

ECOLOGICAL FACTORS INFLUENCING OVERWEIGHT STATUS AMONG PRIMARY SCHOOL CHILDREN LIVING IN BANGKOK

Benchaporn Sukprasert¹, Siriorn Sindhu^{2*}, Rungnapa Panitrat³, and Chukiat Viwatwongkaserm⁴

Received: July 23, 2018; Revised: November 11, 2018; Accepted: November 11, 2018

Abstract

Overweight status in children is a global public health problem and in Thailand, Bangkok has the most prevalence. This case-control study aimed to identify the ecological factors which include individual and socio- environmental factors in the family and school associated with overweight status among Bangkok school children in the 4th to 6th grades. The study's participants included 510 children and 52 class teachers in public and private primary schools. Data were collected using a structured self-administered questionnaire. Using multiple logistic regression analysis to determine significant predictors of overweight status showed that being a boy (aOR 3.13; 95% CI 1.80-5.44) and perceived self-body image as large (aOR 45.74; 95% CI 17.91-116.83) had higher risks of overweight status. Parenting practices with a high coercive control in food eating and physical activity (aOR 0.23; 95% CI 0.09-0.62), and moderate (aOR 0.44; 95% CI 0.19-0.99) and high autonomy support (aOR 0.28; 95% CI 0.11-0.71) in food eating proved to be a protective factor against overweight status. Meanwhile, the physical home environments and school environmental factors were not associated with overweight status. These findings indicated that individual and family environmental factors were the best predictors of overweight status among the children. Thus, the health care system should develop effective and comprehensive strategies that promote healthy eating and physical activity to control weight among children taking into consideration the difference in sex and social home environments.

¹ DNS candidate of Faculty of Nursing, Mahidol University, Salaya, Nakhon Pathom 73170, Thailand.

² Department of Surgical Nursing, Faculty of Nursing, Mahidol University, 2 Wanglang Road, Bangkoknoi, Bangkok 10700, Thailand. Tel. 099- 251- 9592; Fax: 02- 412- 8415; E- mail: siriorn.sin@mahidol.ac.th

³ Department of Mental Health and Psychiatric Nursing, Faculty of Nursing, Mahidol University, Salaya, Nakhon Pathom 73170, Thailand.

⁴ Department of Biostatistics, Faculty of Public Health, Mahidol University, Ratchathewi, Bangkok 10400, Thailand.

* Corresponding author

Keywords: Ecological factors, overweight status, primary school children, healthy eating, physical activity

Introduction

Childhood overweight and obesity are major public health concerns worldwide and have dramatically increased over the past few decades in both developed and developing countries (Ng *et al.*, 2014) including Thailand. The surveillance and monitoring of nutritional status by the Department of Health, Ministry of Public Health showed that the prevalence of childhood overweight and obesity between the ages of 6-14 years had increased to 13.7% in 2010 and 17% in 2011 (Bunsuk *et al.*, 2014). The government sectors have led a campaign with various national policies or activities addressing childhood obesity related to the World Health Organization's (WHO) global strategy on diet, physical activity, and health in 2004 and 2008 (WHO, 2015a, 2015b). Examples are "Foods for Children" to limit food advertising to children on prime-time television, "Sweet Enough Network" to campaign against the sales of sugary beverages at schools, and "Moderate Class, More knowledge" to cut class hours and increase extra-curricular activities including sports (Teerawattananon and Luz, 2017) in order to reduce the overweight and obesity prevalence to less than 10% by 2017 (Bunsuk *et al.*, 2014). Consequently, the prevalence of childhood overweight and obesity between the ages of 5-14 years remarkably decreased into a range from 8.9% to 9.9% between 2013 and 2015 (Bureau of Nutrition, 2015); but, the prevalence of childhood overweight and obesity between the ages of 6-11 years in Bangkok in 2012 was still higher than 10%, and accounted for 13.48% (Health Promotion Division, 2013). It demonstrated that the management of intervention programs in preventing or reducing the overweight status in children might not be suitable for the precise causes of childhood overweight and obesity which nowadays include the life styles of children living in Bangkok that are different from the past. Thai children in generations Y and Z have more sedentary behaviors and less

physical activity at the ages of 5-6 years (Institute for Population and Social Research, 2016) when compared to the Fourth National Health Examination Survey in 2008-2009 (Aekplakorn, 2011). Sirikulchayanonta *et al.* (2011) also found that children in Bangkok were eating more than 3 meals a day, favored eating high caloric and sugary foods and drinks, and watched television more than 2 hours per day.

