ORIGINAL ARTICLE

Weight Status, Dietary Intake, and Mealtime Behaviour Among Autism Spectrum Disorder Children in Klang Valley, Malaysia

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ABSTRACT

Introduction: Nutrition is one of the important contributors to the well-being of children with disability. Given the various data on the nutritional status of autism spectrum disorder (ASD) children, it is imperative to conduct a detailed nutritional assessment of the local population. This study compares ASD with typical developing (TD) children to determine the weight status and association of mealtime behavior with dietary intake in Klang Valley, Malaysia. **Methods:** A total of 106 children aged five to nine years old participated in this cross-sectional study. Sociodemographic were assessed through self-administered questionnaires. The body weight and height were collected; the body mass index (BMI) was calculated. A three-day food record and a Brief Autism Mealtime Behavior Inventory (BAMBI) data were obtained from the caretakers. **Results:** More than one-third (39%) of the ASD children were overweight or obese compared to TD children (23%). However, there is a significant difference (X2=10.29, p=0.03) when TD children were categorized as stunted and severely stunted. Meanwhile, the total energy intake was statistically significant (X^2=9.53, p=0.008). The majority (88.2%) of ASD children experience problems in mealtime behavior characteristically limited food acceptance with a mean score of (28.78±6.80). Mealtime behavior was not associated with energy, carbohydrate, protein, and fat when the p>0.05. **Conclusion:** Even though there was no association of mealtime behavior with dietary intake, the BMI was significantly influenced by excessive daily calorie consumption. Because of growth parameters influence physical development, nutritional intervention program should be carried out in order to improve nutritional status of AS children.
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INTRODUCTION

Autism Spectrum Disorder (ASD) is defined as a neurodevelopmental condition that impaired the communication skills, restricted, repetitive patterns, and behavior (1) as well as lack of interest in activity which oftenly associated with multiple comorbidities such as gastrointestinal symptoms, eating behaviour, and distruptive behaviour (2). While in a study done by (3), they categorized the criteria into three groups which are social interaction, social communication, and social imagination. The case of a child diagnosed with ASD are in increasing trends. Usually, it will be diagnosed during the first three years of life at the age of three and four, and prevalence among males than females. In the United States (US), the prevalence rate is 1 in 59 children with ASD (4). The data of 2008 from the Journal of Morbidity and Mortality weekly report; Surveillance Summaries (5) showed the prevalence of ASD increase 23% from 2006 and tremendously high up to 78% compared with 2002. While ASD prevalence in Malaysia has not yet been identified. Nevertheless, a feasibility study carried out by the Ministry of Health (MOH) on Malaysian children with ASD aged 18 to 36 months using the Modified Checklist for Autism in Toddlers (M-Chart) as a tool for screening at various clinics discovered that the prevalence of children with ASD is predicted to be 1.6 per 1000 children (6).

Weight status and dietary intake are close related each other. As the growth and development are detrimental at early age, compromising the adequacy of nutritional intake may lead to malnutrition in both category of thinness (7–9) as well as overweight and obesity (10,11). (12) found that an overweight status and obesity were

more prevalent in autistic children. It was supported by previous meta-analysis study which had linked obesity in ASD (13). However, the classification for underweight and severe underweight were not included in the data and not fully explored (14).

Atypical mealtime behaviours, which are estimated to range from 46% to 89%, are frequently reported among children with ASD and are linked to food fussiness, a very selective eating style, and a refusal to try new foods (15). Several evidence also suggest that ASD children are prone to had feeding problems compared with TD children such as unfavourable to try new food (16,17), sensitive toward texture, temperature, ingredients of food as well as the brand.

A cross-sectional study among sample aged 2 to 18 years old in Kuala Lumpur healthcare facility discovered that 91.4% of ASD children exhibited behavioural issues linked to diet and food restriction, which led to an unhealthy body mass index (BMI) category (18). Growing evidence suggest that children with ASD are more likely than TD children to develop and demonstrate feeding issues, such as refusing to try new foods (16,17), and being extremely picky about texture, temperature, brand, or food recipe (19–21), as well as having a limited number of foods options (22,23), which may cause an uncomfortable environment and stress among carers during mealtimes. In comparison with TD children, ASD children have ratio of eating-related issues and nutrient deficiency risk that is five times higher (24).

