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Socio-demographic factors and parental feeding practices predicted body mass index of Malaysian children with learning disabilities

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ABSTRACT

Introduction: Overweight and obesity have emerged as significant global health concerns among children. Previous studies have provided evidence that children with intellectual and learning disabilities (LD) are at a higher risk of obesity compared to their peers without disabilities. **Methods:** This study aimed to predict body weight status of children with LD who attended Special Education Integration Program in Kelantan, located on East Coast of Peninsular Malaysia. Parents completed a self-administered questionnaire in Malay language, which included "Screening Tool of Feeding Problems" children's version (STEP-CHILD) and Comprehensive Feeding Practice Questionnaire (CFPQ). The children's body weight and height were measured to determine body mass index (BMI). Research hypothesis was tested through stepwise multiple linear regression analysis. **Results:** This study recruited 245 subjects with mean age of 10.5±1.7 years and mean BMI of 18.5±4.9 kg/m^2. Prevalence of underweight, thinness and severe thinness was 12.2%, while overweight and obesity was 29.0%. Male children with LD (β=0.109, p<0.044), older age (β=0.226, p<0.001), higher child birth weight (β=0.119, p<0.029), lack of parental modelling (β=-0.170, p=0.004), lower parental pressure (β=-0.266, p<0.001), and higher restriction for weight control (β=0.361, p<0.001) were found to predict higher BMI values. **Conclusion:** Positive parental feeding practices during mealtime are crucial for addressing the poor nutritional status of children with LD.

Keywords: BMI, children, learning disabilities, parental feeding practices

INTRODUCTION

According to the European Association for the Study of Obesity (EASO, 2023), overweight and obesity rank as the fifth leading cause of global deaths. The World Health Organization (WHO) estimated that nearly 18.4% of children and adolescents aged 5 to 19 years were overweight and 6.8% were obese worldwide in 2016, compared to 14.8% overweight and 4.9% obese in 2010. Meanwhile, the prevalence of thinness among this age group slightly decreased from 11.0% in 2010 to 10.5% in 2016. The increasing prevalence of overweight and obesity among children has become a significant global health concern, as it outpaces the rate of underweight children (WHO, 2021).

As anticipated, Malaysia has also witnessed an alarming upward trend in the prevalence of overweight and obesity

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among children and adolescents. The Global Nutritional Report (2022) stated that in 2019, the prevalence of overweight and obesity among Malaysian children and adolescents aged 5 to 19 years were 30.0% and 14.8%, respectively, compared to 26.8% and 12.9% in 2016. However, the prevalence of thinness decreased from 7.5% in 2016 to 7.1% in 2019. Additionally, the National Health & Morbidity Survey (NHMS) indicated a rise in the national prevalence of thinness and obesity among children aged 5 to 17 years, with thinness increasing from 7.8% in 2015 to 10.0% in 2019 and obesity rising from 11.9% in 2015 to 14.8% in 2019 (IPH, 2015; IPH, 2020). While several previous studies in Malaysia have examined unhealthy body weight status among typically developing children (Rahim, Chin & Sulaiman, 2019; Tay *et al.*, 2016), there is limited research conducted on children with learning disabilities (LD) in Malaysia (Chen *et al.*, 2015; Hashim *et al.,* 2017). This vulnerable group is struggling to get the right nutrition they need to avoid malnutrition and prevent infectious diseases.

The Malaysian Department of Social Welfare has defined LD as disorders in learning, cognition, and intelligence that deviate from an individual's chronological age. National surveys conducted in the United States, such as National Health and Nutrition Examination Survey (NHANES), covering the period from 2005 to 2012 have revealed that children and youth with intellectual and LD were 35.0% more likely to be obese compared to their peers without disabilities. Furthermore, data from the 2011 National Survey of Children's Health (NSCH), which was conducted in the United States and the District of Columbia targeting individuals aged 10 to 17 years indicated that children and youth with disabilities showed a 27.0% higher likelihood of experiencing obesity compared to those without disabilities (Bandini *et al.*, 2015).

Previous research findings consistently indicate that children with disabilities have a higher prevalence of underweight, overweight, and obesity compared to children without disabilities (Bandini *et al.*, 2015; Sayin & Ilik, 2017). Currently, there is a dearth of research dedicated to LD in Malaysia. A recent study, which had a limited scope, only included a small sample of children with LD in Kelantan and did not accurately represent the broader Malaysian population. The study reported a prevalence of 22.5% for underweight and 22.1% for overweight/obesity among the participants (Chen *et al.*, 2015). Despite extensive prior research conducted in various countries and among different disability groups, there remains a significant knowledge gap regarding the prevalence of different body weight status among children with disabilities in Malaysia.

