

## ORIGINAL ARTICLE

# Picky Eating Behaviour, Feeding Practices, Dietary Habits, Weight Status and Cognitive Function Among School Children in Kuala Lumpur, Malaysia

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## ABSTRACT

**Introduction:** Picky eating behaviour was linked to nutritional problems due to limited dietary variety. This study aimed to determine the causes and consequences associated with picky eating behaviour among school-aged children in Kuala Lumpur, Malaysia. **Methods:** A total of 339 children aged seven to nine years participated in this cross-sectional study. Socio-demographic factors, eating behaviours and child/ parental feeding style were assessed through parent's questionnaires, while eating habits of children were accessed through child's questionnaire. Body height and weight were measured; body mass index (BMI) was calculated. Cognitive function level was determined using the Raven's Coloured Progressive Matrices test. **Results:** One third (38%) of the children were picky eaters and consumed lesser vegetables ( $\chi^2=4.49, p=0.034$ ) and fish ( $\chi^2=5.55, p=0.019$ ), but more milk and dairy products ( $\chi^2=3.91, p=0.048$ ), snacks ( $\chi^2=6.25, p=0.012$ ) and fast food ( $\chi^2=7.35, p=0.007$ ) compared to non-picky eaters. Picky eaters were more likely to have normal weight status based on weight-for-age, height-for-age and BMI-for-age compared to non-picky eaters ( $p<0.05$ ). Picky eaters came from a household with other picky eaters in the family and their parents tend to use an instrumental feeding style. Picky eaters had a poorer cognitive function compared to non-picky eaters ( $p=0.03$ ). **Conclusion:** We did not find significant differences in growth parameters between picky and non-picky eaters but picky eaters were more likely to have a poorer cognitive function. As parental feeding styles significantly influenced children's eating behaviour, interventions should target parents to improve their children's dietary variety.

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## INTRODUCTION

Picky eating behaviour is commonly reported among young children aged one to ten years, where the prevalence of picky eaters ranges from 25% to 66% (1-4). To date, there is no universal definition of picky eating behaviour. Nevertheless, picky eating behaviour is characterised by the unwillingness to try unfamiliar foods or new foods, as well as having strong preferences towards certain foods (5). Picky eating behaviour can cause imbalanced energy intake and inadequate dietary nutrients intake (5,6). Some examples of unhealthy diet include limited vegetable consumption, excess meat consumption and unhealthy snacks such as sweets or chips (7-9). Such unhealthy diet can further result in

unfavourable health outcomes, including nutritional deficiencies and poorer cognitive function (10,11).

Children's growth and development can be compromised due to picky eating behaviour, which could lead to malnutrition in both spectrums; thinness (12-14) or obesity/ overweight (5,16). In addition, picky eating behaviour can compromise children's cognitive function, as reported in several cross-sectional and longitudinal studies (3,10,17,18). Cognitive function is critical for school-going children, which is often associated with academic performance in school (18,19); Hence, identifying the modifiable causes and consequences associated with picky eating behaviour can be beneficial to improve their growth and developmental outcomes.

It was reported that picky eating behaviour during childhood might also act as a precursor of eating disorders in adolescents and early adulthood (9,20).

A recent report by Herle et al. (22) suggested that persistent picky eating behaviour was associated with greater anorexia nervosa risk among adolescents. Nevertheless, most studies explored on picky eating behaviour internationally and in Malaysia were mainly among pre-schoolers (10,12,15,27,45), but rarely among school children. Hence, the main study objective was to determine the causes and consequences of picky eating behaviour among school children, which would be useful to support arguments for picky eating behaviour prevention initiatives in the future.

## MATERIALS AND METHODS

### Design and sampling

This cross-sectional study was conducted on seven to nine years old children in Kuala Lumpur, Malaysia using multistage stratified random sampling method. From a list of primary schools in Kuala Lumpur that were multi-ethnic and co-educational (n=171), the schools were further stratified into national (Sekolah Kebangsaan, n=114) and national-type schools (Sekolah Jenis Kebangsaan Cina, n=42; Sekolah Jenis Kebangsaan Tamil, n=15). To ensure each school type were represented, two schools were randomly selected from each school type (n=6). Malaysian children who lived in Kuala Lumpur aged seven to nine years were included in the study while children with mental, physical or learning disabilities, chronic medical problems or dietary restriction were excluded. The sample size was calculated at 95% confidence level based on the prevalence of cognitive function below average level (p=23.5%) as reported in a Malaysian study (34). By using the formula,  $n = [z^2 p(1-p)]/d^2$  (33), a minimum of 333 children was needed in this study.

### Participants

Of 637 parent-child pairs invited, a total of 361 of them participated in the study. Due to missing data and incomplete questionnaire, 22 were excluded making a total of 339 completed the study (Response rate = 53%). Informed consent by parents were obtained, while the children's assents were obtained before the data collection.

The research protocol was reviewed and approval was obtained from Institutional Ethics Committee of UCSI University [IEC-2019-FAS-005], the Ministry of Education Malaysia (MOE) [KPM.600-3/2/3-eras(4075)] and the Department of Education Federal Territory of Kuala Lumpur [JPNWP. 900-6/1/7 Jld.22 (76)], Malaysia. A pre-test was conducted among 30 parent-child pairs to test the readability and reliability of the instruments prior to the data collection. The actual data collection took place from May 2019 to December 2019.

### Questionnaires

#### *Parent's questionnaire*

The first section consisted of 13 questions to obtain

the socio-demographic information. Such information included the parent and child's age, sex, ethnicity, educational level, monthly household income and household size.

A total of 20 questions adapted from the Child Eating Habits Survey (1) was used to assess parents' behaviour, attitudes and perception towards picky eating behaviour and child feeding practices. In addition, parents were asked to report any family history of picky eating behaviour and how often it occurs among their children. The questions were measured using a 4-point Likert scale (1=never, 2=rarely, 3=sometimes, 4=all the time). The Cronbach's  $\alpha$  was 0.82.