There are various individual and socio-environmental factors in family and school that influence eating, physical activity, and sedentary behaviors related to weight status among children (Glanz *et al.*, 2008). Meanwhile, most studies in Thailand have explored the relationship between childhood overweight status and children's eating and physical activity behaviors at the individual level. Some studies examined the associations amongst family environmental factors but rarely studied the relationship between school environmental factors. Consequently, the findings of previous studies still were not able to identify what were the significant factors influencing childhood overweight and obesity among all individual, family, and school factors.

The empirical research findings from international studies indicated that various individual and environmental factors in family and school were associated with the overweight status in children, namely, daily school pocket money, self-efficacy towards healthy eating and physical activity, cognitive eating behaviors, social and physical home environment, school type and location, school food and physical environments, teaching practices, and teacher skills/attitudes, and knowledge towards healthy eating and physical activity for children; but they never have been examined in previous Thai studies. From literature reviews, the prevalence of overweight status among children in different school types in Bangkok including

public primary schools under the Department of Education of the Bangkok Metropolitan Administration (EDU, BMA) and Office of the Basic Education Commission (OBEC), and private primary schools under the Office of the Private Education Commission (OPEC), Ministry of Education were very different (Health Promotion Division, 2013). Various school types located in the inner city and urban fringes of Bangkok might reflect the diversity in the social and economic status of families, school food, and physical activity environments that can impact eating, physical activity behaviors, and weight status among children. Thus, these factors could be significantly associated with overweight status and were the best predictors of the overweight status among children in Bangkok.

The purposes of this study were to determine the factors that are associated with overweight status and were the best predictors of overweight status among primary school children in the current society of Bangkok by applying an ecological model (McLeroy *et al.*, 1988) to direct consideration to the eating and physical activity behaviors related to individual and environmental influences in an ecological perspective, in which the child had direct contact or interaction with his/ her surroundings particularly at family and school. The study's findings could be a contribution to develop multifactorial overweight preventive strategies and implement effective intervention programs which are both for improving the eating and physical activity behaviors and reducing the overweight status sustainably, and are suitable for the differences in individual, family, and school environments.

Materials and Methods

Study Design and Setting

A case-control study design was conducted to examine the individual and socio-environmental factors in the family and school that influence the overweight status among primary school children in the 4th to 6th grades in Bangkok. The sample size of children was selected by the stratified multi-stage random

sampling of districts, schools, and classrooms, respectively. One district was in the inner city and another district was in an urban fringe of Bangkok; each district comprised 2 public primary schools under the EDU, BMA and OBEC, and 1 private primary school under OPEC.

The study protocol was approved by the ethical committee of the Institutional Review Board, Nursing (IRB-NS) (COA No. IRB-NS 2017/400.2203), Faculty of Nursing, Mahidol University, Thailand. Written informed consent was obtained from the parents, class teachers, and child assent before collecting data, and confidentiality was assured.

Participants

The study participants consisted of 1060 children and their 53 class teachers in the 4th to 6th grades from 6 primary schools who were invited and gave their consent to participate in the study between June and August, 2017. Children who had medical conditions related to body weight were excluded from the study.

The body weights and heights of the children were collected from the schools' health records taken within 1 month in the recent semester; there was a weight scale to the nearest 0.1 kg and height was measured to the nearest 0.1 cm to calculate the BMI z-score, using the WHO AnthroPlus software version 1.0.4. (WHO, 2017). Weight status was determined according to the cutoffs of the WHO Growth Reference 2007 (WHO, 2015c). Of 1060 children, 426 had an overweight status including overweight and obesity (BMI-z score $> +1SD$) and 634 had normal weight (BMI-z score between $-2SD$ and $+1SD$).