Previous research has indicated that several factors contribute to unhealthy body weight status among children and adolescents with LD. These factors include age, gender, socioeconomic status, feeding difficulties, high consumption of energy-dense foods, co-morbidities, genetic disorders, and parental feeding practices (Chen *et al.,* 2015; Wang *et al.*, 2018; Eow *et al.*, 2021). Parents play a critical role in determining a child's nutritional status, as they are the ones responsible for choosing foods that can influence the child's taste preferences, eating habits, dietary intake, and eventual weight status. Families with disabled children face additional financial costs and often encounter financial difficulties due to the need for specialised healthcare, medications, specific foods, and disability-specific aids. The financial

burden can influence food choices, leading to a range of nutrition-related disorders and diseases. Additionally, unhealthy body weight status among this vulnerable group imposes an extra burden on family healthcare costs (Pushpalatha, 2020). Hence, it is crucial to investigate potential factors, such as parental factors, that may contribute to unhealthy weight status in children and subsequently lead to adverse health consequences, particularly non-communicable diseases.

The objective of this study was to explore the predictive factors associated with body weight status among children with LD. This vulnerable group often has limited knowledge and understanding to make informed dietary choices. Additionally, they encounter difficulties in feeding themselves and frequently experience unmet healthcare needs in terms of dietary services (Tan, 2015).

MATERIALS AND METHODS

Study design and data collection

This cross-sectional study was conducted in primary schools located in different districts with varying socioeconomic statuses in Kelantan. Stratified random sampling was employed to ensure representation from urban and rural areas. The minimum sample size was calculated using Daniel's (1999) single proportion formula. Consequently, nine primary schools with the Special Education Integration Program (SEIP) were randomly chosen. The study protocol received ethical approval from the Human Research Ethics Committee USM (Reference no. USM/JEPeM/19110827). In addition, approval was also obtained from the Ministry of Education and the State Department of Education. The researchers obtained approval from school principals and communicated the dates of data collection. Subsequently, class teachers assisted in distributing the invitation letters to parents or primary caregivers for their attendance during the data collection sessions.

All parents/caregivers and their children with LD between the ages of 7 and 14 years from the selected schools were invited to participate in the study. The inclusion criteria consisted of children with LD who were attending the Special Education Integration Program (SEIP), regardless of the aetiology of their disability, and who were capable of standing straight and still during anthropometric measurements without assistance. Additionally, parents/caregivers needed to be willing to participate. The exclusion criteria were children with LD who were following a special diet for medical reasons, as well as those with oedema or physical deformities in their limbs and spine that could interfere with anthropometric measurements. Prior to administering the questionnaire, written informed consent was obtained from parents/caregivers. Every respondent received an honorarium for their participation.

Children with LD underwent measurements of body weight and height, while their parents/caregivers were required to complete a set of questionnaires. Data collection took place between the years 2020 and 2021, during the Movement Control Order (MCO) period implemented due to the COVID-19 pandemic. To ensure adherence to the standard operating procedures published by the National Security Council and the School Management and Operations New Norm Guidelines 2.0 by the Ministry of Education Malaysia at that time, adjustments were made to the data collection procedure. Researchers briefed parents on the research objectives and provided them with the necessary instruments. The research instruments had undergone pre-testing for reliability and validity at a community-based rehabilitation centre in Kelantan prior

to data collection. Parents completed the self-administered questionnaire at home and returned it to the school the following day, minimising face-to-face interaction. Researchers then thoroughly reviewed the completed questionnaires, seeking clarification from participants when necessary. The response rate was 82.8%, resulting in 245 participants who successfully completed the study and were included in the final data analysis.

Measurements

Demographic and socioeconomic background

Parents of children with LD were asked to self-report their education level, monthly household income, and household size. The monthly household income in Kelantan was categorised according to the survey report by Department of Statistics Malaysia (2020). Additionally, parents provided information about the child, including their date of birth, gender, ethnicity, birth weight, gestational age at delivery, and any co-morbidities the child may have.

