.5% of them were eating starchy food everyday while consumption of milk and milk products, vegetables & fruits was 48.75%, 43.75%, 46% respectively as shown in Figure 1. Highest percentage of autistic children never consume red meat 35% followed by 31.25% consume red meat one/ week. High percent 67.5% ingest sweets every day while only 5% who never ingest them (Table3).

Table 3: Food frequency

Food frequency	**Once/day**	**3-4/week**	**Once/week**	**Once/month**	**Never**
Starch	78(97.5)	2(2.5)	-	-	-
Fat	47(58.7)	13(16.3)	16(20.0)	-	4(5.0)
Sweets	54(67.5)	18(22.5)	4(5.0)	-	4(5.0)
Vegetables	35(43.7)	13(16.3)	7(8.7)	-	25(31.3)
Fruits	46(57.5)	15(18.7)	9(11.3)	-	10(12.5)
White meats	5(6.3)	35(43.7)	25(31.3)	-	15(18.7)
Red meats	4(5.0)	22(27.5)	24(30.0)	2(2.5)	28(35.0)
Milk & milk products	39(48.7)	7(8.75)	8(10.0)	-	26(32.5)

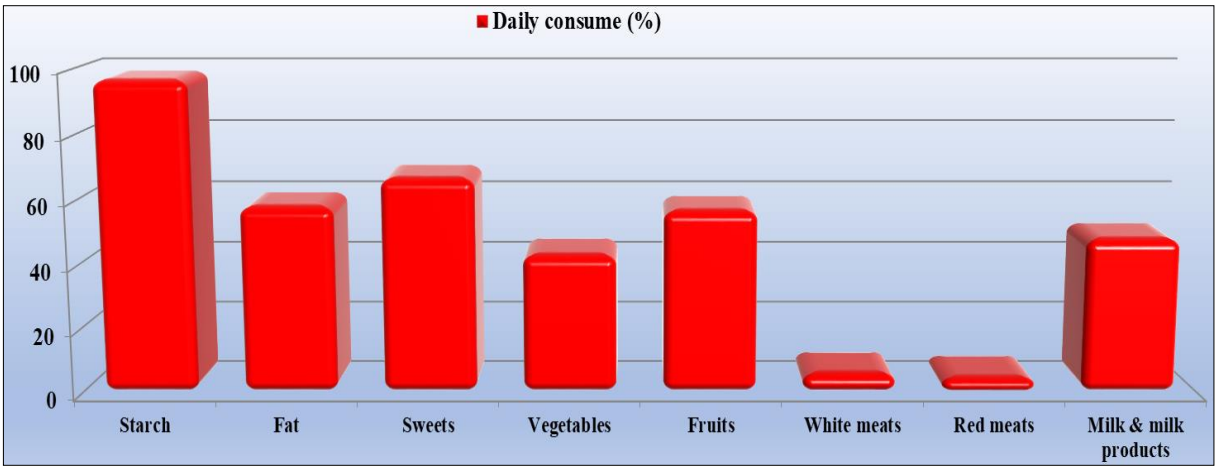

Fig 1: Daily consumption of food

Regarding the biochemical assessment, the greatest deficiency was observed for vitamin D (91.25%) and only 8.75% with normal level. While normal levels of hemoglobin, ferritin and calcium were observed in 83.75%, 72.5% and 48.75% respectively (Table 4).

Table 4: The biochemical tests

Biochemical tests		No.	%
Hemoglobin	Low	13	16.3
	Normal	67	83.7
Serum ferritin	Low	22	27.5
	Normal	58	72.5
Vitamin D3	Deficiency or Insufficiency	73	91.3
	Normal	7	8.7
Serum calcium	Low	41	51.2
	Normal	39	48.8

There is no correlation between autism severity according to CARS scores and vitamin D level(p-value 0.136), 75.3% who have vitamin D deficiency were in mild to moderate category for CARS while 24.7% in severe category. All severe cases in our study had vitamin D deficiency (Table 5).

Table 5: Vitamin D3 & Autism severity

Vitamin D3	Mild to Moderate	Severe	P value
Deficiency or Insufficiency	55(75.3)	18(24.7)	0.136
Normal	7(100)	-	
*Significant difference between percentages using Pearson Chi-square test (χ^2-test) at 0.05 level.			