A longitudinal study is necessary to assess the age range on the incidence of eating issues in children since different words and instruments are used to define eating or mealtime behaviour (10). Clinically, children's eating disorders was divided into three categories which are i) restricted dietary ranges that priorities particular food brands, ii) refraining from trying new foods because they are associated with neophobia symptoms, and iii) rejecting a specific type of food due to its texture, flavour, or smell (25). Little research has been done on the relationship of feeding behaviour and the nutritional status among ASD children. Major of the therapy studies focus on behaviour interventions and lack of information on dietary consumption and nutritional quality (26).

Given the vast range of information on the nutritional status of ASD children worldwide and the paucity of information regarding local Malaysian population, it is crucial to explore the nutritional adequacy as well as eating behaviour among ASD children in community. Therefore, the objectives of this study is to determine the weight status, dietary intake (nutritional adequacy), and mealtime behaviour as well as their association among ASD children in comparison with TD children.

MATERIALS AND METHODS

Study Design

This is a case-control cross sectional study, involved two groups of children which are ASD as a case group and typically developing (TD) children as a control group. Data was collected in between June 2021 until May 2022.

Study Location

Online information was gathered from a number of non-govermental organizations and social support groups, which are Autisme Malaysia, Disleksia dan Autisme Malaysia (DDAM), Sayap Biru Autisme (Kumpulan Sokongan), Malaysia High Functioning Autism Association, OT_Terapi carakerja Untuk Kanak-Kanak Berkeperluan Khas, as well as the Malaysia Autism Parents Support Group & Special Needs (MAPSG).

Sample of Subjects

The subjects were recruited from non-government organizationa and social support groups. The inclusion and exclusion criteria were outlined for both subjects and their guardians. Children aged four to nine years old, girl or boy, lived in Klang valley were included in this study. Whereby, guardians or parents must be legal or biological mother and father. Besides, children were excluded in this study if they are having other comorbidities such as gastrointestinal disorder, auditory problems, or any infections, commited to any chronic diseases like kidney, liver, heart disease, cancers, and any non-communicable diseases. Whereas, the caretakers, teachers or instructor at the school and intervention centre also excluded in this study.

A total sample of N=106 (ASD, n=51; TD, n=55) involved in this study. Sample size was calculated by using the GPower 3.1.9 Software. The effect size was set to 0.2 with the power of 0.8 and percent of error 0.05 make the total sample is 80. In consideration of 20% drop out rates, a total of 100 samples were recruited for both groups.

Data Collection

Data was collected via online through social support group. Information recruitment of subject was blasted and interested guardian or parents responded through email or personal message. Then an online consent form was given for those who meet all the inclusion criteria listed as well as a link of questionnaire consist of sociodemographic, anthropometric, 3-day food record, and Brief Autism Mealtime Behaviour Inventory (BAMBI).

Research Instruments

Sociodemographic data

The first section consisted of 15 questions to obtain the sociodemographic information including the guardian or parents and child's age, sex, ethnicity, educational level, siblings with ASD, monthly household income, and household size.

Anthropometric Data

Weight status was defined by using the weight and height. Body weight (kg) and height (cm) was self-reported by the guardian or parents. Body mass index (BMI) then calculated and classified into one of the four categories: severely underweight (≤ 3rd percentile), underweight (≤ 15th percentile), normal (≥15th to ≤85th percentile), overweight (≥85th percentile), or obese (≥97th percentile).

3-Day Food Record

This 3-day food record is considered a gold standard among methods in accessing dietary intake (27). Guardian or parents were given a link of food record and they were required to record the intake of all food and drinks taken for 2-working days and 1-non-working day. The records of food consumed were then used to calaculate the calories and macronutrients of carbohydrate, protein, and fat by using NutriPro version 8.1.

The Recommended Nutrient Intake (RNI) Malaysia 2017 were then used to compare the nutritonal adequacy of the children. It is categorized either inadequate, adequate, or excessive intake of energy, carbohydrate, protein, and fat.

Brief Autism Mealtime Behaviour Inventory (BAMBI)

Brief Autism Mealtime Behaviour Inventory was developed with the aim to evaluate the diet and eating behaviour by using the standardized information specifically for an autistic child.