Feeding problems

Feeding problems were evaluated using the "Screening Tool of Feeding Problems" children's version (STEP-CHILD) (Tareq *et al.*, 2019; Seiverling, Hendy & Williams, 2011). STEP-CHILD was employed to assess the occurrence of feeding problems among disabled children, consisting of 15 items with six subscales: chewing problems, rapid eating, food refusal, food selectivity, vomiting, and stealing food. Participants rated the frequency on a 3-point Likert scale: "0" indicated no occurrence of the behaviour, "1" denoted the behaviour occurring between 1 and 10 times per month, and "2" represented the behaviour happening more than ten times per month. The total feeding problem score was determined by summing the responses from the 15 items, with scores ranging from 0 to 30. A higher score indicated more severe feeding problems (Tareq *et al.*, 2019). The study's internal consistency reliability was found to be good, with a Cronbach's alpha coefficient of 0.850.

Parental feeding practices

Parental feeding practices were assessed using the Malay version of the Comprehensive Feeding Practice Questionnaire (CFPQ) (Shohaimi, Wei & Shariff, 2014). The CFPQ comprised 39 items organised into 12 subscales, which are as follows:

1. Monitoring: Parents keep track of the child's intake of less healthy foods.
2. Child control: Parents allow the child to control their eating behaviours.
3. Emotion regulation: Parents use food to regulate the child's emotional states.
4. Encourage dietary balance and variety: Parents promote balanced food intake.
5. Environment: Parents make healthy foods available in the home.
6. Food as a reward: Parents use food as a reward for the child's behaviour.
7. Involvement: Parents encourage the child's involvement in meal planning and preparation.
8. Modelling: Parents actively demonstrate healthy eating for the child.
9. Pressure: Parents pressure the child to consume more food at meals.
10. Restriction for health: Parents control the child's food intake with the purpose of limiting less healthy foods and sweets.
11. Restriction for weight control: Parents control the child's food intake with the purpose of decreasing or maintaining the child's weight.

12. Teaching about nutrition: Parents provide nutrition knowledge to the children during meals.

Each item within each subscale was rated by the parents using a five-point scale. The scores for each item were then summed to calculate a total score for each subscale. A higher total score on a subscale indicated a higher intensity of the specific parental feeding practice. This study demonstrated good internal consistency reliability, with a Cronbach's alpha coefficient of 0.856.

Anthropometric measurements

Children's height was measured using a SECA 206 Body Meter (SECA, Germany) to the nearest 0.1 cm, while their body weight was measured with a SECA Robusta 813 digital weighing scale (SECA, Germany) to the nearest 0.1 kg. To determine the *z*-score for body mass index, expressed as BMI-for-age, the WHO AnthroPlus Version 1.0.4 software was utilised.

Body weight status of all children was categorised into four groups based on the WHO Growth Reference (WHO, 2007), except for children with Down Syndrome (DS). Children with a BMI below the 5th percentile were classified as underweight; normal weight was defined as a BMI within the range of the 5th percentile to less than the 85th percentile; overweight individuals were those with a BMI falling between the 85th and less than the 95th percentiles; and obesity was identified when BMI was at or above the 95th percentile. Meanwhile, a specific growth chart was applied for children with DS (Zemel *et al.*, 2015) as recommended by the Centers for Disease Control and Prevention, CDC.

Statistical analysis

Statistical analysis was conducted using IBM SPSS Statistics for Windows version 26.0 (IBM Corp, Armonk, New York, USA). The normality of the data was tested using the Kolmogorov-Smirnov test. Descriptive data for categorical variables were presented in frequencies and percentages, while continuous variables were summarised as means and standard deviations for comparison by employing independent sample *t*-test. To predict body weight status of children with LD, a stepwise multiple linear regression was performed. The independent variables included in the regression model were selected based on simple linear regression results, with a significance level of $p<0.25$. The level of statistical significance for the overall analysis was set at $p<0.05$.

RESULTS

Table 1 presents the data on a total of 245 children with LD, with 68.2% males and 31.8% females, and a mean age of 10.5±1.7 years. Majority of the children (62.9%) were categorised as having intellectual disability. Regarding parental education, more than half of the fathers (57.9%) and mothers (56.8%) had completed secondary school. The majority of families (84.3%) fell under the B40 category, with a monthly household income of less than RM3,030, while only 3.7% belonged to the T20 category with a monthly income of more than RM6,620. The mean household size was 5.60±1.81 persons, with 54.7% of families having five to seven members living in the house.