Research Instruments

Research instruments for collecting data of individual, family, and school environmental characteristics that are the demographic characteristics of the children and family questionnaire and a self-report survey to measure a school's food and physical activity environment were developed by the researchers. The Self-Efficacy for Healthy Eating and Physical Activity measure (SE-HEPA) for preadolescents, Weight-Related

Eating Questionnaire (WREQ), Healthy Home Survey (HHS) Questionnaire, and Teacher Questionnaire originated in the West and were translated into Thai through the back-translated method to ensure culturally equivalent versions of the questionnaires in the Thai language. The modified Thai versions were judged by 5 Thai experts to ensure content equivalence/cultural validity with a pilot test for reliability; an internal consistency (Cronbach coefficient alpha) was carried out among 33 primary school children and 15 class teachers in the 4th to 6th grades as described below.

Individual and Family Environmental Characteristics (Children Report)

1) The demographic characteristics of the children and family comprised sex, current main caregiver, number of siblings, household's economic status, parental education level, daily school pocket money, and perceived self-body image and parental body image by comparing with a body figure drawing (Collins, 1991; Montoya *et al.*, 2016).

2) The SE-HEPA for preadolescents (16 items) was developed by Steele *et al.* (2013) to evaluate the child's confidence and belief in his or her ability to perform the appropriate healthy eating and physical activity behaviors with a Likert scale, ranging from 'disagree a lot = 1' to 'agree a lot = 5' ($\alpha = 0.79$).

3) The WREQ (16 items) was developed by Schembre *et al.* (2009) to explore the cognitive eating behaviors: routine restraint, compensatory restraint, susceptibility to external cues, and emotional eating. A Likert scale with the score ranging from 'not at all descriptive of me = 1' to 'very much descriptive of me = 5' ($\alpha = 0.83$) was used.

4) The HHS questionnaire via a modified version of the original instrument (65 items) was developed by Bryant *et al.* (2008) to measure the perceived family environmental characteristics of the children including food availability and accessibility, physical activity, and media availability with 'yes = 1' and 'no = 0' scale response options; and parenting practices with coercive control, autonomy support, and structure given a Likert scale response options ranging from 'always = 5' to

'never = 1', taking into consideration reverse scoring on negative items ($\alpha = 0.76$).

School Environmental Characteristics (Teacher Report and Observed)

1) The Teacher Questionnaire (16 items) requiring 46 responses was developed by Wilson *et al.* (2013) to assess teaching practices, teacher skills/attitudes and knowledge towards healthy eating and physical activity for children. Teaching practices towards healthy eating and physical activity had a rating score on a Likert scale for responses from 'not used = 1' to 'daily = 5' inclusion in the school curriculum, and training/experience in healthy eating and physical activity rated on a Likert scale, ranging from 'not at all = 1' to 'a lot = 4'. Teacher skills rated on a Likert scale for responses with 'none = 1' to 'a lot = 4' and some items were reported with scale 'yes = 1' and 'no = 0'. Teacher attitudes rated on a Likert scale for responses with 'very much disagree = 1' to 'very much agree = 5' and reversed scores on some items, e.g. "Unsure of ability to teach fruit and vegetables", "Encourage to eat fruit and vegetables is responsibility of family, not school", and "Not important teacher to role model physical activity". Teacher knowledge was given a correct response with a value of 1 and incorrect response received a value of 0 ($\alpha = 0.72$).

2) A Self-Report Survey to Measure School Food and Physical Activity Environment (22 items) included school types and locations, school physical activity facilities and equipment, and food availability or foods/ beverages sold in school. All items were reported with a scale 'yes = 1' and 'no = 0'. Reversing scores were given on the unhealthful foods and beverages categories sold in school.

Data Analysis

SPSS/FW version 22.0 was used for data analysis, using descriptive statistics to summarize the demographic characteristics of the participants. The multiple binary logistic regression was analyzed for the predictors of overweight status among children at a 95% interval. The odds ratio (OR) and its 95% confidence interval (CI) were estimated and computed for

each categorical factor. All independent variables whose ORs for overweight status demonstrated a P -value <0.2 in the univariate analysis were included in a multivariate model with the enter and forward conditional method to calculate the OR adjusted for the effect of other variables. A categorical factor with an OR significantly ($p < 0.05$) higher than 1.00 was taken as a risk factor of childhood overweight status, whereas an OR significantly ($p < 0.05$) less than 1.00 was mentioned as a protective factor.

Results and Discussion

Participant Characteristics

Of the participants, a total of 510 (48.1%) children and 52 class teachers completed the entire protocol. Classified by weight status, 287 (56.3%) children were normal weight and 223 (43.7%) children had overweight status. The mean age of the children was 10.62 years. Most class teachers were females with an average age 42.21 years, experience working time average 12.18 years, and the highest education level was bachelor degree (71.2%).

