ORIGINAL ARTICLE

FACTORS AFFECTING BODY MASS INDEX OF CHILDREN AND ADOLESCENTS WITH LEARNING DISABILITY IN KELANTAN, MALAYSIA

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Abstract

Objectives: This study was conducted with two objectives, i) to assess the prevalence of malnutrition among children and adolescents with learning disability (LD) in Kelantan, a rural state located at the north-eastern region of Peninsular Malaysia; and ii) to examine the associations of participants’ socioeconomic and feeding characteristics with their body mass index (BMI).

Methods: A total of 271 children and adolescents with LD aged between 4 to 19 years old were recruited from 32 community-based rehabilitation centres using purposive sampling method. Standing height and body weight of participants were measured. Socioeconomic and feeding information were obtained from their primary caregivers through interviews using structured questionnaire. Multiple linear regression analyses were performed to examine the associations of socioeconomic and feeding characteristics with participants’ BMI.

Results: The prevalence of underweight among children and adolescents with LD was 22.5%; while another 22.1% of them were overweight and obese. Multiple linear regression models showed that being Down’s syndrome (Adjusted regression coefficient $\beta=2.63, p<0.001$), birth weight ($\beta=1.41, p=0.005$), caregiver’s years of education ($\beta=-0.26, p=0.003$), eating duration ($\beta=-0.06, p=0.025$) and not needing food texture modification ($\beta=2.63, p=0.001$) were significantly associated with participant’s BMI. No significant association between monthly household income, ambulatory status, seizure status and eating ability with their BMI was found.

Conclusions: This study presented that children and adolescents with LD in Kelantan were suffering from the double burden of malnutrition. The above
findings would be helpful for the public health care system to initiate social-cultural sensitive rehabilitation strategies towards this population.

**Keywords:** Adolescent, Body Mass Index, Children, Learning Disability, Malnutrition

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**Introduction**

Learning disability (LD) is an umbrella term for a wide range of learning problems. It is defined as the disorder of learning and cognition that is intrinsic to an individual; which can significantly affect his or her academic and performance outcomes [1]. A child with LD has the intelligence that is inconsistent with his biological age and is usually manifested by significant difficulties in the acquisition and application of skills in reading, writing, listening, speaking, reasoning or doing mathematics. Among the Malaysian children population, an estimation of more than 850,000 were diagnosed with various forms of disability; with at least 30% being severe and needing rehabilitation [2]. In addition, there might be even a larger number go undetected. To our knowledge, there was no documentation on the definite quantity or prevalence for children and adolescents with LD. According to the disability categorization of Malaysia Department of Social Welfare (JKM), LD include those who diagnosed with global developmental delay, Down’s syndrome, intellectual deficit, autistic spectrum disorder, attention deficit hyperactivity disorder and specific LD such as dyslexia [3].

Community-based rehabilitation (CBR) centres serve as the training and rehabilitation centres for the persons with disabilities who were too young or too severely disabled to enter special education or rehabilitation workshop. It is a community-based public health notion which is generally managed in rural areas. Its purpose is to develop local resources and to enable the unfortunate population to gain access to rehabilitation in their own communities using predominantly local resources [3]. Training services provided include gross motor and fine motor skills, activities of daily living, social and communication skills, writing and reading, sports and recreation services.

Malnutrition has been defined as “a pathological state due to relative or complete deficiency or excess of one or more essential nutrients” [4]. It refers to four aspects – under-nutrition (or underweight); over-nutrition (or overweight and obesity); imbalance; and specific deficiency resulting from inadequate consumption of specific nutrient. Being the most vulnerable population, children and adolescents with disabilities are more likely to suffer from both underweight and overweight or obesity. Among the population with LD, overweight and obesity become the main concern as it accounted for an alarming prevalence in international studies. Prevalence between 20-40% of overweight and obesity had been documented in France (22.9%) [5], Ireland (33%) [6], United States (33.5%) [7] and Taiwan (37.7%) [8] among children and adolescents with LD. Moreover, Hove (2004) [9] further noted that people with LD even
had a higher rate of overweight and obesity than the general population. This condition warrant greater attention from the public health practitioners as well as the researchers.