In terms of birth-related factors, the majority of children (80.9%) had a normal birth weight and 77.4% were delivered full-term, between 37 to 41 weeks. Regarding co-morbidities, 18.1% participants reported that their children had additional health conditions, with the most common being epilepsy, asthma, and cardiovascular diseases, each reported by 4.2% of the participants. This study observed that a significant number of participants reported that their children frequently displayed rapid eating (1.98±1.31), food refusal (1.48±1.34), and food selectivity (1.27±1.13) during the past six months.

Table 1. Characteristics of children with learning disabilities and parental factors (*N*=245)

Characteristic	*n (%)*	*Mean±SD*
Children		
Type of disabilities		
Intellectual disability	154 (62.9)	
Autism	32 (13.1)	
Down syndrome	27 (11.0)	
Attention deficit hyperactivity disorder	16 (6.5)	
Dyslexia	16 (6.5)	
Sex		
Male	167 (68.2)	
Female	78 (31.8)	
Age (years)		10.5±1.7
7-9	57 (23.3)	
10-12	152 (62.0)	
13-14	36 (14.7)	
Ethnicity		
Malay	240 (98.0)	
Chinese	4 (1.6)	
Indian	1 (0.4)	
Birth weight (kg) (*n*=245)		2.9±0.6
Very low birth weight (<1.49)	4 (1.6)	
Low birth weight (<2.50)	43 (17.6)	
Normal birth weight (≥2.50)	198 (80.8)	
Gestational age (weeks) (*n*=234)		37.8 ±2.7
<37	49 (20.0)	
37–41	182 (77.8)	
≥42	3 (1.2)	
Co-morbidities		
Yes	47 (19.2)	
No	198 (80.8)	
Parents		
Father's education level (*n*=240)		
PhD/Master/Bachelor	18 (7.5)	
STPM/Diploma/A-Level	35 (14.6)	
Secondary school (PMR/SPM/O-Level)	139 (57.9)	
Primary school (UPSR)	36 (15.0)	
No formal education	12 (5.0)	
Mother's education level (n=243)		
PhD/Master/Bachelor	33 (13.6)	
STPM/Diploma/A-Level	36 (14.8)	
Secondary school (PMR/SPM/O-Level)	138 (56.8)	
Primary school (UPSR)	27 (11.1)	
No formal education	9 (3.7)	

Table 1. Characteristics of children with learning disabilities and parental factors (*N*=245) (*cont.)*

Characteristic	*n (%)*	*Mean±SD*
Monthly household income (RM) (*n*=242)†		
B40 (<RM3,030)	204 (84.3)	
M40 (RM3,030 – RM6,619)	29 (12.0)	
T20 (>RM6,620)	9 (3.7)	
Household size (persons)		5.60±1.81
<5	73 (29.8)	
5-7	134 (54.7)	
>8	38 (15.5)	
Feeding problems (maximum score)		
Chewing problem (6)		0.84±1.16
Rapid eating (6)		1.98±1.31
Food refusal (6)		1.48±1.34
Food selectivity (4)		1.27±1.13
Vomiting (4)		0.42±0.88
Stealing food (4)		0.70±0.98
Parental feeding practices (maximum score)		
Monitoring (20)		13.35±3.20
Child control (20)		11.25±2.62
Emotional regulation (15)		6.34±2.65
Encourage dietary balance and variety (15)		12.01±2.03
Environment (10)		8.17±1.56
Involvement (15)		11.37±2.45
Food as reward (10)		6.33±2.14
Restriction for health (10)		7.68±2.28
Teaching about nutrition (10)		7.95±2.00
Restriction for weight control (35)		23.76±7.08
Pressure (15)		8.75±3.24
Modelling (20)		16.57±3.41

UPSR: *Ujian Penilaian Sekolah Rendah* (Primary School Assessment Test); PMR: *Penilaian Menengah Rendah* (Lower secondary Assessment); SPM: *Sijil Pelajaran Malaysia* (Malaysian Certificate of Education); STPM: *Sijil Tinggi Pelajaran Malaysia* (Malaysian Higher Certificate of Education); PhD: Doctor of Philosophy; RM: *Ringgit Malaysia*; B40: Bottom 40%; M40: Middlle 40%; T20: Top 20%

†Classification was based on monthly household income by household group and state

Table 2 displays the mean weight of the children, which was 34.3±13.5 kg, and the mean height, which was 134.2±12.2 cm. The average BMI of all children was 18.5±4.9 kg/m^2. It was observed that the mean BMI for males (18.8±4.8 kg/m^2) was significantly higher compared to females (17.5±4.8 kg/m^2; t=2.165, p=0.031). The overall prevalence of underweight / thinness/ among the children was 12.2%, while 58.8% were categorised as having a normal weight and 29.0% were classified as overweight/obese.