Factors Associated with Overweight Status among Primary School Children

In univariate analysis, as presented in Table 1, a number of individual factors appeared to be significantly associated with overweight status ($p < 0.05$) including being a boy (OR 1.92, 95% CI 1.35-2.74), perceived self-body image as large (OR 41.98, 95% CI 17.44-101.08), received daily school pocket money more than or equal to 50 baht (OR 1.44, 95% CI 1.01-2.05), cognitive eating behaviors with moderate and high routine restraint (OR 1.76, 95% CI 1.20-2.60 and OR 2.05, 95% CI 1.16-3.62, respectively), including moderate and high compensatory restraint (OR 1.73, 95% CI 1.18-2.52 and OR 2.00, 95% CI 1.11-3.62, respectively). Family environmental factors were significantly associated with overweight status, namely, paternal body image overweight (OR 1.78, 95% CI 1.21-2.62) and obesity (OR 3.27, 95% CI 1.66-6.43), maternal body image overweight (OR 1.89, 95% CI 1.29-2.76) and

obesity (OR 3.32, 95% CI 1.76-6.26). Meanwhile, parenting practices with moderate and high autonomy support in food eating for their children were a negatively significant association with overweight status and obesity (OR 0.31, 95% CI 0.17-0.57 and OR 0.23, 95% CI 0.12-0.44, respectively). Surprisingly, self-efficacy towards healthy eating and physical activity, paternal and maternal education level, physical home environment, including all school environmental factors, were not significantly associated with overweight status among the children ($p > 0.05$).

Factors Influencing Overweight Status among Primary School Children

As shown in Table 2 on the multivariate analysis, sex, perceived self-body image, parenting practices with coercive control in eating and physical activity behaviors, and autonomy support in food eating for children were significantly associated with overweight status among the children ($p < 0.05$) and could explain 58% of the variance in overweight status among them. Compared with girls, boys had 3-fold higher odds of having overweight status (aOR 3.13, 95% CI 1.80-5.44). Children who perceived their self-body image as large had 46-fold higher odds of having overweight status (aOR 45.74, 95% CI 17.91-116.83) compared with those who perceived their self-body image as thin. Regarding social home environment, parenting practices with high coercive control in eating and physical activity (aOR 0.23, 95% CI 0.09-0.62) and moderate and high autonomy support in food eating (aOR 0.44, 95% CI 0.19-0.99 and aOR 0.28, 95% CI 0.11-0.71, respectively) were associated with a decreased likelihood of overweight status compared with those who had parenting practices with low coercive control and low autonomy support.

Discussion

The study was conducted to identify the factors most strongly associated with overweight status among primary school children in Bangkok. Regarding individual factors, boys

Table 1. Univariate logistic regression analysis of factors associated with overweight status among primary school children