The Child Eating Behaviour Questionnaire (CEBQ), specifically the food fussiness (FF) construct, was used to assess picky eating behaviour among children (23). Each question was rated using a 5-points Likert scale (1=never, 2=rarely, 3=sometimes, 4=often, 5=always). The mean score was calculated based on the participants' responses. A higher mean score indicated greater severity of picky eating behaviour (14). The mean score was further categorised into moderate (>3.0) and severe picky eating behaviour (>3.33) (24). The Cronbach's  $\alpha$  was 0.69.

The aspect of parental attitude, belief and practices on child feeding were assessed using the Child Feeding Questionnaire (CFQ) developed by Birch et al. (25). Two constructs, namely "monitoring" (three items) and "pressure to eat" (four items), were used in the present study to obtain data on the parents' use of control in child feeding, while the rest of the constructs were not used as they were weight-related. The response options were based on a 5-point Likert scale (1=never, 2=rarely, 3=sometimes, 4=often, 5=always). The mean score of each construct was calculated; a higher score indicated a higher frequency of parents' monitoring and a greater tendency to pressure their child to eat. The Cronbach's  $\alpha$  was 0.71.

There were 27 items on parental feeding style across four constructs. These constructs were adapted from Parental Feeding Style Questionnaire (PFSQ) (26), namely: - (i) instrumental feeding (four items), (ii) emotional feeding (five items), (iii) prompting and encouragement to eat (eight items) and (iv) control overeating (ten items). All items were measured using a 5-point Likert scale (1=never, 2=rarely, 3=sometimes, 4=often, 5=always). The mean score of each construct was then calculated; a higher mean score reflected a greater tendency for parents to feed the children using a particular style (26). The Cronbach's was reported at 0.76.

The section on retrospective infant feeding practices consisted of seven questions adapted from Infant Feeding Practices Questionnaire (27). The parents were asked to report the duration of breastfeeding and

exclusive breastfeeding practices and the age where complementary foods were first introduced following the guidelines by the American Academy of Pediatrics (AAP) in 2012 (28) and World Health Organization (WHO) recommendations (29).

### **Child's Questionnaire**

The first section of the child's questionnaire consisted of five items adapted from the Eating Behaviours Questionnaire (30) to assess a child's frequency of consuming main meals, snacking between meals, and supper. Other questions such as the use of dietary supplement and children's participation in body change programme were not included in this study as the main objective was to assess the frequency of meal consumption among children. Children were required to report using 6-point Likert scale (1="every day", 2="four to six days in a week", 3="two to three days in a week", 4="once a week", 5="one to three days in a month" to 6="never at all"). The frequencies were then further categorised into three categories, "never", "never skip" and "skipped more than once per week". The Cronbach's  $\alpha$  was 0.59.

Next, 12 questions from the Youth Risk Behaviour Survey (YRBS) 2009 questionnaire were included in this study (31). The original YRBS consisted of 99 questions with six constructs, namely the health risk behaviours that contribute to unintentional injury and violence, health risk of tobacco use, health risk of alcohol and other drug use, sexual health risk behaviours; dietary behaviours; and physical inactivity health risk behaviour. In this study, only one construct on dietary behaviours was included as the other risk behaviours were not related to the objective of this study. Children were asked to report the frequency of food using a 7-point Likert scale (1="never eaten for the past 7 days", 2="one to three times in a week", 3="four to six times in a week", 4="one time a day", 5="two times a day", 6="three times a day" to 7="four or more times a day"). Fruits, fruit juice, meat or poultry, fish, legumes, milk or dairy products and snacks were categorised into three categories, namely "never", "less than two times per day", and "more than two times per day". Meanwhile, the frequency of vegetables, sweets and fast-food intake were categorised into three categories, namely "never", "one to three times per day", and "more than three times per day". The Cronbach's  $\alpha$  was 0.63.

### **Anthropometric Measurements**

The children's height and weight were measured using SECA Body Meter SE206 (SECA GmbH & Co. KG, Hamburg, Germany) and OMRON Body Fat Analyzer model HBF-356 (Omron Matsusaka Co. Ltd, Matsusaka, Japan) respectively. The measurements were conducted twice, and the mean were calculated. Height-for-age, weight-for-age, and BMI-for-age z-scores were determined using the WHO AnthroPlus Version 1.0.3 software, which then classified based on the WHO

Growth Reference 2007.

### **Cognitive Function**

The children's cognitive function was assessed using Raven's Coloured Progressive Matrices (RCPM) (32), which consisted of three sets of puzzles with 12 matrices in each set. Children were asked to choose the suitable figure to complete the puzzle. One point was allocated for every correct answer. The raw score was then converted to a standard score based on the norm tables (32). The standard score was then categorised into "extremely low/ borderline/ low average" (below 90), average (90-109), "high average/ superior/ very superior" (above 109).

### **Statistical Analysis**

The statistical analysis was carried out using IBM Statistical Package for Social Sciences (SPSS) version 23.0 for Windows. The Kolmogorov-Smirnov test of normality was performed to test for normality. The mean differences of parental feeding practices among picky and non-picky eaters were determined by independent T-test (emotional feeding and control overeating) and Mann Whitney U-test (instrumental feeding, prompting and encouragement to eat, monitoring and pressure to eat). Pearson's Chi-square test was used to assess the association between picky eating behaviour and variables (socio-demographic, meal frequency, food intake, feeding practices, nutritional status and cognitive function). Logistic regression was used to determine the causes and consequences of picky eating behaviour, using the variables in the adjusted model: gender, ethnicity, age of the child and monthly household income. The level of significance for all analysis was set to  $p < 0.05$ .