Table 3 presents the results of the stepwise multiple linear regression analysis, which identified six significant predictors of BMI among children with LD. The results indicated that being male (β=0.109, p=0.044), higher age

Table 2. Body weight status of children with learning disabilities by gender (*N*=245)

Anthropometric measurements	*All*	*Male (n=167)*	*Female (n=78)*	*p-value*¶
Weight (kg), mean±*SD*	34.3±13.5	35.4±13.6	31.9±13.1	0.057
Height (cm), mean±*SD*	134.2±12.2	134.8±11.9	132.8±12.8	0.224
BMI (kg/m^2), mean±*SD*	18.5±4.9	18.9±4.8	17.5±4.9	0.031*
BMI classification, *n* (%)				
Underweight‡/Thinness†	30 (12.2)	18 (10.8)	12 (15.4)	
Normal‡,†	144 (58.8)	88 (52.7)	56 (71.8)	
Overweight†/Obesity†,‡	71 (29.0)	61 (36.5)	10 (12.8)	
Total	245 (100.0)			

‡Zemel *et al.* (2015) for children with DS, †WHO (2007) for all other children, ¶Independent sample *t*-test
*Significant at $p<0.05$

(β=0.226, $p<0.001$), and higher birth weight (β=0.119, p=0.029) significantly predicted higher BMI values in children with LD. In terms of parental feeding practices, the regression analysis revealed that a lower mean score of parental modelling (β=-0.170, p=0.004), a lower mean score of pressure (β=-0.266, $p<0.001$), and a higher mean score of restriction for weight control (β=0.361, $p<0.001$) were significant predictors of higher BMI values among children with LD. Notably, restriction for weight control demonstrated the largest beta coefficient, indicating that it was the strongest predictor for BMI value. Overall, this prediction model was statistically significant, $F(5,238)=18.907$, $p<0.001$, and accounted for approximately 30.6% of the variance in BMI (adjusted R^2=0.306).

DISCUSSION

This present study observed a high prevalence of overweight and obesity among children with LD. They are at a higher risk of experiencing poor nutritional status than typical children due to limited ability to comprehend and assess information about nutrition, which leads to challenges in maintaining a healthy diet. The current study highlighted that the double burden

Table 3. Significant predictors for body mass index of children with learning disabilities (*n*=223)

Variables	*B*	*β*	*95% CI*		*p-value*
			Lower bound	*Upper bound*	
Age	0.641	0.226	0.339	0.944	<0.001
Sex					
Male	1.138	0.109	0.032	2.244	0.044
Birth weight	0.985	0.119	0.104	1.866	0.029
Parental feeding practice					
Modelling	-0.244	-0.170	-0.411	-0.077	0.004
Pressure	-0.401	-0.266	-0.564	-0.237	<0.001
Restriction for weight control	0.250	0.361	0.170	0.330	<0.001

Multiple linear regression model: R=0.568, R^2=0.323, Adjusted R^2=0.306; $F(6, 238)=18.907$, $p<0.001$; associations are significant at $p<0.05$.

of malnutrition (undernutrition and overnutrition) not only occurs among typical children, but is also prevalent among children with LD. This study found that more males were overweight or obese than females. Being male was identified as a predictive factor for higher BMI, which aligns with a recent study in Malaysia showing higher BMI for males than females (Eow *et al.,* 2021). However, the relationship between gender and BMI in disabled children remains inconsistent, as previous studies in Chile and South Korea reported that females had higher BMI than males (Barria *et al.*, 2018; Joo *et al.*, 2019). Previous evidence suggested that gender differences become more pronounced during pubertal maturation, as males and females have different body compositions. Girls who experience delayed puberty are negatively associated with obesity, body fat percentage, fat mass, and fat-free mass (He *et al.,* 2017).