There is significant association between vitamin D level and nutritional status (p-value 0.022), 19.2% who have vitamin D deficiency were underweight, 45.2% were normal weight and 35.6% were overweight (Table 6).

Table 6: Vitamin D3 & Nutritional status

Vitamin D3	Under-weight	Normal weight	Overweight/obese	P value
Deficiency or Insufficiency	14(19.2)	33(45.2)	26(35.6)	0.022*
Normal	-	7(100)	-	
*Significant difference between percentages using Pearson Chi-square test (χ^2-test) at 0.05 level.				

There is significant correlation between behavioral problems when introducing new food items and nutritional status of autistic children (p-value 0.003) that 45% of children had these problems, of them 16.7% were underweight, 69.4% were normal weight and 13.9% overweight/obese.

There is significant association between position during feeding and nutritional status (p-value 0.012) 50% were remain in sitting position during meal of them 5% were underweight, 60% were normal weight and 35% were overweight/obese. Our study shows significant relation between food refusal (41.25%) and nutritional status (p-value 0.0001), 24.3 % underweight, 72.7% normal weight, and 3% overweight/obese. In regard to selection of food type and texture there is significant association to nutritional status (p-value 0.002 and 0.008) respectively, while no association between food color and nutritional status (p-value 0.375) (Table 7).

Table 7: Feeding and mealtime behavioral problems & Nutritional status

	Under-weight	Normal weight	Overweight/obese	P value
Behavioral problems when introducing new food items: Yes	6(16.7)	25(69.4)	5(13.9)	0.003*
No	8(18.2)	15(34.1)	21(47.7)	
Position during feeding: Sitting	2(5.0)	24(60.0)	14(35.0)	0.012*
Moving	12(30.0)	16(40.0)	12(30.0)	
Food refusal: Yes	8(24.3)	24(72.7)	1(3.0)	0.0001*
No	6(12.8)	16(34.0)	25(53.2)	
Select food type: Yes	8(21.0)	25(65.9)	5(13.1)	0.002*
No	6(14.2)	15(35.7)	21(50.0)	
Preferred food texture: Yes	10(34.5)	13(44.8)	6(20.7)	0.008*
No	4(7.8)	27(53.0)	20(39.2)	
Preferred food color: Yes	4(25.0)	9(56.3)	3(18.7)	0.375
No	10(15.6)	31(48.5)	23(35.9)	
*Significant difference between percentages using Pearson Chi-square test (χ^2-test) at 0.05 level.				

Discussion

In recent years, there has been a significant increase in the number of reported cases of ASD, with a particularly higher prevalence noted among boys in comparison to girls [12, 13]. This rise in prevalence may be linked to various factors, such as enhancements in diagnostic criteria, advancements in identification and screening methods, and increased awareness among parents and healthcare providers [14]. Evaluating the nutritional status of children and adolescents throughout their developmental phases is crucial for the timely identification and rectification of possible disorders [15]. In this cross sectional study we assessed nutritional status, feeding and meal time behavioral problems and biochemical tests.

Among 80 autistic children in our study we found that fifty percent of them had normal BMI, this is consistent with Şengüzel *et al* [16]. While the prevalence of overweight and obesity in this study was (27.5%) and (5%) respectively. This is Similar to the result of kadhim *et al* [17] and Raspini *et al* [18]. Higher percentage of obesity was founded by Nor *et al* and Egan *et al* [19, 20]. Obesity is arising and especially challenging health problem in children with ASD, therefore its management is crucial since it predisposes them to various health consequences [18]. We found that 17.5% were underweight this is close to the result of Marı´-Bauset *et al* [21] and Eltuhami *et al* [22], lower percentage in other studies Wtwt *et al*[23] and Raspini *et al* [18]. It is important to emphasize that nutritional status in children with ASD should not be exclusively assessed by means of anthropometric measurements, since subclinical nutritional inadequacies could remain under-diagnosed [24].