## **RESULTS**

Out of the 339 children, 47.8% were male, and 55.2% were females with a mean age of  $8.03 \pm 0.81$  years. In terms of ethnic composition, 44.5% of them were Malays, followed by Chinese (33.6%), Indians (17.1%) and other ethnicities (4.7%). More than half of the parents attained tertiary level education (52.8%), and the mean monthly household income was MYR 5012.92 (USD 1184.67) with a mean household size of 4.89.

Over half of the children were non-picky eaters (61.9%), followed by moderate or severe picky eaters (38.0%) and severe picky eaters (15.9%). Picky eaters were more likely to be reported among those with a family history of picky eaters compared to those without ( $\chi^2=8.08$ ,  $p=0.004$ ). There were no statistical differences in the gender, age, ethnicity, and parent's education level between picky eaters and non-picky eaters (Table I).

As shown in Fig. 1, picky eaters tended to skip breakfast ( $\chi^2=9.12$ ,  $p=0.003$ ), had snacks ( $\chi^2=8.34$ ,  $p=0.004$ ) and supper ( $\chi^2=4.46$ ,  $p=0.035$ ) compared to non-picky

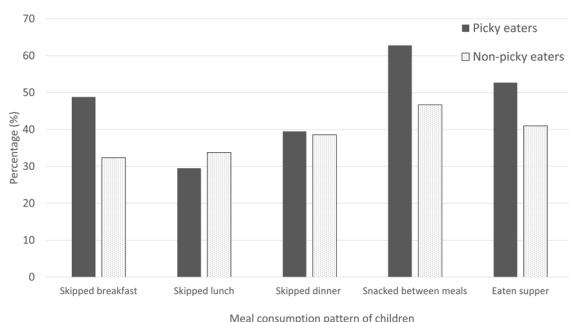
**Table 1: Socio-demographic characteristics, meal frequency and of picky and non-picky eaters.**

	n (%)		p-value	
	Non-picky eaters (N = 210)	Picky eaters (N = 129)		
<b>Gender</b>			1.599 <sup>a</sup>	0.206
Male	106 (50.5)	56 (43.4)		
Female	104 (49.5)	73 (56.6)		
<b>Age (mean ± SD)</b>	8.03 ± 0.81		2.706 <sup>a</sup>	0.259
7 years old	61 (29.0)	46 (35.7)		
8 years old	70 (33.3)	45 (34.9)		
9 years old	79 (37.6)	38 (29.5)		
<b>Ethnicity</b>			5.848 <sup>a</sup>	0.119
Malay	96 (45.7)	55 (42.6)		
Chinese	76 (36.2)	38 (29.5)		
Indian	28 (13.3)	30 (23.3)		
Others	10 (4.8)	6 (4.7)		
<b>Parent's highest education level</b>			0.545 <sup>a</sup>	0.761
Non-schooling/ primary school	12 (5.7)	9 (7.0)		
Secondary school	89 (42.4)	50 (38.8)		
Tertiary education	198 (51.9)	70 (54.3)		
<b>Monthly household income (mean ± SD) †</b>	5012.92 ± 3910.50			
Below MYR4849	127 (60.5)	69 (53.5)	2.377 <sup>a</sup>	0.305
MYR4850-MYR10,959	69 (32.9)	53 (41.1)		
MYR10,960 and above	14 (6.7)	7 (5.4)		
<b>Number of siblings</b>			9.100 <sup>a</sup>	0.059
No siblings	12 (5.9)	12 (9.4)		
1 sibling	23 (11.3)	16 (12.6)		
2 siblings	60 (29.4)	43 (33.9)		
3 siblings	52 (25.5)	38 (29.9)		
4 or more siblings	57 (27.9)	18 (14.2)		
<b>Family history of picky eating behaviour</b>			8.084 <sup>a</sup>	0.004 <sup>*</sup>
Yes	73 (34.9)	65 (50.4)		
No	137 (65.2)	64 (49.6)		

<sup>a</sup> Based on Pearson's Chi Square;

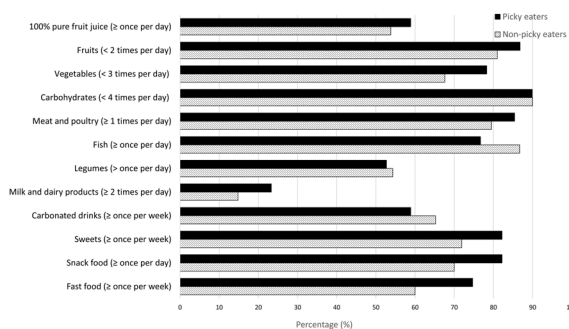
<sup>\*</sup> Statistically significant at p-value < 0.05

† Categorisation based on Department of Statistics' (DOSM) Household Income and Basic Amenities Survey 2019; USD 1 = MYR 4.23 (as of 26 July 2021)



**Figure 1: Meal consumption pattern of picky and non-picky eaters.** The bar graph showed the frequency of meal consumption pattern for breakfast, lunch, dinner, snack between meals and supper among the picky and non-picky eaters. The proportion of picky eaters who skipped breakfast, had snacks between meals and had supper was significantly higher than the non-picky eaters (p < 0.05).

eat. On the contrary, no significant association was found between picky eating behaviour with lunch ( $\chi^2=0.69$ ,  $p=0.405$ ) and dinner ( $\chi^2=0.03$ ,  $p=0.860$ ). Meanwhile, the frequency of food intake between picky and non-picky eaters was shown in Fig. 2. Picky eaters had a lower intake of vegetables ( $\chi^2=4.49$ ,  $p=0.034$ ) and fish ( $\chi^2=5.55$ ,  $p=0.019$ ), higher intake of milk and dairy products ( $\chi^2=3.91$ ,  $p=0.048$ ), sweets ( $\chi^2=4.59$ ,  $p=0.032$ ), snack ( $\chi^2=6.25$ ,  $p=0.012$ ) and fast food ( $\chi^2=7.35$ ,  $p=0.007$ ) compared to non-picky eaters.