Meanwhile, studies conducted among Japanese children with intellectual disabilities have also revealed that the onset of obesity among boys is more likely to occur at early ages, whereas for girls, it tends to appear later, specifically during the period of pubertal maturation (Haga & Aihara, 2015). Interestingly, despite previous studies suggesting that female children with LD are at a greater risk of overweight and obesity (Barria *et al.*, 2018; Joo *et al.*, 2019), this does not seem to be the case among children with LD in the current findings. However, caution should be exercised when making a direct comparison, as these differences could be attributed to other possible factors such as variations in reference standards used, socio-demographic factors, dietary patterns, lifestyle, and cultural practices in different countries.

The present study observed that increased age predicted higher BMI values in children with LD. This finding aligns with previous studies conducted in Asian countries (Eow *et al.*, 2021; Wang *et al.*, 2018), which reported a positive correlation between BMI and age in disabled children. It has been suggested that BMI increases in conjunction with age during puberty. Our study supports this idea, as almost three-quarters of the children aged 10 years and older were predominantly boys. Boys tend to gain more fat-free and skeletal mass during puberty, which contributes to their weight gain, while females tend to accumulate a significantly higher amount of fat mass during this stage of development. On the other hand, lower physical activity levels as children with LD age and spending more time in sedentary activities could be another contributing factor to the observed increase in BMI. Previous research has found that lower physical activity levels, resulting from poor social interaction and motor functioning, were associated with weight gain among disabled children (Wouters, Evenhuis & Hilgenkamp, 2019). Thus, the relationship between physical activity and BMI among children with LD warrants further investigation in future studies.

Additionally, this study also found that higher birth weight predicted higher BMI among children with LD. This finding is consistent with a previous study (Chen *et al.*, 2015), but contradicts another study (Chen *et al.*, 2019) that reported low birth weight as being correlated with an increased risk of severe obesity, as well as thinness. The variation in these findings may be elucidated by the fact that children with low birth weight exhibit catch-up growth in accordance with their genetic factors, subsequently experiencing a relatively rapid increase in body weight as they grow (Baran *et al.*, 2019). However, it is important to note that not all children with low birth weight follow a regular catch-up development trend, as different growth patterns may exist (Chen *et al.*, 2019). Given these discrepancies, it becomes

crucial to consider these various factors when developing interventions to address childhood overweight and obesity among children with LD. However, it is worth mentioning that there is still limited evidence specifically focusing on children with LD, and further prospective studies are warranted to investigate the temporal relationship between birth weight and BMI in this population.

This study highlighted that children with LD frequently exhibited rapid eating, food refusal, and food selectivity during the past six months. These findings align with a study conducted by Leader *et al.* (2020), who reported that disabled children experiencing these feeding problems had a higher prevalence of gastrointestinal symptoms compared to those who did not. Children with gastrointestinal problems were found to be susceptible to conditions such as constipation, diarrhoea, and abdominal pain, which could potentially lead to unhealthy body weight due to poor nutrient absorption (Eow *et al.*, 2021).

Regarding parental feeding practices, higher restriction for weight control was found to be associated with higher BMI among children with LD. This could be explained by the fact that parents may encourage their children to eat less, provide smaller portions at meals, skip meals, and limit them to certain foods, under the perception that it would prevent them from becoming overweight. When parents believe their children are gaining weight, they intentionally restrict their food consumption, which aligns with the concept that restrictive parental feeding behaviours are linked to a child's weight status (Freitas *et al.*, 2019). Parents may believe that severely restricting a child's food intake will positively influence his/her eating habits. However, higher restriction for weight control may have a negative impact, as this may cause children to experience stress and lead to increased food consumption as a means to relieve tension, ultimately resulting in a higher BMI (Joo *et al.*, 2019). Restricting food intake in children with LD often makes them crave it more. They keep thinking about the food they cannot have, which can lead to strong cravings and obsessions. This makes it harder for children to control themselves when they finally get to eat what they have been missing out on. Also, restricting their food intake can make them turn to eating for comfort when they are feeling stressed or deprived, which weakens their self-control even more. Consequently, such parental restrictive practices might not effectively promote moderation in food consumption, but instead encourage children to consume more and weaken their self-control concerning food.

Furthermore, the higher restriction for weight control could also explain the lower instances of pressure to eat. This study revealed that a lower practice of pressuring children to eat was associated with higher BMI in children with LD, while higher pressure to eat was more commonly observed among children with a lower BMI. A similar study conducted in Malaysia found that parents exerted less pressure on disabled children who were overweight and obese (Eow *et al.*, 2021). The possible explanation for this behaviour is that parents are aware of their children's weight gain, leading them to apply less pressure and avoid forcing them to eat more when they are not hungry or have not finished their meals. This finding demonstrated that Malaysian parents are concerned about their children's weight issues, which aligns with the higher prevalence of overweight and obesity among children with LD, as observed in the current study. However, it should be noted that parents tended to underestimate their children's weight status (Warkentin *et al.*, 2018). Consequently, children's eating behaviours might not be effectively controlled until they have already become overweight or obese.