Considering food intake, we found high percent of autistic children consuming starchy foods and sweets, lower consumption of vegetables, fruits and milk while meat is the least food consumed every day. The higher consumption of starchy food is consistent with Kadhim *et al* [17], Şengüzel *et al* [16] and Sharp *et al* [25] who found that high percent of autistic children with severe food selectivity preferred bread and cereals. In regard to sweets our result agreed with Canals-Sans *et al* [26]. This excessive consumption is frequently linked to these children's inclination towards sweet flavors [27], but according to the findings of Wallace *et al*. [28], children with ASD exhibited a correlation between emotional overeating and a greater consumption of sweet foods. This behavior, often linked to negative feelings like anxiety, could lead to both short-term and long-term health consequences. The lower Consumption of vegetables and fruits may be due these foods have strong flavors and firm textures, which can result in lower acceptance among children with ASD. Although, some autistic children may eat them regularly, their choices are typically limited to one or two specific types. Some studies found that fruit and vegetables were the least consumed foods among children with ASD [29, 30]. About third of our study sample were never consumed milk and milk products this is due to some children follow casein free diet However, systematic reviews on the gluten- and casein free diet (GCFD) indicate that the evidence is insufficient to support or refute it [30]. Consequently, it is not advisable to recommend GCFD for children with ASD unless they have been properly diagnosed with an allergy or intolerance to a specific substance or allergen. [30]. Also third of our study sample never consume meat this is in line with Kadhim *et al*[17] and Eltuhami *et al* [22].

ASD is recognized as a multifactorial condition arising from the interaction of genetic and environmental influences [31]. Recent studies have brought attention to vitamin D deficiency as a significant environmental factor in the etiology of autism [32]. In our study, assessment of serum vitamin D revealed that about 91.25% of autistic children have vitamin D insufficiency and deficiency this is correlate with other studies Şengenç *et al* (95%) [32], Eltuhami *et al* (94.1) [22], Mansour *et al* (92.6%) [31] and Saad *et al* (87%) [9]. Vitamin D deficiency and insufficiency may arise from a lack of adequate sunlight exposure, insufficient dietary intake of vitamins, impaired conversion to active forms, and the use of antiepileptic medications [31].

The present study shows no correlation between vitamin D level and disease severity according to CARS scores this is similar to Mansour *et al* [31] and Jayanath *et al* [33]. Although Jayanath *et al* [33] found that improvement in ASD symptoms associated with a reduction in CARS scores among children with vitamin D deficiency who received vitamin D replacement therapy. Our result is in contrast to other studies which found a negative correlation between serum vitamin D levels and the severity of ASD based on CARS scores [9, 34].

There is significant association between vitamin D level and BMI in this study. We found that about one third of obese children have vitamin D deficiency or insufficiency in line with Muskens *et al* [35] which found a significant inverse association between vitamin D level and BMI. The mechanisms linking low vitamin D in obesity include volumetric dilution, fatty tissue sequestration and reduced

sunlight exposure. It is hypothesized that fatty tissue contributes for lower circulating 25-hydroxycholecalciferol levels as it serve as a more extensive storage site for this fat-soluble vitamin [35].

Mealtimes for parents of autistic children and young people and feeding problems can be 'one of the most stressful times of the day', absent of enjoyment, horrible and even 'hell on earth' [4]. Our study identified a notable correlation between challenges when introducing new food items and nutritional status, aligning to the finding of Wtwt *et al* [23]. Additionally, we observed that 50% of children in the study were moving during mealtime a finding that parallels Kang *et al* [36] where 40.3% got up from the table during meal, the presence of co-morbid attention deficit hyperactivity disorder symptoms which affect 30-50% of children with ASD may exacerbate this situation [36]. Our study shows significant association between position during feeding and nutritional status, this is inconsistent with Wtwt *et al* [23].Children with ASD may have difficulty understanding the social cues relevant to mealtime or exhibit limited motivation to engage in activities they find less enjoyable, such as eating [36]. Field *et al* [37] define food refusal as the rejection of all or most foods presented to the participant, which led to that the child not consuming enough food to meet caloric or nutritional needs. In this study there was significant association between food refusal and nutritional status, this result is consistent with Wtwt *et al* [23].

Food selectivity is a frequently encountered behavior in autistic children, due to their sensory sensitivities and a tendency to maintain consistent routines. In our study, 47.5% of them had food selectivity this is close to Wtwt *et al* [23] but higher percentage was found by Şengüzel *et al*, [16] and Kadhim *et al* [17]. There was statistical correlation between food selectivity and nutritional status. Da Silva and colleagues emphasize the connection between nutritional status and children's eating habits. They note that a preference for sweets and ultra-processed foods, especially when consumed in excess, can lead to overweight. Conversely, if a child exhibits severe selectivity in their food intake, favoring lower-calorie options in limited amounts, this can result in underweight [38].