**Figure 2: Frequency of food intake between picky and non-picky eaters.** Picky eaters had a lower intake of vegetables\* and fish\*, higher intake of milk and dairy products\*, sweets\*, snacks\* and fast food\*\* compared to non-picky eaters. \*Statistically significant at p-value < 0.05 level; \*\* Statistically significant at p-value < 0.001 level.

Table II present the parental feeding styles according to the children's picky eating behaviour. Parents of picky eaters used instrumental feeding ( $t=3.34$ ,  $p=0.001$ ) and emotional feeding style ( $z=-2.02$ ,  $p=0.044$ ), and lower monitoring over their child's diet ( $z=-2.31$ ,  $p=0.021$ ) compared to parents of non-picky eaters. Picky eaters were more likely to either never been breastfed (17.1%) or breastfed for 6 months or less (73.6%). Furthermore, they experienced an early introduction of complementary food (30.2%) compared to non-picky eaters, although no significant association was found (Table III). Although the growth parameters (BMI-for-age, height-for-age and weight-for-age) indicated that most children had normal weight status, the proportion of non-picky eaters who were overweight or obese based on BMI was significantly higher than the picky eaters ( $p<0.001$ ). Picky eaters were found to have normal BMI-for-age compared to non-picky eaters ( $\chi^2=15.54$ ,  $p<0.001$ ). In addition, picky eaters also had lower height-for-age as compared to non-picky eaters ( $\chi^2=6.13$ ,  $p=0.047$ ). When comparing cognitive function, picky eaters were more likely to have had poorer cognitive function compared to non-picky eaters ( $\chi^2=10.52$ ,  $p=0.005$ ); non-picky eaters were more likely to have had average cognitive function.

Table IV showed the odds ratio (OR) of logistic regression models. Picky eaters were found among those who had history or presence of picky eaters in the family (OR=0.49 CI=0.306-0.791), consumed fish less than

**Table II: Parental feeding style according to picky eating behaviour of children.**

Parental feeding style	Mean ± SD			Median	IQR	t/z	p-value
	Non picky eaters (N = 210)	Picky eaters (N = 129)	Total (N=339)				
Control overeating †	35.81 ± 5.39	35.49 ± 5.11	35.92 ± 0.30	36.00	8.00	0.55	0.582
Instrumental feeding	8.84 ± 3.07	9.98 ± 2.97	9.27 ± 0.17	9.00	4.00	-3.34	0.001**
Emotional feeding †	11.60 ± 4.11	12.52 ± 3.90	11.93 ± 0.22	12.00	6.00	-2.02	0.044*
Prompting and encouragement to eat	29.82 ± 5.45	29.76 ± 5.02	29.23 ± 0.29	30.00	6.00	-0.66	0.510
Monitoring	11.40 ± 2.71	10.85 ± 2.67	11.19 ± 0.15	12.00	4.00	-2.31	0.021*
Pressure to eat	15.39 ± 2.92	15.46 ± 3.22	15.42 ± 0.16	16.00	5.00	-0.33	0.745

Note: † denotes Independent T-test, denotes Mann Whitney U-test.

\*Statistically significant at p-value < 0.05 level

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

**Table III: Infant feeding practices, nutritional status and cognitive function of picky and non-picky eaters**

	n (%)		p-value	p-value
	Non-picky eaters (N = 210)	Picky eaters (N = 129)		
<b>Duration of breastfeeding</b>			1.489 <sup>a</sup>	0.685
Never	26 (12.4)	22 (17.1)		
< 6 months	74 (35.2)	42 (32.6)		
≥ 6 months	110 (52.4)	65 (50.4)		
Mean ± SD (months)	8.22 ± 8.34	7.27 ± 7.51		
<b>Duration of exclusive breastfeeding</b>			3.208 <sup>a</sup>	0.073
< 6 months	135 (64.3)	95 (73.6)		
≥ 6 months	75 (35.7)	34 (26.4)		
Mean ± SD (months)	4.23 ± 5.62	3.41 ± 4.97		
<b>Complementary feeding</b>			0.504 <sup>a</sup>	0.478
< 6 months	56 (26.7)	39 (30.2)		
≥ 6 months	154 (73.3)	90 (69.8)		
Mean ± SD (months)	5.84 ± 1.74	5.53 ± 2.50		
<b>Weight (kg); mean ± SD</b>	28.20 ± 8.81	25.23 ± 7.01	8.230 <sup>a</sup>	0.016 <sup>*</sup>
<b>Weight-for-age (WAZ)</b>				
Severely underweight/ underweight	17 (8.1)	5 (3.9)		
Normal	161 (76.7)	115 (89.1)		
Overweight/ obese	32 (15.2)	9 (7.0)		
<b>Height (cm); mean ± SD</b>	126.36 ± 11.78	125.04 ± 7.62		
<b>Height-for-age (HAZ)</b>			6.134 <sup>b</sup>	0.047 <sup>*</sup>
Severe stunting/ stunting	7 (3.3)	2 (1.6)		
Normal	195 (92.9)	127 (98.4)		
Tall/ very tall	8 (3.8)	0 (0)		
<b>Body Mass Index (BMI) (kg/m<sup>2</sup>); mean ± SD</b>	17.20 ± 3.93	15.90 ± 2.91		
<b>BMI-for-age (BAZ)</b>			15.541 <sup>a</sup>	0.001 <sup>**</sup>
Severe thinness/ thinness	12 (5.7)	9 (7.0)		
Normal	122 (58.1)	99 (76.7)		
Overweight/ obese	76 (36.2)	21 (16.3)		
<b>Cognitive function</b>			10.518 <sup>a</sup>	0.005 <sup>*</sup>
Extremely low/ border-line/ low average	47 (22.4)	43 (33.3)		
Average	83 (39.5)	30 (23.3)		
High average/ superior/ very superior	80 (38.1)	56 (43.4)		

CI, confidence interval.