Causes of malnutrition in children and adolescents with LD are multi-factorial. Medical condition that causes metabolic disturbances serves as the major contributing non-modifiable factor towards either underweight or obesity. Besides, it was recognized that socioeconomic status of the family was associated with children’s BMI. Poverty that leads to reduced food purchasing power and inadequate food intake remains the main culprit of undernourishment [10]. Other study, however, reported a higher prevalence of overweight was present in a lower socioeconomic status group [11, 12]. Furthermore, in socioeconomic disadvantaged families, low educational level of the parents or childcare providers [10] and big household size are commonly known to be associated with children’s malnutrition. Feeding characteristics during infancy and childhood may also influence the nutritional status of children and adolescents. Delayed introduction of solid food and longer mealtime duration resulting from feeding difficulties may increase risk of under-nutrition. Children with disabilities were 1.1 to 2.4 times more likely to have moderate to severe underweight if a feeding difficulty was present [13].

Most of the attention either globally or at national level has been focused on the epidemic of childhood malnutrition in general population. How about those with disabilities. Thus, this study aimed to determine the prevalence of malnutrition among children and adolescents with LD in Kelantan, a rural state located at the north-eastern region of Peninsular Malaysia; and to assess the association of participants’ socioeconomic and feeding characteristics with their BMI.

Methods

Study design and sample size

Based on the Malaysia Third National Health and Morbidity Survey 2006 [14], the national prevalence of underweight and overweight children and adolescents in Kelantan aged below 18 years were 16.8% and 2.9%, respectively. Thus, by considering an estimated malnutrition prevalence of 19.7%; an absolute precision set at 5%; a standard value at 95% confidence level; and an estimated of 10% dropout rate, this cross-sectional study required a sample size of 268 participants.

Participants

This study was conducted from June to August 2011 at 32 CBR centres in Kelantan. All CBR centres in Kelantan took part in this study except PDK Bertam due to logistics limitation. Participants were recruited using purposive sampling method. This sampling method was used based on the feedback from the centres on the availability of eligible participants in each centre. Inclusion criteria were children or adolescents 1) aged below 19 years old; 2) categorized in learning disability (LD), with no consideration of aetiology and degree of disability; 3) receiving rehabilitation training in the centres; 4) able to stand straight and still without assistance during anthropometric measurement; 5) willing to participate, cooperative and able to follow instructions and 6) whose primary caregivers willing to be interviewed on their children’s socioeconomic and feeding information.
This study was approved by the Malaysia Department of Social Welfare (Ref no. JKMM: 100/12/5/2 Jld 37[29]) and ethical approval was granted by The Research Ethics Committee (Human), Universiti Sains Malaysia (Ref. no. USMKK/PPP/JEPeM 218.4.[1.1]). Participants and their primary caregivers were explained the purpose of the study and procedure of anthropometric measurements. Written informed consent was obtained from each caregiver before inception of the study.

**Data collection procedures**

The study protocol comprised of i) standing height and weight measurements of children and adolescents with LD and ii) interviews with caregivers on socioeconomic and feeding information. Therefore, the supervisors of the CBR centres were informed the date of data collection one week before so that they could contact the caregivers to attend for the interviews. For those caregivers who were unable to attend, they were interviewed through telephone.

Anthropometric measurements were taken by one researcher according to standard techniques. Standing height was measured using body meter (SECA model 206, Germany). Participants were told to be barefoot, wearing no cap, fez or hair clips, legs straight, shoulders relaxed and to look straight ahead at the horizontal plane. They were asked to inhale deeply, hold the breath and maintain an erect position just before taking the measurement. Reading of standing height measurement was taken twice to the nearest 0.1cm. Weight was measured using portable electronic weighing scale (SECA model 881, Germany). Participants were informed to wear minimum attire and stand still in the middle of the scale’s platform. Reading of weight was taken twice to the nearest 0.1kg. BMI was then calculated: weight in kilogram divided by height in meter square, BMI = weight (kg) / height (m)². Nutritional status of the children and adolescents with LD was determined using standard reference, the sex- and age-specific BMI-for-Age Growth Chart [15]. Participants who had their BMI-for-age less than 3rd percentile were categorized as underweight; those with BMI-for-age between 85th and 97th percentile were overweight while those having BMI-for-age more than 97th were considered as obese.

Participants’ socioeconomic and feeding information were obtained from their caregivers (parents, foster parents or primary guardians) through interviews by a trained enumerator using structured questionnaire. The information included age, birth weight, prematurity, caregiver’s years of education, monthly household income, household size, ambulatory status, seizure status, age of weaning, eating duration, eating ability and the need for food texture modification.