For children who have ASDs and pervasive eating problems, effective behavior strategies need to address both the neophobia and sensory sensitivities (color, taste and texture), which were the reflections of the limited interest of these children and their difficulty in adapting to change [39]. We found significant association between preferred food texture and nutritional status; this is agreed with Wtwt [23]. But in regard to preference of special food color there is no correlation with nutritional status. Children with ASD tend to have specific food preferences that are influenced by sensory factors, such as heightened sensory sensitivity, along with the dietary habits of their families. Nevertheless, a comprehensive understanding of the fundamental mechanisms involved necessitates additional research [40].

Conclusion

This study highlights the importance of assessment of nutritional status, biochemical indices and feeding problems in children with ASD. Our study demonstrates high rates of vitamin D deficiency in autistic children with significant association with nutritional status. Raising awareness among clinicians about the prevalence of vitamin D deficiency in children and adolescents with ASD is crucial, as it represents a common and manageable risk factor. Current study also found association between mealtime/ feeding behavioral problems and nutritional status. These results indicate that early identification and management of feeding difficulties, coupled with consistent growth monitoring, are essential. Collaboration among dietitians, therapists, parents and caregivers, is essential to enhance the nutritional well-being of children with ASD.

References

1. Child and Adolescent Mental Health, 2nd ed, 2020.
2. Zheng Z, Zhang L, Li S, *et al*. Association among obesity, overweight and autism spectrum disorder: a systematic review and meta-analysis. Sci Rep,2017:7(1):1-9.
3. Hill AP, Zuckerman KE, Fombonne E. Obesity and autism. Pediatrics,2015:136(6):1051-61.
4. Clinical Paediatric Dietetics. 5th ed, 2020.
5. Ferguson BJ, Marler S, Altstein LL, *et al*. Psychophysiological associations with gastrointestinal symptomatology in autism spectrum disorder. Autism Res,2017:10(2):276-88.
6. Zeidan J, Fombonne E, Scorah J, *et al*. Global prevalence of autism: a systematic review update. Autism Res,2022:15:778–790.
7. WHO. World Health Organization. Department of Child and Adolescent Health and Development. WHO Child Growth Standards (0-5 Years), 2006. Available from: https://www.who.int/publications/i/item/924154693X.
8. WHO. World Health Organization. Department of Child and Adolescent Health and Development. WHO Child Growth Standards (5-19 years), 2007. Available from: https://www.who.int/tools/growth-reference-data-for-5to19-years.
9. Saad K, Abdel-rahman AA, Elserogy YM, *et al*. Vitamin D status in autism spectrum disorders and the efficacy of vitamin D supplementation in autistic children. Nutr Neurosci,2015:18(6):476-83.
10. Holick MF. Vitamin D deficiency. N Engl J Med,2007:357:266–81.
11. Gunes S, Ekinci O, Celik T. Iron deficiency parameters in autism spectrum disorder: clinical correlates and associated factors. Ital J Pediatr,2017:43:86.
12. Nag HE, Nordgren A, Anderlid B-M, *et al*. Reversed gender ratio of autism spectrum disorder in Smith-Magenis syndrome. Mol Autism,2018:9:1.
13. Salari N, Rasoulpoor S, Rasoulpoor S, *et al*. The global prevalence of autism spectrum disorder: a comprehensive systematic review and meta-analysis. Ital J Pediatr,2022:48:112.
14. Zeidan J, Fombonne E, Scorah J, *et al*. Global prevalence of autism: a systematic review update. Autism Res,2022:15:778–790.
15. World Health Organization. Noncommunicable Diseases Country Profiles 2018. Geneva, Switzerland: World Health Organization, 2018.
16. Şengüzel S, Cebeci AN, Ekici B, *et al*. Impact of eating habits and nutritional status on children with autism spectrum disorder. J Taibah Univ Med Sci,2021:16(3):413-21.