<sup>a</sup> Based on Pearson's Chi Square; <sup>b</sup> Based on Fisher exact test;

\*Statistically significant at p-value < 0.05; \*\*Statistically significant at p-value < 0.001 level (2-tailed).

once per day (OR=2.44; CI=1.291-4.977), consumed milk or dairy products less than two times per day (OR=0.31; CI=0.153-0.614), parents' use of instrumental feeding style (OR=1.15; CI=1.055-1.261), normal BMI-for-age (OR=0.49; CI=1.846-5.97) and poorer cognitive

function level (OR=0.49; CI=0.263-0.914).

## DISCUSSION

The prevalence of picky eaters in the present study was 38%, much lower than previous findings (3,4). This showed that picky eating behaviour was not limited to pre-schoolers but also among school-aged children. Chao and Chang (4) also found that school-going children (seven to ten years old) showed stronger dislikes towards specific foods as compared to younger children. This finding demonstrated the need to identify the factors associated with picky eating behaviour among children at this age.

Picky eating behaviour was more likely to occur among children with mothers or other family members who were picky eaters (36), and similar findings were found in the present study. Previous studies also suggested that children often imitate or adopt the eating behaviours observed from their parents as influential role models (7,37). Hence, family members, especially parents, should portray good eating habits to influence a child's dietary preference.

In this present study, picky eaters were more likely to be severely thin, thin or have a normal BMI. This finding may be of greater significance among school-aged children, as most picky eaters in our study had normal BMI. It was possible that picky eating behaviour be undetected among normal weight children, which was similar to previous studies, where persistent picky eating behaviour during childhood was associated with lower (12,13) or normal weight (38,39) in both children and adolescents. A longitudinal study by Beiger et al. (38) found that picky eating behaviour was not related to weight related issues among school-aged children. However, picky eaters may still experience inadequate nutrient intake due to limited dietary intake (3,10), which consequently leads to unfavourable growth (4,8,13). Nevertheless, the inconsistent findings between picky eating behaviour and nutritional status might be due to the lack of a universal definition for picky eating behaviour used in past studies (2,3,4).

This study found that picky eaters had a lower intake

**Table IV: Odds ratio for picky eating behaviour and predicting variables.**

Variables	Predictor category	Adjusted model		p-value
		OR	95% CI	
Presence of picky eaters in the family	Yes	0.492	0.306, 0.791	0.003*
Breastfeeding	Yes	1.625	0.824, 3.204	0.161
<b>Exclusive breast-feeding</b>	Yes	1.654	0.984, 2.779	0.057
<b>Meal skipping pattern</b>	Skip breakfast	0.656	0.386, 1.115	0.656
	Skip lunch	0.808	0.466, 1.401	0.808
	Skip dinner	1.479	0.846, 2.585	1.479
	Eat snacks	1.424	0.798, 2.538	1.424
	Eat supper	1.296	0.814, 2.064	1.296
<b>Frequency of food group consumption</b>				
100% Pure fruit juice	Never	1	-	0.966
	Once per day	1.247	0.694, 1.914	0.794
	> Once per day	1.236	0.162, 3.227	0.801
Fruits	< 2 times per day	1.584	0.281, 1.194	0.224
Vegetables	< 3 times per day	1.469	0.796, 2.712	0.219
Carbohydrates	≥ 4 times per day	0.888	0.365, 2.162	0.793
Meat and poultry	Never (Less than once per day)	0.598	0.291, 1.227	0.161
Fish	Never (Less than once per day)	2.444	1.291, 4.977	0.014*
Legumes	Never (Less than once per day)	1.055	0.619, 1.801	0.843
Milk and dairy products	< 2 times per day	0.307	0.153, 0.614	0.001*
Carbonated drinks	≥ Once per week	0.659	0.371, 1.170	0.155
Sweets	≥ Once per week	1.923	0.970, 3.809	0.061
Snacks food	≥ Once per day	1.716	0.883, 3.333	0.111
Fast food	≥ Once per week	1.604	0.871, 2.953	0.129
<b>Parental feeding style</b>				
Emotional feeding	Yes	1.007	0.942, 1.076	0.839
Encouragement to eat	Yes	0.995	0.944, 1.048	0.847
Controlling Instrumental feeding style	Yes	0.999	0.951, 1.049	0.956
	Yes	1.153	1.055, 1.261	0.002*
Monitoring	Yes	0.929	0.844, 1.022	0.131
Pressure to eat	Yes	1.032	0.949, 1.122	0.463
<b>Weight-for-age</b>				
Severely under-weight/ underweight	Normal	1	-	-
	Normal	0.391	0.128, 1.193	0.099
	Overweight/ obese	0.539	0.119, 2.448	0.423
<b>Height-for-age</b>				
Severe stunting/ stunting	Normal	1	-	-
	Normal	2.617	0.440, 12.457	0.227
	Tall/ very tall	2.447	0.272, 22.054	0.425
<b>BMI-for-age</b>				
Overweight/ obese	Normal weight	1	-	-
	Normal weight	3.319	1.846, 5.970	0.001**
	Severely thin/ thin	2.739	0.986, 7.610	0.053
<b>Cognitive function level</b>				
Extremely low/ borderline/ low average	Average	1	-	-
	Average	0.490	0.263, 0.914	0.025*
	High average/ superior/ very superior	0.980	0.535, 1.797	0.949

OR: Odd Ratio; CI: Confidence Interval

\*Significant odds ratio using complex sample logistic regression at p<0.05

\*\*Significant odds ratio using complex sample logistic regression at p<0.001

Model adjusting for socio-demographic variables: child's gender, ethnicity, age and household income

of vegetables compared to non-picky eaters. Similarly, numerous studies reported that children with picky eating behaviour do not like to eat vegetables or do not eat them at all (2,10,36). The low acceptance of vegetables may be due to several reasons, such as the texture of the vegetables (36) and sensory factors such as colour or taste (41). As eating behaviours might persist until adulthood, it is important to focus on increasing vegetable consumption from a young age. Past studies observed lower fish intake among picky eaters (3,8,14), which was similar to the present study's findings. However, it was unclear whether a lower intake of fish was due to a child's refusal, being picky, or other reasons such as low availability, accessibility, affordability (42). In addition, the fear of choking or dealing with fish bones due to past experiences might be another reason why the fish intake was low among children (43).