Factors	Normal weight n (%)	Overweight status n (%)	Crude OR (95% CI)	P-value
Sex				
Girls	175 (61.0)	100 (44.8)	Reference	
Boys	112 (39.0)	123 (55.2)	1.92 (1.35-2.74)	0.000*
Paternal education level				
< High school	82 (37.4)	69 (41.6)	Reference	
High school	61 (27.9)	40 (25.6)	0.88 (0.53-1.48)	0.633
> High school	76 (34.7)	55 (35.5)	0.97 (0.60-1.57)	0.910
Maternal education level				
< High school	90 (40.2)	69 (41.6)	Reference	
High school	56 (25.0)	44 (26.5)	1.03 (0.62-1.70)	0.924
> High school	78 (34.8)	53 (31.9)	0.89 (0.55-1.42)	0.614
Paternal body image				
Non-overweight	121 (42.6)	61 (27.7)	Reference	
Overweight	146 (51.4)	131 (59.5)	1.78 (1.21-2.62)	0.004*
Obesity	17 (6.0)	28 (12.7)	3.27 (1.66-6.43)	0.001*
Maternal body image				
Non-overweight	146 (51.6)	74 (33.8)	Reference	
Overweight	118 (41.7)	113 (51.6)	1.89 (1.29-2.76)	0.001*
Obesity	19 (6.7)	32 (14.6)	3.32 (1.76-6.26)	0.000*
Self-body image				
Thin	37 (12.9)	24 (10.8)	Reference	
Average	122 (42.5)	118 (52.9)	1.77 (0.68-4.59)	0.241
Large	128 (44.6)	81 (36.3)	41.98 (17.44-101.08)	0.000*
Daily school pocket money (Baht)				
<50	145 (50.5)	92 (41.4)	Reference	
≥50	142 (49.5)	130 (58.6)	1.44 (1.01-2.05)	0.042*
Self-efficacy toward healthy eating (8-40)				
Low (<19)	30 (10.5)	21 (9.4)	Reference	
Moderate (19-29)	124 (43.2)	108 (48.4)	1.24 (0.67-2.30)	0.486
High (>29)	133 (46.3)	94 (42.2)	1.01 (0.54-1.87)	0.976
Self-efficacy toward physical activity (8-40)				
Low (<19)	37 (12.9)	24 (10.8)	Reference	
Moderate (19-29)	122 (42.5)	118 (52.9)	1.49 (0.84-2.64)	0.171
High (>29)	128 (44.6)	81 (36.3)	0.98 (0.54-1.75)	0.934
Cognitive eating behaviors				
a) Routine restraint (3-15)				
Low (<7)	127 (44.6)	68 (30.6)	Reference	
Moderate (7-11)	127 (44.6)	120 (54.1)	1.76 (1.20-2.60)	0.004*
High (>11)	31 (10.9)	34 (15.3)	2.05 (1.16-3.62)	0.013*
b) Compensatory restraint (3-15)				
Low (<7)	137 (48.1)	76 (34.2)	Reference	
Moderate (7-11)	121 (42.5)	116 (52.3)	1.73 (1.18-2.52)	0.005*
High (>11)	27 (9.5)	30 (13.5)	2.00 (1.11-3.62)	0.021*
c) Susceptibility to external cues (5-25)				
Low (<12)	127 (44.3)	90 (40.4)	Reference	
Moderate (12-18)	113 (39.4)	101 (45.3)	1.26 (0.86-1.85)	0.232
High (>18)	47 (16.4)	32 (14.3)	0.96 (0.57-1.62)	0.881

Abbreviations: OR, odds ratio; CI, confidence interval; * P-values ($p < 0.05$)

Table 1. Univariate logistic regression analysis of factors associated with overweight status among primary school children (continued)

Factors	Normal weight n (%)	Overweight status n (%)	Crude OR (95% CI)	P-value
d) Emotional eating (5-25)				
Low (<12)	197 (68.6)	137 (61.4)	Reference	
Moderate (12-18)	72 (25.1)	72 (32.3)	1.44 (0.97-2.13)	0.070
High (>18)	18 (6.3)	14 (6.3)	1.12 (0.54-2.32)	0.764
<u>Physical home environment</u>				
a) Unhealthy food availability at home in the past week				
None	10 (3.5)	13 (5.9)	Reference	
1-3 items	105 (37.1)	109 (49.8)	0.80 (0.33-1.90)	0.611
4-7 items	168 (59.4)	97 (44.3)	0.44 (0.19-1.05)	0.065
b) Unhealthy food accessibility				
None	9 (3.3)	7 (3.4)	Reference	
1-3 items	152 (56.5)	129 (62.0)	1.09 (0.39-3.01)	0.866
4-5 items	108 (40.1)	72 (34.6)	0.86 (0.30-2.40)	0.770
c) Healthy physical activity availability				
None	13 (4.6)	14 (6.4)	Reference	
1-2 items	165 (58.7)	132 (60.3)	0.74 (0.34-1.63)	0.460
3 items	103 (36.7)	73 (33.3)	0.66 (0.29-1.48)	0.313
d) Media availability				
None	1 (0.4)	1 (0.5)	Reference	
1-3 items	187 (66.8)	147 (67.1)	0.79 (0.05-12.67)	0.865
4-5 items	92 (32.9)	71 (32.4)	0.77 (0.05-12.55)	0.856
<u>Social home environment</u>				
a) Coercive control (12-60)				
Low (<28)	77 (27.4)	58 (26.5)	Reference	
Moderate (28-44)	168 (59.8)	147 (67.1)	1.16 (0.77-1.74)	0.470
High (>44)	36 (12.8)	14 (6.4)	0.52 (0.25-1.04)	0.066
b) Autonomy support (5-25)				
Low (<12)	18 (6.3)	42 (18.8)	Reference	
Moderate (12-18)	190 (66.2)	139 (62.3)	0.31 (0.17-0.57)	0.000*
High (>18)	79 (27.5)	42 (18.8)	0.23 (0.12-0.44)	0.000*
c) Structure (3-15)				
Low (<7)	34 (12.0)	21 (9.5)	Reference	
Moderate (7-11)	197 (69.4)	173 (78.6)	1.42 (0.79-2.54)	0.235
High (>11)	53 (18.7)	26 (11.8)	0.79 (0.39-1.63)	0.530
<u>School environment</u>				
School type				
Public schools under EDU, BMA	121 (42.2)	98 (43.9)	Reference	
Private schools under OPEC, MOE	76 (26.5)	65 (29.1)	1.06 (0.69-1.61)	0.802
Public schools under OBEC, MOE	90 (31.4)	60 (26.9)	0.82 (0.54-1.25)	0.365
School location				
Inner city	139 (48.4)	113 (50.7)	Reference	
Urban fringe	148 (51.6)	110 (49.3)	0.91 (0.64-1.30)	0.616
Healthy school food environment (0-14)				
Low (<7)	261 (90.9)	201 (90.1)	Reference	
High (≥7)	26 (9.1)	22 (9.9)	1.10 (0.60-2.00)	0.757