This questionnaire examined a series of behaviours in this population and it can be used in a clinical setting as it is easy and understandable as well as adequate evaluation of feeding problems among this population (28).

This questionnaire has been validated, translated and used in Malaysia. It used forward and backward translation method by translators who were both fluent in English and Malay language, and has been checked as well by two paediatricians. A pilot study was conducted among 30 subjects and the reliability showed good, whereby the Cronbach's Alpha was found to be 0.83 (18). This questionnaire has 18 items with three categories which are features of autism, a limited variety of food, and food refusal. The items were rated in Likert scale from '1'= never/rarely, '2'= seldom, '3'= occasionally, '4'= often, and '5'= almost every meal.

A problematic feeder was determined when the scores were more than 34 after all the scores were added up for each question (29).

Data Analysis

Data analysis was carried out by using Statistical Package for Social Sciences (SPSS) version 23.0. Descriptive analysis will be used to provide mean (SD) for continuous variables. Besides, chi square were used to determine whether it is statistically significant difference between the frequencies. Meanwhile, Pearson Coefficient of Correlation was used to determine the strength of linear correlation between the scores of mealtime behaviour with the dietary intake of energy, carbohydrate, protein, and fats.

RESULTS

Out of 106 children, 62.2% were boys, and 37.7% were girls with mean age of 7.27 ± 1.30 years. Most of ASD children were boys when the X2=6.273, p=0.012. Most of our respondents were Malays (96.2%), followed by Chinese (1.9%), while Indians and other composed of 1.9%.

In terms of birth weight, 77.4% were born normal with weight 2.5 – 3.99 kg, followed by 17.0% of low birth weight 2.0 – 2.49kg, 2.8% of high birth weight 4.0 – 4.49kg, 1.9% of very high birth weight >4.5kg, and only 0.9% born with very low birth weight <2.0kg. BMI of ASD's father showed more in a group of overweight and obese compared to TD children (X2=7.828, p=0.05). Statistically significant seen in educational level of parents (X2=10.771, p=0.013; X2=17.987, p<0.001) when more than three-quarter of ASD mother and father attained tertiary level of education compared with TD children. While, household income also showed that the group of ASD children had higher monthly earnings compared to TD children when X2=15.888, p=0.003. However, there were no statistical differences in the birth weight, birth order, race, religion, and BMI of mother. Table I summarize the sociodemographic of both subjects ASD and TD group.

Table II showed the weight status of ASD and TD children. Although the growth parameters of weight status (BMI-for-age, and weight-for-age) showed no significant difference between ASD and TD group, the proportion of ASD children who were overweight (11.8%) and obese (27.5%) as well as underweight (11.8%) and severe underweight (13.7%) were higher compared to TD children as illustrated in Fig 1. However, TD children showed more stunted than ASD children as height-for-age showed significant when X2=10.29, p=0.03.

Table I : Sociodemographic characteristic of autism spectrum disorder and typically developing children and body mass index of parents

		n (%)			
		ASD (n=51)	TD (n=55)	X^2	p-value
Gender				6.273[a]	0.012*
	Boy	38 (74.5)	28 (50.9)		
	Girl	13 (25.5)	27 (49.1)		
Age (mean±SD)		7.27 ± 1.30		14.782[b]	0.000**
	4-6 years old	4 (7.8)	22 (40.0)		
	7-9 years old	47 (92.2)	33 (60.0)		
Birth weight				3.605[a]	0.462
	> 4.5 kg	2 (3.9)	0 (0.0)		
	4.0 – 4.49kg	1 (2.0)	2 (3.6)		
	2.5 – 3.99 kg	39 (76.5)	43 (78.2)		
	2.0 – 2.49 kg	8 (15.7)	10 (18.2)		
	< 2.0 kg	1 (2.0)	0 (0.0)		
Birth Order				5.432[a]	0.365
	1	29 (56.9)	23 (41.8		
	2	11 (21.6)	14 (25.5)		
	3	7 (13.7)	9 (16.4)		
	4	3 ((5.9)	8 (14.5)		
	> 5	1 (2.0)	1 (1.8)		
Total Siblings in Family				3.390[a]	0.184
	1	6 (11.8)	2 (3.6)		
	2 – 4	39 (76.5)	49 (89.1)		
	5 – 7	6 (11.8)	4 (7.3)		
Total Siblings with ASD				13.438[a]	0.001*
	0	34 (66.7)	52 (94.5)		
	1	11 (21.6)	2 (3.6)		
	2 – 4	6 (11.8)	1 (1.8)		
Total Number of Family Members				3.951[a]	0.139
	> 3	8 (15.7)	3 (5.5)		
	4 – 6	37 (72.5)	48 (87.3)		
	7 -10	6 (11.8)	4 (7.3)		
Race				4.483[a]	0.214
	Malay	47 (92.2)	55 (100.0)		
	Indian	1 (2.0)	0 (0.0)		
	Chinese	2 (3.9)	0 (0.0)		
	Others	1 (2.0)	0 (0.0)		
Religion				3.330[a]	0.344
	Islam	48 (94.1)	55 (100.0)		
	Christian	1 (2.0)	0 (0.0)		
	Hindu	1 (2.0)	0 (0.0)		
	Buddha	1 (2.0)	0 (0.0)		