**Data analysis**

Data were analysed using Statistical Package for the Social Sciences (SPSS) version 18.0 for Windows (SPSS Inc, Chicago, IL). Descriptive statistics was used to demonstrate the socioeconomic and feeding characteristics of the participants. Data on monthly household income, household size and eating duration were described in median and inter-quartile range as they were positively skewed. BMI which was selected as the dependent variable was normally distributed. Therefore, associations between socioeconomic and feeding characteristics of children and adolescents with LD in relation to their BMI were examined using multiple linear regression analyses. Those independent variables with p-value less than 0.25 in univariate analysis
were selected into the multiple linear regression models. These included diagnosis, birth weight, caregiver’s years of education, monthly household income, ambulatory status, seizure status, eating duration, eating ability and food texture modification. Stepwise selection procedure was then followed to determine the significant associating factors. The level of significance was set at \( p < 0.05 \). Multicollinearity was checked by variance inflation factor. Model assumptions of linearity, normality and equal variance were also verified. Linearity of independent variables was checked by plotting a scatter plot of unstandardized residual value with each numerical independent variable. Normality of residual was checked by plotting a histogram of the residual. Equal variance of residual was checked by plotting scatter plot between unstandardized predicted value and unstandardized residual.

Results

Table 1 shows the socioeconomic and feeding characteristics of participants. Of the total 271 children and adolescents with LD recruited, all were Malays; 50.9% were boys, this represented equal distribution of sex. More than half of them (63.9%) aged 10 years and above. Around one third of them (35.8%) had a diagnosis of Down’s syndrome. Others were diagnosed with intellectual deficit (41%), autistic spectrum disorders (5.2%), cerebral palsy (7.4%) and physical, vision, hearing or speech disabilities (10.7%). In this study, participants were further categorized into diagnosis with Down’s syndrome and without Down’s syndrome. This is because based on expert opinion, diagnosis with Down’s syndrome which is greatly affected by clinical and metabolic abnormalities was potential predictor of BMI. The mean birth weight was adequately normal and only a small proportion (9.2%) was born prematurely. On average, the primary caregivers received their highest educational level at lower secondary school and their monthly household income was Malaysian Ringgit, MYR988.62 (equivalent to USD 320). Nine point four percents of the children and adolescents had seizure; while 12.5% of them required either helper or apparatus to move. For feeding information, they needed almost twenty minutes to finish a meal. Nine point two percents of the participants needed to be fed by others and around 20% required food texture modification.

Table 1. Socioeconomic and feeding characteristics of participants

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Descriptive statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (%)</td>
</tr>
<tr>
<td>Sex (N=271)</td>
<td></td>
</tr>
<tr>
<td>Boys</td>
<td>138 (50.9)</td>
</tr>
<tr>
<td>Girls</td>
<td>133 (49.1)</td>
</tr>
<tr>
<td>Age group (years) (N=271)</td>
<td></td>
</tr>
<tr>
<td>Children (4-9.99)</td>
<td>98 (36.2)</td>
</tr>
<tr>
<td>Adolescents (10-18.99)</td>
<td>173 (63.9)</td>
</tr>
<tr>
<td>Characteristics</td>
<td>Descriptive statistics</td>
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<tr>
<td>----------------------------------------</td>
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</tr>
<tr>
<td></td>
<td>n (%)</td>
</tr>
<tr>
<td>Age (years)</td>
<td></td>
</tr>
<tr>
<td>Children</td>
<td>6.89 (1.70)</td>
</tr>
<tr>
<td>Adolescents</td>
<td>14.71 (2.52)</td>
</tr>
<tr>
<td>Diagnosis (N=271)</td>
<td></td>
</tr>
<tr>
<td>With Down’s syndrome</td>
<td>97 (35.8)</td>
</tr>
<tr>
<td>Without Down’s syndrome</td>
<td>174 (64.2)</td>
</tr>
<tr>
<td>Birth weight (kg) (N=240)</td>
<td>2.75 (0.67)</td>
</tr>
<tr>
<td>Prematurity (N=251)</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>23 (9.2)</td>
</tr>
<tr>
<td>No</td>
<td>228 (90.8)</td>
</tr>
<tr>
<td>Caregiver’s years of education (N=259)</td>
<td>7.71 (3.95)</td>
</tr>
<tr>
<td>Monthly household income (MYR) (N=258)</td>
<td></td>
</tr>
<tr>
<td>Household size (N=251)</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: SD, standard deviation; IQR, inter-quartile range; MYR, Malaysian Ringgit.
Figure 1 presents the prevalence of malnutrition according to age group. As overall, almost half of the participants were malnourished. There was a prevalence of 22.5% who were underweight while 22.1% whom were overweight or obese. This condition was especially noticeable among the adolescents.