17. Kadhim MA, Ali BM, Al-Bundi S. Impact of dietary habits on children with autism spectrum disorder. HIV Nurs,2023:23(2):782-7.
18. Raspini B, Prosperi M, Guiducci L, *et al*. Dietary patterns and weight status in Italian preschoolers with autism spectrum disorder and typically developing children. Nutrients,2021:13(11):4039.
19. Nor NK, Ghozali AH, Ismail J. Prevalence of overweight and obesity among children and adolescents with autism spectrum disorders and associated risk factors. Front Pediatr,2019:7:38.
20. Egan AM, Dreyer ML, Odar CC, *et al*. Obesity in young children with autism spectrum disorders: prevalence and associated factors. Childhood Obes, 2013, 9(2).
21. Marí-Bauset S, Llopis-González A, Zazpe-García I, *et al*. Nutritional status of children with autism spectrum disorders (ASDs): A case-control study. J Autism Dev Disord,2015:45:203–212.
22. Eltuhami A, Nouh F, Elfagi S, *et al*. Nutritional assessment of autism spectrum disorder in Benghazi. SAS J Med,2021:354-365.
23. Wtwt ET, Farhood HF. Feeding problems and nutritional assessment in children with autism. Karbala J Med, 2015, 8(1).
24. Sharp WG, Berry RC, McCracken C. Feeding problems and nutrient intake in children with autism spectrum disorders: A meta-analysis and comprehensive review of the literature. J Autism Dev Disord,2013:43(9):2159–2173.
25. Sharp WG, Postorino V, McCracken CE, *et al*. Dietary intake, nutrient status, and growth parameters in children with autism spectrum disorder and severe food selectivity: An electronic medical record review. J Acad Nutr Diet,2018:118(10):1943-1950.
26. Canals-Sans J, Esteban-Figuerola P, Morales-Hidalgo P. Do children with autism spectrum disorders eat differently and less adequately than those with subclinical ASD and typical development? EPINED epidemiological study. J Autism Dev Disord,2022:52(1):361-375.
27. Schreck KA, Williams K, Smith AF. A comparison of eating behaviors between children with and without autism. J Autism Dev Disord,2004:34(4):433–438.
28. Wallace GL, Richard E, Wolff A, *et al*. Increased emotional eating behaviors in children with autism: Sex differences and links with dietary variety. Autism,2021:25(3):603-612.
29. Evans EW, Must A, Anderson SE, *et al*. Dietary patterns and body mass index in children with autism and typically developing children. Res Autism Spectr Disord,2012:6(1):399–405.
30. Plaza-Diaz J, Flores-Rojas K, Torre-Aguilar MJ, *et al*. Dietary patterns, eating behavior, and nutrient intakes of Spanish preschool children with autism spectrum disorders. Nutrients,2021:13(10):3551.
31. Mansour A, Amer A, Sobh A, *et al*. Vitamin D profile in autism spectrum disorder children and its relation to the disease severity. Egypt J Otolaryngol,2024:40:7.
32. Şengenç E, Kıykım, Saltik S. Vitamin D levels in children and adolescents with autism. J Int Med Res,2020:48(7):1–9.
33. Jayanath S, Fong Y, Sarvananthan R. Autism spectrum disorder and vitamin D status: A cross-sectional study of children in a developing country in Southeast Asia. Res Autism Spectr Disord,2021:84:101786.
34. Undang DR, Sitaresmi MN, Naning R. Hypovitaminosis D as a risk factor for severe autism spectrum disorder. Paediatr Indones,2021:61(2):82–88.
35. Muskens J, Klip H, Zinkstok JR, *et al*. Vitamin D status in children with a psychiatric diagnosis, autism spectrum disorders, or internalizing disorders. Front Psychiatry,2022:13:958556.
36. Kang YQ, Teo CM, Tan ML. Feeding difficulties in Asian children with autism spectrum disorder. Pediatr Neonatol,2022:63(1):48-56.
37. Field D, Garland M, Williams K. Correlates of specific childhood feeding problems. J Paediatr Child Health,2003:39:299–304.
38. Da Silva RV, Gomes L. Eating behavior and nutritional profile of children with autism spectrum disorder in a reference center in the Amazon. Nutrients,2024:16(3):452.
39. Emond A, Emmett P, Steer C, *et al*. Feeding symptoms, dietary patterns and growth in young children with autism spectrum disorders. Pediatrics,2010:126(2):e337–42.
40. Liu X, Liu J, Xiong X, *et al*. Correlation between nutrition and symptoms: Nutritional survey of children with autism spectrum disorder in Chongqing, China. Nutrients,2016:8(5):294.