BMI of Mother				3.480[a]	0.323
	Underweight	0 (0.0)	1 (1.8)		
	Normal	18 (35.3)	15 (27.3)		
	Overweight	26 (51.0)	25 (45.5)		
	Obese	7 (13.7)	14 (25.5)		
Education Level of Mother				10.771[a]	0.013*
	Primary School	0 (0.0)	6 (10.9)		
	Secondary School	3 (5.9)	22 (40.0)		
	Diploma	8 (15.7)	25 (45.5)		
	Degree	34 (66.7)	2 (3.6)		
	Master	6 (11.8)	0 (0.0)		
BMI of Father				7.828[a]	0.05*
	Underweight	0 (0.0)	1 (1.8)		
	Normal	12 (23.5)	26 (47.3)		
	Overweight	22 (43.1)	16 (29.1)		
	Obese	17 (33.3)	12 (21.8)		
Education Level of Father				17.987[a]	0.000*
	Primary School	0 (0.0)	0 (0.0)		
	Secondary School	2 (3.9)	13 (23.6)		
	Diploma	15 (29.4)	20 (36.4)		
	Degree	22 (43.1)	21 (38.2)		
	Master	12 (23.5)	1 (1.8)		
Household Income				15.888[a]	0.003*
	< RM 2500	3 (5.9)	0 (0.0)		
	RM 2501 – RM4500	7 (13.7)	9 (16.4)		
	RM 4501 – RM 7000	4 (7.8)	18 (32.7)		
	RM 7001 – RM 10000	22 (43.1)	22 (40.0)		
	> RM 10000	15 (29.4)	6 (10.9)		

CI, confidence interval.

[a] Based on Pearson's Chi Square;

[b] Based on Fisher exact test;

*Statistically significant at p-value < 0.05;

**Statistically significant at p-value < 0.001 level (2-tailed).

As shown in Table III, a total 88.2% of ASD children were identified had problem in mealtime behaviour based on BAMBI scoring with the mean±SD 54.55±16.11. As there are three characteristic of mealtime behaviour in BAMBI tools (limited variety of food, food refusal, and features of autism), the result showed ASD children were prone to have behaviour of limited variety of food or very selective in food choices when the mean±SD were 28.78±6.804 compared with food refusal and features of autism which were 12.22±4.88 and 13.55±5.50 respectively.

Table IV summarizes the result of the macronutrients analysis. Descriptively, the mean±SD for both age group showed ASD took higher in total energy intake as well as other macronutrients of carbohydrate, protein, and fat. The mean±SD of total energy, carbohydrate, protein, and fat for ASD group, aged 4-6 years old were 1883.75±718.53, 258.74±77.75; 52.31±12.98; 66.72±39.0. In contrast with TD in a same age group were 1360.79±483.9, 192.51±69.76; 47.42±14.65; 51.91±20.32. While for the age group of 7-9 years old, the mean±SD for energy, carbohydrate, protein, fat among ASD were 1847.17±440.24, 231.82±61.57, 72.35±23.17, 70.63±23.13; compared with TD group which were 1633.89±382.72, 220.81±54.35, 54.40±20.18, 62.26±23.17. However, despite of age group, only total energy showed significant difference at X2=9.53, p=0.008 when ASD had consumed excessive calorie intake daily.