Figure 1. Prevalence of malnutrition according to age group

<table>
<thead>
<tr>
<th>Age group</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children</td>
<td>20.4, 13.2</td>
</tr>
<tr>
<td>Adolescents</td>
<td>23.7, 27.2</td>
</tr>
<tr>
<td>Total</td>
<td>22.5, 22.1</td>
</tr>
</tbody>
</table>

Children (N=98); Adolescents (N=173); Total (N=271)

Table 2 demonstrates the associations of socioeconomic and feeding characteristics with BMI. The multiple linear regression analyses showed that diagnosis with Down’s syndrome, birth weight and not needing food texture modification were positively associated with participant’s BMI. Conversely, caregiver’s years of education and eating duration were negatively associated with BMI. There was no significant association between monthly household income, ambulatory status, seizure status and eating ability in relation to BMI.

Table 2. Associated factors of body mass index (kg/m\(^2\)) among children and adolescents with learning disabilities

<table>
<thead>
<tr>
<th>Variables</th>
<th>β (95% CI)</th>
<th>t-stat</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnosis(^a) (with Down’s syndrome)</td>
<td>2.63 (1.30, 3.97)</td>
<td>3.88</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Birth weight (kg)</td>
<td>1.41 (0.43, 2.39)</td>
<td>2.84</td>
<td>0.005</td>
</tr>
<tr>
<td>Caregiver’s years of education</td>
<td>-0.26 (-0.44, -0.09)</td>
<td>-3.05</td>
<td>0.003</td>
</tr>
</tbody>
</table>
Eating duration (minutes)  
-0.06 (-0.11, -0.01)  
-2.26  
0.025  

Food texture modification\(^{a}\) (not needed)  
2.63 (1.04, 4.23)  
3.25  
0.001  

\(\beta\)Adjusted regression coefficient  
Stepwise multiple linear regression method applied. Model assumptions are fulfilled.  
There was no interaction amongst the independent variables. No multicollinearity detected.  
Coefficient of determination \((R^{2}) = 0.186\)  
\(^{b}\)Significant at 95% confidence interval \(p<0.05\)  
\(^{a}\)Categorical independent variable

**Discussion**

In this study, the participants were relatively homogenous, all Malays, as Malays are the major population in Malaysia especially for the state of Kelantan. Most of the participants can manage daily living activities such as walking, playing and eating by own-self, only a small proportion of them needed help. The caregiver’s educational level and monthly household income categorized as low income. Based on the report on Malaysian Population and Housing Census 2010 [16], Kelantan recorded as the poorest state with limited state resources and urbanization rate of only 42.4%, the lowest in Malaysia. In addition, there was an estimated 50,000 Kelantanese living under the poverty line with monthly earnings of less than MYR1000. Reduced food purchasing power together with low caregivers’ education as the result of poverty was common socioeconomic determinants of malnutrition in children in Malaysia [10].

The prevalence of malnutrition (underweight and overweight or obese) among children and adolescents with LD in Kelantan raised our major concerns as it recorded around two folds higher rate than the general children population in Kelantan (19.7%) [14]. The prevalence of overweight or obesity among study participants is consistent with a French study [5].

Surprisingly, the prevalence for underweight was much higher than study by Mikulovic et al. (5.4%) but almost similar with an Asian study by Lin et al. (2010) (28.1%). Higher prevalence of malnutrition (41.0% for underweight; 46.7% for overweight and obesity) was significantly observed among participants in early adolescence (10-15.99 years) than other age groups \((p<0.05)\). Early adolescence may be challenging as they can spend on food by themselves based on their preferences. Incompetent cognitive capacity and peer influence might further predispose them towards unhealthy eating. Undernutrition may increase risk of co-morbidities and mortalities among children and adolescents with LD. Underweight children are weak and require greater effort from caregivers. On the other hand, overweight and obesity pose greater health risks of chronic diseases such as diabetes mellitus, hypertension, hyperlipidemia and heart disease. Obesity in children with LD may lead to negative social consequences such as stigmatization which can further prevent them from societal participation. This dual burden nutrition problem, which occurred among the most vulnerable group at the rural region, is of paramount importance for public health efforts to be taken place.