This study found that picky eaters consumed more milk and dairy products as compared to non-picky eaters. Chao (10) also reported high milk intake as one of the characteristics for picky eating behaviour observed among Taiwanese children. Higher frequency of drinking milk might cause the lack of appetite during meals (10) due to the satiety-inducing effect of milk protein, carbohydrate (lactose), and fat (44) leading to being picky about their food during mealtime. Picky eaters were more likely to consume sweets, snacks and fast foods compared to non-picky eaters in this study. High sugar intake from refined products such as sweets and snacks might lead to excessive calorie intake, poorer micronutrient composition among picky eaters (42,45), leading to childhood obesity (14). Furthermore, a study suggested that children preferred foods with a sweet taste (46). Hence, they were likely to be picky and prefer sugary or energy-dense foods.

Our study found that parents of picky eaters tend to use greater instrumental and emotional feeding, while lower parental monitoring over children's diet. This was in line with reports from Tharner et al. (14), as mothers of picky eaters tend to monitor less on their children's diet. One of the possible reasons for these findings was that with a higher monitoring style, the child tends to be less picky as parents oversee their child's eating and weight status (48). Previous studies found that snacks or sweets were commonly used as reward or bribes to ensure cooperation by the children (47). Similar to other studies, the greater use of instrumental feeding was found to increase exposure and likability of snacks or energy-dense food in the rewarding strategy (21,40,47). Hence, the habitual consumption pattern of snacks and fast food were high among the picky eaters was potentially related to the parental feeding style in this study.

Interestingly, picky eaters were more likely to demonstrate poorer cognitive function compared to non-picky eaters. Previous findings reported that children with persistent

feeding difficulties, specifically picky eating behaviour, showed significant negative impact not only on growth status but also their cognitive function (3,17). A previous study by Northstone et al. (49) found that practising a healthier diet high in fruit and vegetables, lean meat, and wholegrains can improve cognition. Conversely, an unhealthy diet with less nutrient-dense food, high sugar, and high saturated fat may limit optimal neurological development (50).

Similar to several past studies, there was a lack of evidence and association between infant feeding practices such as breastfeeding, exclusive breastfeeding (EBF) and complementary feeding with children's picky eating behaviour (7,12). Breastfeeding for more than six months and EBF were associated with the promotion of satiety and responsiveness to food in young children. Consequently, this led to a lower risk of picky eating behaviour during childhood (35). This was because the practice of EBF provided earlier exposure to food flavours from the mothers' diet for infants.

The strengths of the present study included the use of questionnaire which covered a full range of 'picky eating' traits and our attempt to include children from different diversities through recruitment from multi-ethnic primary schools. However, several limitations should be considered in which this cross-sectional study cannot induce the causality of picky eating behaviour and cognitive function, and the results would not represent the entire population of primary school children (aged seven to nine) in Malaysia. However, this study provided some insights into the current situation of picky eating behaviour among the non-clinical children population in Malaysia. Future efforts can focus on nationwide longitudinal study among the school children population.

## CONCLUSION

The current study found an association between parental feeding styles and picky eating behaviour among school children. Picky eaters were more likely to have normal weight status (weight-for-age, height-for-age and BMI-for age) and poorer cognitive function compared to non-picky eaters. Picky eaters were more likely to consume less vegetables and fish but more milk, dairy products, snacks and fast food. As prolonged picky eating behaviour in young children might precede into adolescence or adulthood, immediate actions must be taken to manage such eating behaviour in children. Nutritional education or guidance for parents especially in the aspect of parental feeding styles is necessary to overcome picky eating behaviour in primary school-aged children.

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## REFERENCES

1. Goh D, Jacob A. Perception of picky eating among children in Singapore and its impact on caregivers: a questionnaire survey. *Asia Pacific Family Medicine*. 2012;11(1):5. doi: 10.1186/1447-056X-11-5.
2. Haszard JJ, Skidmore PML, Williams SM, Taylor RW. Associations between parental feeding practices, problem food behaviours and dietary intake in New Zealand overweight children aged 4–8 years. *Public Health Nutrition*. 2014;18(6):1036–1043. doi: 10.1017/S1368980014001256
3. Xue Y, Lee E, Ning K, Zheng Y, Ma D, Gao H, Yang B, Bai Y, Wang P, Zhang Y. Prevalence of picky eating behaviour in chinese school-age children and associations with anthropometric parameters and intelligence quotient. A cross-sectional study. *Appetite*. 2015;91:248–255. doi: 10.1016/j.appet.2015.04.065
4. Chao H, Chang H. Picky eating behaviors linked to inappropriate caregiver e child interaction, caregiver intervention, and impaired general development in children. *Pediatrics and Neonatology*. 2017;58(1):22–28. doi: 10.1016/j.pedneo.2015.11.008
5. Taylor C, Wernimont S, Northstone K, Emmett P. Picky/fussy eating in children: Review of definitions, assessment, prevalence and dietary intakes. *Appetite*. 2015;95: 349-359. doi: 10.1016/j.appet.2015.07.026
6. Mascola A, Bryson S, Agras W. Picky eating during childhood: a longitudinal study to age 11 years. *Eating Behaviors*. 2010;11(4):253-257. doi: 10.1016/j.eatbeh.2010.05.006
7. Emmett P, Hays N, Taylor C. Antecedents of picky eating behaviour in young children. *Appetite*. 2018;130:163-173. doi: 10.1016/j.appet.2018.07.032
8. Taylor CM, Northstone K, Wernimont SM, Emmett PM. Macro- and micronutrient intakes in picky eaters : a cause for concern? *Am J Clin Nutr*. 2016;104:1647–1656. doi: 10.3945/ajcn.116.137356
9. Cardona CS, Hoek H, van Hoeken D, de Barse L, Jaddoe V, Verhulst F, et al. Behavioral outcomes of picky eating in childhood: a prospective study in the general population. *Journal of Child Psychology and Psychiatry*. 2016;57(11):1239-1246. doi: 10.1111/jcpp.12530
10. Chao H. Association of picky eating with growth, nutritional status, development, physical activity, and health in preschool children. *Frontiers in Pediatrics*. 2018;6. doi: 10.3389/fped.2018.00022
11. Kwon KM, Shim JE, Kang M, Paik H. Association