Table II : Weight status of autism spectrum disorder and typically developing children

Variables	Total (n=106)		ASD (n = 51)		TD (n = 55)		X^2	p-value
	n (%)	Mean±SD	n (%)	Mean±SD	n (%)	Mean±SD		
		WEIGHT STATUS						
		4 – 6 years old (n=26) / 7 – 9 years old (n=80)		4 – 6 years old (n=4) / 7 – 9 years old (n=47)		4 – 6 years old (n=22) / 7 – 9 years old (n=33)		
Weight		20.07 ± 5.39 / 26.82 ± 9.35		24.48 ±7.81 / 25.63 ±7.56		19.44 ±6.39 / 27.53 ±10.76		
Height		110.46 ± 10.21 / 124.83 ± 12.38		118.27 ±7.35 / 123.59 ±9.76		103.01 ±12.33 / 125.75 ±14.89		
BMI		16.43 ± 3.94 / 16.9 ± 3.93		14.46 ±4.46 / 16.79 ±4.61		14.73 ±3.93 / 16.77 ±2.81		
		BMI-for-age						
Severely Under-weight	12 (11.3)		7 (13.7)		5 (9.1)		7.602[a]	0.107
Under-weight	14 (13.2)		6 (11.8)		8 (14.5)			
Normal	47 (44.3)		18(35.3)		29(52.7)			
Overweight	14 (13.2)		6 (11.8)		8 (14.5)			
Obese	19 (17.9)		14(27.5)		5 (9.1)			
		Weight-for-age						
Severely Under-weight	24 (22.6)		10(19.6)		14 (25.5)		3.112[a]	0.539
Under-weight	20 (18.9)		8 (15.7)		12 (21.8)			
Normal	32 (30.2)		18(35.3)		14 (25.5)			
Overweight	11 (10.4)		4 (7.8)		7 (12.7)			
Obese	19 (17.9)		11(21.6)		8 (14.5)			
		Height-for-age						
Severely Stunted	35 (33.0)		11(21.6)		24 (43.6)		10.29[b]	0.03*
Stunted	16 (15.1)		8 (15.7)		8 (14.5)			
Normal	28 (26.4)		19(37.3)		9 (16.4)			
Tall	17 (16.0)		10(19.6)		7 (12.7)			
Very Tall	10 (9.4)		3 (5.9)		7 (12.7)			

CI, confidence interval.

[a] Based on Pearson's Chi Square;

[b] Based on Fisher exact test;

*Statistically significant at p-value < 0.05;

**Statistically significant at p-value < 0.001 level (2-tailed).

Table III : Brief Autism Mealtime Behaviour Inventory (BAMBI) score and each criteria with mean±SD among autism spectrum disorder (ASD) children

		Total	Mean±SD
		n (%)	
BAMBI Score	Have Problem in Mealtime Behavior	45 (88.2)	54.55 ± 16.11
	Do not have Problem in Mealtime Behavior	6 (11.8)	
Limited Variety of Food			28.78 ± 6.804
Food Refusal		12.22 ± 4.876	
Features of Autism		13.55 ± 5.500	

Table IV : Dietary Intake of autism spectrum disorder (ASD) and typically developing (TD) children