This study revealed that lower

parental modelling of healthy eating practices predicted higher BMI in children with LD. A significant number of parents in this study were less likely to serve as role models for their children in terms of consuming healthy foods and showed less enthusiasm for practising healthy eating habits themselves. The manner in which parents model healthy eating in front of their children, including their eating habits and food preferences, can greatly influence the development of healthy eating behaviours in children, directly impacting their diet quality and nutritional status. It is important to note that this study was conducted during the COVID-19 lockdown period, known as MCO, which significantly affected lifestyle behaviours. This context highlighted the crucial role of parental modelling and feeding practices as parents and children spent most of their time together at home due to lockdown restrictions.

The current findings underscore the importance of parental role modelling as a critical factor in children's body weight status, indicating its potential as a target for future interventions. Given the lower scores of parental modelling observed in our study, it is evident that efforts should be directed towards parents to enhance their feeding practices. By doing so, we can implement a valuable strategy to improve children's health behaviours and BMI. However, it is essential to consider the findings of Russell *et al.* (2018), who suggested that although modelling feeding practices are crucial for promoting children's healthy weight, this approach may be less effective in detecting changes in children's eating behaviours, mainly because most parents tend to report following best practices in their daily lives.

There are several limitations in this study. Firstly, the cross-sectional study design only allowed for the examination of correlations between variables and not establishing causal relationships between them. Secondly, the study relied on self-reported questionnaires to gather information on demographic and socioeconomic backgrounds, feeding problems, and parental feeding practices. Self-reporting introduces a high risk of under- or over-report responses, potentially affecting the accuracy of the data. Additionally, the instruments used to assess parental feeding practices were not validated specifically among children with LD, even though they have been validated and commonly used in local studies involving children with typical development. Therefore, it is essential for future research on children with LD to explore the validity and reliability of LD-specific questionnaires related to feeding problems and parental feeding practices, as neither of these questionnaires have been validated among Malaysian children with LD. This step will enhance the accuracy and applicability of findings in this population. The main limitation of this study was the absence of information on the physical activity levels of children with LD. Physical activity is a crucial factor that should have been assessed to establish a correlation with obesity/overweight among this vulnerable group.

Despite these limitations, this study successfully investigated the relationship between demographic and socioeconomic factors, feeding problems, and parental feeding practices with the BMI of children with LD in Malaysia, a topic that has not been extensively explored. As a result, it contributes to a better understanding of BMI and its predictive factors within this vulnerable group. The study's findings, particularly concerning parental feeding practices, emphasised the crucial role of parents in preventing unhealthy weight status among children with LD. This insight could potentially inform interventions and support strategies aimed at promoting better health outcomes in children population with LD.

CONCLUSION

This study revealed a concerning prevalence of overweight and obesity among children with LD in Kelantan, with almost one-third of them falling into this category. Additionally, approximately one out of ten children were classified as underweight, thin, or severely thin. The study also highlighted the prevalence of rapid eating, food refusal, and food selectivity among these children during the past six months. Through multivariate analysis, several factors were identified as predictors of higher BMI among children with LD, including being male, older age, higher birth weight, negative parental modelling, lower pressure to eat, and higher restriction for weight control. Given the potential long-term health consequences associated with being overweight or obese, these findings underscore the importance of addressing weight issues in children with LD. Moreover, the study emphasises the critical role of positive parental feeding practices in combating body weight problems within this vulnerable group. Effective interventions and support strategies should be implemented to promote healthy weight management and overall well-being in children with LD.

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Authors' contributions

Siti FM, conducted the data collection, data analysis and interpretation, prepared the initial draft of the manuscript and reviewed subsequent versions; Soo KL, served as the principal investigator and collaborated with Siti FM in conceptualising and formulating the research plan, also provided guidance on data analysis and interpretation, and made revisions to the final draft of the manuscript; Divya V, assisted with data analysis and also reviewed the manuscript. All authors participated in reading and approving the final version of the manuscript.

Conflict of interest

The authors declare that they have no conflicts of interest.

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