- between picky eating behaviors and nutritional status in early childhood: performance of a picky eating behavior questionnaire. *Nutrients*. 2017;9(463):1–15. doi: 10.3390/nu9050463
12. de Barse L, Tiemeier H, Leermakers E, Voortman T, Jaddoe V, Edelson L, Franco O, Jansen P. Longitudinal association between preschool fussy eating and body composition at 6 years of age: The Generation R Study. *International Journal of Behavioral Nutrition and Physical Activity*. 2015;12(1). doi: 10.1186/s12966-015-0313-2.
  13. Antoniou E, Roefs A, Kremers S, Jansen A, Gubbels J, Sleddens E, et al. Picky eating and child weight status development: a longitudinal study. *Journal of Human Nutrition and Dietetics*. 2015;29(3):298-307. doi: 10.1111/jhn.12322.
  14. Tharner A, Jansen P, Kiefte-de JJ, Moll H, van der Ende J, Jaddoe V, et al. Toward an operative diagnosis of fussy/picky eating: a latent profile approach in a population-based cohort. *International Journal of Behavioral Nutrition and Physical Activity*. 2014;11(1):14. doi: 10.1186/1479-5868-11-14.
  15. Tee JYH, Gan WY. Factors associated with picky eating among preschoolers aged 4 to 6 years in Petaling Perdana, Selangor. Presented at the 31st Annual Scientific Conference, Nutrition Society of Malaysia, Kuala Lumpur.
  16. Jansen P, Roza S, Jaddoe V, Mackenbach J, Raat H, Hofman A, et al. Children's eating behaviour, feeding practices of parents and weight problems in early childhood: results from the population-based Generation R Study. *International Journal of Behavioural Nutrition and Physical Activity*. 2012;9(1):130. doi: 10.1186/1479-5868-9-130.
  17. Hegazi M, Sehlo M, Al-Jasir A, El-Deek B. Development and cognitive functions in Saudi pre-school children with feeding problems without underlying medical disorders. *Journal of Paediatrics and Child Health*. 2015;51(9):906-912. doi: 10.1111/jpc.12880.
  18. Haile D, Nigatu D, Gashaw K, Demelash H. Height for age z score and cognitive function are associated with Academic performance among school children aged 8–11 years old. *Archives of Public Health*. 2016;74(1). doi: 10.1186/s13690-016-0129-9
  19. Nesayan A, Amani M, Asadi GR. A Study of the Cognitive Profile of Children and Its Relationship With Academic Performance. *Basic and Clinical Neuroscience Journal*. 2019;10(2):165–174. doi: 10.32598/bcn.9.10.230.
  20. Van Tine M, McNicholas F, Safer D, Agras W. Follow-up of selective eaters from childhood to adulthood. *Eating Behaviors*. 2017;26:61-65. doi: 10.1016/j.eatbeh.2017.01.003
  21. Raaijmakers L, Gevers D, Teuscher D, Kremers S, van Assema P. Emotional and instrumental feeding practices of Dutch mothers regarding foods eaten between main meals. *BMC Public Health*. 2014;14(1). doi: 10.1186/1471-2458-14-171
  22. Herle M, Stavola B, Hübner C, Abdulkadir M, Ferreira D, Loos R, et al. A longitudinal study of eating behaviours in childhood and later eating disorder behaviours and diagnoses. *The British Journal of Psychiatry*. 2019;216(2):113-119. doi: 10.1192/bjp.2019.174
  23. Wardle J, Guthrie C, Sanderson S, Rapoport L. Development of the Children's Eating Behaviour Questionnaire. *Journal of Child Psychology and Psychiatry*. 2001;42(7):963-970. doi: 10.1111/1469-7610.00792
  24. Steinsbekk S, Bonneville-roussey A, Fildes A, Llewellyn CH, Wichstrøm L. Child and parent predictors of picky eating from preschool to school age. *International Journal of Behavioral Nutrition and Physical Activity*. 2017;14(87):1–8. doi: 10.1186/s12966-017-0542-7.
  25. Birch L, Fisher J, Grimm-Thomas K, Markey C, Sawyer R, Johnson S. Confirmatory factor analysis of the Child Feeding Questionnaire: a measure of parental attitudes, beliefs and practices about child feeding and obesity proneness. *Appetite*. 2001;36(3): 201-210. doi: 10.1006/appe.2001.0398
  26. Wardle J, Sanderson S, Guthrie C, Rapoport L, Plomin R. Parental Feeding Style and the Inter-generational Transmission of Obesity Risk. *Obesity Research*. 2002;10(6):453-462. doi: 10.1038/oby.2002.63
  27. Shim J, Kim J, Mathai R. Associations of Infant Feeding Practices and Picky Eating Behaviors of Preschool Children. *Journal of the American Dietetic Association*. 2011;111(9):1363-1368. doi: 10.1016/j.jada.2011.06.410.
  28. American Academy of Pediatrics. Breastfeeding and the Use of Human Milk. *PEDIATRICS*. 2012;129(3):e827-e841. doi: 10.1542/peds.2011-3552
  29. World Health Organisation. The WHO Child Growth Standards [Internet]. 2007 [cited 26 July 2021]. Available from: <https://www.who.int/tools/child-growth-standards>
  30. Chin Y, Mohd NM. Eating Behaviors among Female Adolescents in Kuantan District, Pahang, Malaysia. *Pakistan Journal of Nutrition*. 2009;8(4):425-432. doi:10.3923/pjn.2009.425.432
  31. Centers for Disease Control and Prevention. 2009 State and Local Youth Risk Behavior Survey [Internet]. 2017. [cited 26 July 2021]. Available from: <https://www.cdc.gov/healthyyouth/data/yrbs/index.htm>.
  32. Raven J, Raven JC, Court JH. Raven manual: Section 2. Coloured progressive matrices. Oxford, United Kingdom: Oxford Psychologists Press; 1998.
  33. Daniel WW, Biostatistics: A Foundation for Analysis in the Health Sciences. 7th edition. New York: John Wiley & Sons. 1999.
  34. Sandjaja, Poh B, Rojroonwasinkul N, Le