	Total (n=106)		ASD (n = 51)		TD (n = 55)		X^2	p-value
	Mean±SD		Mean±SD		Mean±SD			
Dietary Intake (Nutritional Adequacy)								
	4 – 6 years old (n=26)	7 – 9 years old (n=80)	4 – 6 years old (n=4)	7 – 9 years old (n=47)	4 – 6 years old (n=22)	7 – 9 years old (n=33)		
Energy	1441.25 ± 543.76	1759.19 ± 428.19	1883.75 ± 718.53	1847.17 ± 440.24	1360.79 ± 483.96	1633.89 ± 382.72		
Carbohydrate	202.70 ± 73.53	227.28 ± 58.59	258.74 ± 77.75	231.82 ± 61.57	192.51 ± 69.76	220.81 ± 54.35		
Protein	48.17 ± 14.27	64.95 ± 23.59	52.31 ±12.98	72.35 ± 23.17	47.42 ±14.65	54.40 ± 20.18		
Fat	54.17 ± 23.66	67.18 ± 23.37	66.72 ± 39.09	70.63 ± 23.13	51.91 ± 20.32	62.26 ± 23.17		
	n (%)		n (%)		n (%)			
Total Energy								
Inadequate	41 (38.7)		21(41.2)		24 (43.6)		9.53[b]	0.008*
Adequate	17 (16.0)		0(0.0)		8 (14.5)			
Excessive	48 (45.3)		30(58.8)		23 (41.8)			
Total Carbohydrate								
Inadequate	36 (34.0)		17(33.3)		20 (36.4)		5.355[a]	0.069
Adequate	37 (34.9)		12(23.5)		22 (40.0)			
Excessive	33 (31.1)		22(43.1)		13 (23.6)			
Total Protein								
Inadequate	4 (3.8)		0 (0.0)		4 (7.3)		4.51[b]	0.119
Adequate	1 (0.9)		0 (0.0)		1 (1.8)			
Excessive	101 (95.3)		51 (100)		50 (90.9)			
Total Fat								
Inadequate	21 (19.8)		8 (15.7)		13 (23.6)		1.059[a]	0.50
Adequate	33 (31.1)		14(27.5)		14 (25.5)			
Excessive	52 (49.1)		29(56.9)		28 (50.9)			

CI, confidence interval.

[a] Based on Pearson's Chi Square;

[b] Based on Fisher exact test;

*Statistically significant at p-value < 0.05;

**Statistically significant at p-value < 0.001 level (2-tailed).

Table V : Association of Mealtime Behaviour with Dietary Intake (Total energy, carbohydrate, protein, and fat)

	Total Energy		Carbohydrate		Protein		Fat	
	r value	p value	r value	p value	r value	p value	r value	p value
Mealtime Behaviour	0.007	0.963	-0.130	0.364	0.155	0.277	0.103	0.471

* Coefficient is significant at the p < 0.05 level (2-tailed)

There were no significant diffference for carbohydrate, protein, and fat when the p>0.05.

The result of Pearson coefficient of correlation analysis revealed that there were no correlation between mealtime behaviour with dietary intake of total energy (r = 0.007, n = 51, p > 0.05); carbohydrate (r = -0.130, n = 51, p > 0.05); (protein (r = 0.155, n = 51, p > 0.05) and fats (r = 0.103, n = 51, p > 0.05), as presented in Table V.

DISCUSSION

This study provide a deeper understanding regarding the weight status, dietary intake, and mealtime behavior as well as their association towards nutritional adequacy among ASD children aged 4-9 years old in Klang Valley, Malaysia. Results from this study demonstrated as much as 11.8% were overweight and 27.5% were obese among ASD children, reflecting a total of 39.3% compared with TD children which were 14.5% and 9.1%, thus make it in a total of 23.6% respectively. These prevalence support the previous study also in Malaysia by (30), whereby the findings almost similar with the rate of 38.5% were found to be overweight and obese. However no data reported the findings for underweight and severe underweight of ASD children. The same finding also found in the study done by (31), which were a total of 37.9% were classified as overweight and obese.

Yet, there were few studies showed higher prevalence of overweight and obesity compared to current study. The previous study obtained by (32) showed 41.9% were reported had overweight and obesity.The same findings by (33) also reported 42.2% and 21.4% were overweight and obesity among ASD compared to TD children in United State.

Meanwhile, higher incidence of underweight category among ASD (25.5%) compared to TD children (23.6%) in this study, support the global prevalence of unhealthy weight among ASD children. According to meta-analysis study by (14), there were an increasing trend of the prevalence unhealthy weight among ASD children aged 2 to 5 years old when the results showed that obesity, overweight and underweight increase from 16.7% to 31.3%; 16.2% to 27.2%; and 5.3% to 8.6% respectively (14).

There were many factors can contribute to the weight status of children with ASD. One of the risk factor that can influence growth is food selectivity behaviour (34). This study proved that 88.2% of ASD children had problematic mealtime behaviour with the highest category was limited variety of food. (30) in his study among ASD children aged 3-11 years old also found that 96% of them had atypical mealtime behaviour. Furthermore, a study in South Africa among ASD children aged 3-10 years old indicated that their children ate a very limited variety of food and self-restricted diet (35). Younger age is one of the significant risk factor of having problematic mealtime behaviour (30). This results highly supported the finding from (36,37), revealed that ASD children showed character of selective in food intake starting at the age of 15 months when this ASD children were difficult to feed and very choosy (p<0.001).