Among the socioeconomic variables, diagnosis with Down’s syndrome, birth weight and caregiver’s years of education
were significantly associated with BMI of children and adolescents with LD. Having a diagnosis with Down’s syndrome had a predicted BMI 2.63 higher than those without Down’s syndrome (p<0.001). Although overweight problem is common among children with Down’s syndrome, there is still limited evidence documented on this issue. Genetic and metabolic complications for instance hypo-metabolism and congenital heart disease that are usually seen among this group might be the reasons for increased risk of overweight. In addition, low physical level due to negative behavioural tendency can further predispose those with Down’s syndrome to overweight problem. Thus, nutrition education programs with creative delivery methods such as using multimedia could be useful to teach healthy eating among children with exceptional learning needs.

Besides, birth weight was also shown to be positively associated with participant’s BMI. When there was an increase of 100g of birth weight, a child’s BMI would be 0.14 units higher. Birth weight has been shown to associate positively with obesity [17, 18]. However, latest evidence showed that being born with low birth weight (<2kg) may also increase the risk of becoming overweight later in life due to ‘catch-up growth’ or ‘BMI rebound’ effect [18]. In the present study, caregiver’s years of education had an inversely association with children’s BMI. A 1-year increase in caregiver’s years of education decreased predicted BMI by 0.26kgm⁻². Lower caregiver’s educational level is commonly associated with poor parental nutrition knowledge and eventually poses a direct impact on the children’s malnutrition. Culturally-appropriate and behaviourally focused nutrition program could be implemented among rural mothers as positive nutrition practice in mothers may benefit the nutritional status of whole family especially the children.

On the contrary, no association was found between household income and participants’ BMI though previous studies had documented that higher household income had predicted a reduced BMI [19] and overweight risk [18]. The possible reason was that there was not much variation in the participants’ household income as 50% of them having monthly income of less than MYR500 (equivalent to USD 160). Moreover, misreporting might also a problem as the caregivers only able to report an estimated family income during data collection. Besides, ambulatory youths with disabilities tend to become obese than non-ambulatory youths [20] and physically disabled youths [7]. BMI was lower in people with seizure as compared to control since they had more food-related difficulties and required greater demand of help from others during meals [21]. However, ambulatory and seizure status did not found to be associated with BMI in current study.

For the feeding variables, not needing food texture modification had relatively strong association with BMI for children and adolescents with LD. Those who did not require food texture modification were predicted of having 2.63 higher BMI than those who needed it. On the other hand, when the child’s eating duration was increased by 10 minutes, his BMI would be 0.6 units lower. Feeding difficulties occurred in over 50% of children with intellectual disabilities [22]. Inability to feed by own-self, having chewing and swallowing difficulties and longer duration of meals considerably increased risk of under-nutrition and impaired child’s growth [22]. Nevertheless, eating ability (self fed or fed by others) was not significantly
associated with participant’s BMI in the present study. More time and effort from caregivers were required to process the food that was suitable for their disabled children. Liquefied food or semi-solid texture though is more acceptable, without considering the adequacy of calories, may cause nutrition deficiency and compromised the BMI among children with eating difficulties. Hence, parenting children with disabilities is another issue of concern.

This study had some limitations. Missing data was evident. This was mainly due to the absence of caregivers during interviews; inability to recall data such as birth weight and age of weaning; caregiver to be interviewed was not the mother or the one who care for the child during birth and infancy; and some of them could not be contacted through telephone calls. Furthermore, physical activity and sedentary behaviour of the children and adolescents with LD were not taken into account as most of the caregivers failed to respond on the type and duration their children spent on such activities.

Conclusions

This study reported a remarkable prevalence of malnutrition (22.5% of underweight; 22.1 % of overweight and obesity) among children and adolescents with LD in Kelantan, Malaysia. Diagnosis with Down’s syndrome, birth weight, caregiver’s years of education, eating duration and food texture modification were among the significant socioeconomic and feeding factors affecting BMI of the participants. Nonetheless, other related factors though insignificantly documented in current study, should also be given attention. Hence, these findings would be helpful for the public health care system to initiate socio-cultural sensitive, appropriate and effective prevention as well as rehabilitation strategies in order to provide sustainable optimal services for this vulnerable population.

Acknowledgements

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