Abbreviations: EDU, BMA, Department of Education Bangkok Metropolitan Administration; OBEC, Office of the Basic Education Commission; OPEC, Office of the Private Education Commission; OR, odds ratio; CI, confidence interval; * P-values ($p < 0.05$)

Table 1. Univariate logistic regression analysis of factors associated with overweight status among primary school children (continued)

Factors	Normal weight n (%)	Overweight status n (%)	Crude OR (95% CI)	P-value
Healthy school physical activity environment (0-6)				
Low (<4)	79 (27.5)	70 (31.4)	Reference	
High (≥4)	208 (72.5)	153 (68.6)	0.83 (0.57-1.22)	0.341
Teaching practices				
a) Healthy eating				
Low (<20)	230 (80.1)	176 (78.9)	Reference	
High (≥20)	57 (19.9)	47 (21.1)	1.08 (0.70-1.66)	0.735
b) Fruit and vegetables				
Low (<16)	203 (70.7)	158 (70.9)	Reference	
High (≥16)	84 (29.3)	65 (29.1)	0.99 (0.68-1.46)	0.976
c) Physical activity				
Low (<30)	240 (83.6)	193 (86.5)	Reference	
High (≥30)	47 (16.4)	30 (13.5)	0.79 (0.48-1.30)	0.361
Teacher skills/attitudes				
a) Healthy eating				
Low (<7)	130 (45.3)	108 (48.4)	Reference	
High (≥7)	157 (54.7)	115 (51.6)	0.88 (0.62-1.25)	0.482
b) Fruit and vegetables				
Low (<24)	209 (72.8)	168 (75.3)	Reference	
High (≥24)	78 (27.2)	55 (24.7)	0.88 (0.59-1.31)	0.521
c) Physical activity				
Low (<31)	213 (74.2)	168 (75.3)	Reference	
High (≥31)	74 (25.8)	55 (24.7)	0.94 (0.63-1.41)	0.773
Teacher knowledge				
Correct 0-1 item	222 (77.4)	174 (78.0)	Reference	
Correct 2-4 items	65 (22.6)	49 (22.0)	0.96 (0.63-1.46)	0.856

Abbreviations: OR, odds ratio; CI, confidence interval; * P-values ($p < 0.05$)

were more likely to have overweight status compared with girls which was consistent with previous studies (Lee and Ham, 2015; Liu *et al.*, 2016). Maruf *et al.* (2013) indicated that boys and girls differ in body composition, patterns of weight gain, hormone biology, and boys had a higher body weight during early childhood and girls had a higher prevalence of being overweight than boys only in the age groups 11-14 years and 15-18 years. Children who perceived their self-body image as large had an increased risk of having overweight status when compared with those who perceived their self-body image as thin. Overweight and obese children need more energy food intake to maintain their energy balance related to body weight; subsequently, they might have

a higher risk of overconsumption leading to overweight or obesity. dos Passos *et al.* (2015) indicated that overweight or obese children had a greater response to food, pleasure in eating, and increased food intake due to the emotional state and a greater desire for beverages; meanwhile, they had a lower response to satiety and a faster eating pattern when compared to normal weight children. Children who received a higher daily amount of pocket money were more likely to have overweight status than those who received a lower amount which was consistent with previous studies (Mwaikambo *et al.*, 2015; Li *et al.*, 2017). Children who received more money more often had sugar- sweetened drinks, snacks, fast food, or ate at street food