A large sample size (n=1112) of cross-sectional study in children with ASD revealed that younger age plays a challenging mealtime behaviour compared to adolescent (38). This finding was in line with the longitudinal study done in Massachusetts in which whereby they observed 18 ASD children (mean age: 7 years) and adolescence (mean age: 13 years), and the result showed that significant improvement in food habits by accepting a variety of food textures and less food restriction (39). In addition, criteria of limited variety in food choosing can be one of the picky eating character.

Besides, ASD also a group of children with picky behaviour. Picky eater is defined as a children who consumes less variety of foods through rejection of certain foods that are familiar and unfamiliar to them as well as rejecting in food textures (40–42). Because of these criteria occurred among ASD children, the habit of selective in food intake will affect limited food choices, which in turn can affect the nutritional adequacy including macro- and micronutrients as well as the growth and development of this population (43,44)

Although this study showed no significant association between mealtime behaviour and dietary intake, it is justified unbalanced nutritional intake will cause high prevalence of unhealthy weight status (obese, overweight, underweight, and severe underweight) of ASD children compared with TD children.

Dietary intake among ASD children is controversial. Various studies were done and showed several results. The present findings revealed that there is significance difference of excessive total energy intake when p=0.008 in ASD children compared to TD children. Although the ASD and TD children for both age groups had almost similar mean intakes of macro- and micronutrients, it is notable that the range of intakes was wider among ASD group. The similar findings also found in the study by (44) when the range intake was higher in ASD children compared to TD children except for certain micronutrient of folate, tryptophan, and tyrosine. (45) also revealed that ASD children took higher intake of energy, carbohydrate, protein and fat compared with non-autistic siblings.

On the other hand, statistically significance were found in mean protein intake, in which ASD children took lower compared with children without ASD (46). In the same study, although the energy and other macronutrients showed no significant, but the mean range showed lower intake of energy as well as the macronutrients. (47) also found that ASD children took 16% lower calories, 9% decrease carbohydrare, 28% less protein, and 20% fewer fat compared with TD children. This study prove that dietary intake among ASD children might be vary because of different etiology which was not investigated, and subsequently affect the growth and development of the children. Excessive intake of daily calorie intake as well as high energy dense food without needs will contribute to excessive weight gain and adiposity (48). Unbalanced intake of fats and fiber (49) as well as cautious parental control in food consumption (50) might explained higher prevalence of underweight and severe underweight among ASD children.

Several strengths exist in our study. Given the paucity of studies on eating habits, general weight status, and daily nutritional consumption, this finding may give a comprehensive overview of the significance of health status, particularly for children with special needs. Since this study was conducted during the pandemic COVID-19, it was inexpensive as the data collected through online. On the other hand, self-reported weight and height as well as self-recorded daily food intake may be less accurate as the parents or legal guardian may over- or under- estimate the weight, height as well as meal consumed. This bias could lead to misclassification of weight status as well as daily nutrient intake. Future research may examine the gender-based difference since it is well known that more boys than girls have ASDs. Also, a thorough analysis of food intake, including the weight of raw materials, the weight of finished goods, and micronutrient analysis can be performed in the future.

CONCLUSION

In summary, summation, the present study findings revealed that the children with ASD were more likely than TD children to be obese, overweight, underweight, and severely underweight. Furthermore, only the energy intake showed a significant difference between ASD and TD in both age groups, despite the fact that ASD children consumed more daily carbohydrates, protein, and fats than TD children. While the ASD population's during meals behaviour showed that one-third of them were engaging in problematic eating habits, with the selective eating habits being the most common. Hence, mealtime behaviour was linked with the macronutrients intake of carbohydrate, protein, and fats daily.

Nutritional adequacy plays an important role in contributing to the overall health status of children with ASD. As this study was done among Malaysian localities, this result will enable key players among nutritional policymakers to potentially assign a proper nutritional management in developing countries.

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