- Nyugen B, Budiman B, Ng L et al. Relationship between anthropometric indicators and cognitive performance in Southeast Asian school-aged children. *British Journal of Nutrition*. 2013;110(S3):S57-S64. doi: 10.1017/S0007114513002079.
35. Specht IO, Rohde JF, Olsen NJ, Heitmann BL. Duration of exclusive breastfeeding may be related to eating behaviour and dietary intake in obesity prone normal weight young children. *PLoS ONE*. 2018;13(7):1–11. doi: 10.1371/journal.pone.0200388.
  36. van der Horst K. Overcoming picky eating. Eating enjoyment as a central aspect of children's eating behaviors. *Appetite*. 2012;58(2):567-574. doi: 10.1016/j.appet.2011.12.019
  37. Yee A, Lwin M, Ho S. The influence of parental practices on child promotive and preventive food consumption behaviors: a systematic review and meta-analysis. *International Journal of Behavioral Nutrition and Physical Activity*. 2017;14(1). doi: 10.1186/s12966-017-0501-3.
  38. Berger P, Hohman E, Marini M, Savage J, Birch L. Girls' picky eating in childhood is associated with normal weight status from ages 5 to 15 y. *The American Journal of Clinical Nutrition*. 2016;104(6):1577-1582. doi: 10.3945/ajcn.116.142430
  39. Taylor C, Steer C, Hays N, Emmett P. Growth and body composition in children who are picky eaters: a longitudinal view. *European Journal of Clinical Nutrition*. 2018;73(6):869-878. doi: 10.1038/s41430-018-0250-7
  40. Rodenburg G, Kremers S, Oenema A, van de Mheen D. Associations of parental feeding styles with child snacking behaviour and weight in the context of general parenting. *Public Health Nutrition*. 2013;17(5):960-969. doi: 10.1017/S1368980013000712
  41. Raggio L, Gámbaro A. Study of the reasons for the consumption of each type of vegetable within a population of school-aged children. *BMC Public Health*. 2018;18(1163):1–11. doi: 10.1186/s12889-018-6067-4
  42. Samuel T, Musa-Veloso K, Ho M, Venditti C, Shahkhalili-Dulloo Y. A Narrative Review of Childhood Picky Eating and Its Relationship to Food Intakes, Nutritional Status, and Growth. *Nutrients*. 2018;10(12):1992. doi: 10.3390/nu10121992
  43. McManus A, Burns S, Howat P, Cooper L, Fielder L. Factors influencing the consumption of seafood among young children in Perth: a qualitative study. *BMC Public Health*. 2007;7(1). doi: 10.1186/1471-2458-7-119
  44. Kavezade S, Mozaffari-khosravi H, Aflatoonian M, Asemi M, Mehrabani S. The effects of whole milk compared to skim milk and apple juice consumption in breakfast on appetite and energy intake in obese children: a three-way randomised crossover clinical trial. *BMC Nutrition*. 2018;4(44):1–10. doi: 10.1186/s40795-018-0253-8
  45. Rohde J, Handel M, Stougaard M et al. Relationship between pickiness and subsequent development in body mass index and diet intake in obesity prone normal weight preschool children. *PLoS One*. 2017;12(3):e0172772. doi: 10.1371/journal.pone.0172772
  46. Mennella J, Nolden A, Bobowski N. Measuring Sweet and Bitter Taste in Children: Individual Variation due to Age and Taste Genetics. *Pediatric Food Preferences and Eating Behaviors*. 2018;1-34. doi:10.1016/B978-0-12-811716-3.00001-4
  47. Jansen P, Derks I, Mou Y, Rijen E, Gaillard R, Micali N et al. Associations of parents' use of food as reward with children's eating behaviour and BMI in a population-based cohort. *Pediatric Obesity*. 2020;15(11). doi: 10.1111/ijpo.12662
  48. Chew W, Kaur S, Tung S, Teoh A, Ng C. Retrospective Child Feeding Practices and Obesity Risk among Young adults. *Malaysian Journal of Medicine and Health Sciences*. 2020;16(3):106-112.
  49. Northstone K, Joinson C, Emmett P, Ness A, Paus T. Are dietary patterns in childhood associated with IQ at 8 years of age? A population-based cohort study. *J Epidemiol Community Health*. 2012;66:624–628. doi: 10.1136/jech.2010.111955
  50. Hernández JL, Čeněk J, Čuta M. The Influence of High sugar Intake on Cognitive Functions and Body Composition of university students. *Anthropologia Integra*. 2017;8: 39–43. doi:10.5817/AI2017-1-39