Table 2. Multivariate logistic regression analysis of factors associated with overweight status among primary school children

Factors	Enter method			Forward conditional method		
	B	Adjusted OR (95% CI)	P-value	B	Adjusted OR (95% CI)	P-value
Sex						
Girls		Reference			Reference	
Boys	1.124	3.08(1.73-5.48)	0.000*	1.140	3.13(1.80-5.44)	0.000*
Paternal body image						
Non-overweight		Reference				
Overweight	0.339	1.40(0.79 -2.50)	0.249			
Obesity	0.964	2.62(0.89-7.70)	0.079		-	-
Maternal body image						
Non-overweight		Reference				
Overweight	0.372	1.45(0.81-2.59)	0.208			
Obesity	0.507	1.66(0.64-4.31)	0.297		-	-
Self-body image						
Thin		Reference			Reference	
Average	0.206	1.23(0.44-3.41)	0.693	0.342	1.41(0.52-3.82)	0.501
Large	3.629	37.68(14.29-99.38)	0.000*	3.823	45.74(17.91-116.83)	0.000*
Daily school pocket money (Baht)						
< 50		Reference				
≥ 50	0.124	1.13(0.65-1.98)	0.664		-	-
Self-efficacy towards healthy physical activity						
Low		Reference				
Moderate	0.254	1.29(0.53-3.12)	0.574			
High	-0.457	0.63(0.25-1.58)	0.326		-	-
Cognitive eating behaviors						
a) Routine restraint						
Low		Reference				
Moderate	0.323	1.38(0.74-2.58)	0.311			
High	0.608	1.84(0.71-4.75)	0.210		-	-
b) Compensatory restraint						
Low		Reference				
Moderate	-0.033	0.97 (0.51-1.82)	0.918			
High	0.219	1.24 (0.44-3.54)	0.681		-	-
c) Emotional eating						
Low		Reference				
Moderate	0.215	1.24 (0.66-2.34)	0.506			
High	-0.457	0.63 (0.21-1.94)	0.423		-	-
Social home environment						
a) Coercive control						
Low		Reference			Reference	
Moderate	-0.151	0.86 (0.45-1.63)	0.643	-0.126	0.88 (0.48-1.62)	0.685
High	-1.604	0.20 (0.07-0.58)	0.003*	-1.465	0.23 (0.09-0.62)	0.004*
b) Autonomy support						
Low		Reference			Reference	
Moderate	-0.800	0.45 (0.19-1.09)	0.076	-0.829	0.44 (0.19-0.99)	0.048*
High	-1.209	0.30 (0.11-0.82)	0.019*	-1.283	0.28 (0.11-0.71)	0.007*
Physical home environment						
Unhealthy food availability						
None		Reference				
1-3 items	0.118	1.13 (0.29-4.29)	0.863			
4-5 items	-0.388	0.68 (0.18-2.57)	0.568		-	-

Abbreviations: OR, odds ratio; CI, confidence interval; * P-values ($p < 0.05$)

stalls and had a higher risk of being overweight and obese (Li *et al.*, 2017). The study's findings found that higher routine restraints and compensatory restraints were positively associated with overweight status. It was consistent with previous studies (Angle *et al.*, 2009; Munguia-Lizarraga *et al.*, 2015). Nevertheless, the finding that emotional eating was not a significant difference between weight categories was contradictory with previous studies (Angle *et al.*, 2009; Schembre and Geller, 2011).

The paternal and maternal education level was not significantly associated with overweight, which was contradictory with previous studies. The prevalence of overweight and obese children was significantly higher in parents with a low educational level (Smetanina *et al.*, 2015) than a high educational level (Liu *et al.*, 2016). Paternal and maternal body image had a significant association with overweight status, which was consistent with previous studies (Khader *et al.*, 2009; Parikka *et al.*, 2015). Parental obesity may increase the risk of obesity through genetic mechanisms or by shared familial characteristics in the environment such as food preferences (Khader *et al.*, 2009) and the cultural resources of the family (Lazzeri *et al.*, 2014).

An interesting finding was that the availability of more unhealthful foods in homes was not associated with overweight status. It was in contrast with a previous finding that children were more likely to be normal weight and less likely to be overweight or obese when there were more vegetables and healthful foods available in homes (Arcan *et al.*, 2013). The families of overweight and obese children had less available unhealthful foods than the families of normal weight children. A possible explanation is that parents of overweight and obese children may be concerned about their children's body weights, resulting in providing less unhealthful foods in homes. Also, overweight and obese children could have sweet and high fat foods at school or activities away from the home, and when they were outside the home high calorie snacks were more available than in the home (Gattshall *et al.*, 2008).

The availability of home media was not significantly associated with overweight status, in contrast with previous findings (Chaput *et al.*, 2014; Ferrari *et al.*, 2015). Additionally, the available home physical activity was not significantly associated with overweight status, similar to previous findings (Gattshall *et al.*, 2008; Maitland *et al.*, 2013). There were available yards, bikes or riding toys, or adequate play space inside the home to do physical activity; but children may not be physically active and might have more sedentary behavior than physical activity.

Parenting practices with a higher autonomy support in food eating could decrease the risk of overweight status. When parents restricted their children's fat and sugar intake, children were more likely to get rid of these foods but then eat the forbidden foods even when they were full; or restricting children's access to unavoidable foods may motivate increased preferences for restricted foods (Larsen *et al.*, 2015). Interestingly, the parents' practice towards their children with a high coercive control in food eating and physical activity correlated with a decreased probability of having overweight status. Regarding Thai culture and society, children will obey their parents and follow the parenting strategy to manage how much, when, and what children should do as part of the cultural socializing of their children. Parents may be concerned about their children's body weight; subsequently, they use restrictive and monitoring feeding practices (Couch *et al.*, 2014). In addition, parents can also influence and increase their children's physical activity by monitoring time spent on screen activities and keeping time for children to play outdoors (Loprinzi *et al.*, 2012).

The school type, school location, and school food and physical activity environment were not influencing factors on overweight status among children. It could be explained that all school types had a similar school health policy related to the national policies or activities addressing childhood obesity from government sectors and had a healthy school physical activity availability and accessibility, such as large areas for playing sport, fixed

playground equipment, and sports equipment. Additionally, schools located in the inner city and urban fringes of Bangkok had a similar food environment surrounding the schools, e.g. food retail stores, convenience stores, and street food. The unhealthful foods sold in schools were not associated with overweight status in children. This finding was consistent with previous studies that children's body weights did not greatly increase even though junk food was available in school and children could purchase it (Datar and Nicosia, 2012). Teaching practices and teacher skills/attitudes and knowledge towards healthy eating and physical activity for children were not associated with overweight status; but, overall the mean scores of these were lower than the target scores. A possible explanation may be that some class teachers might not have been involved in teaching health education, nutrition, and physical education or might not take any responsibility to do activities related to healthy eating and physical activity in school. Additionally, some class teachers have to teach a specific subject by following the contents of each subject in the curriculum. They might not be concerned or apply the teaching related to healthy eating and physical activity into other subjects.

Implications

Implication for Health Care Services

Health care providers should promote action to improve self-efficacy for healthy eating and physical activity and cognitive eating behaviors among children by providing dietary and physical activity counseling programs, and provide education to parents on how to support healthy eating and physical activity for children, for instance, by parent training and family counseling.

Implication for Health Care Policy

The policy makers should develop school health policies to promote healthy eating and physical activity for children through high quality nutrition and physical education, including developing and disseminating standards,

curriculum frameworks, and curriculum guidelines in these subject areas. Additionally, the capacity and knowledge of school teachers should be improved by requiring them to take a course in health education, physical and nutritional education, and nutritional services as part of the professional preparation of primary school teachers.

Implication for Future Research

Future research should focus on the variables and the results of the study in developing preventive intervention program for childhood overweight status. First, using action research for intervention with effective programs in promoting cognitive and behavioral eating and self-efficacy for healthy eating and physical activity for children. Second, a quasi-experimental design is required to assess the efficacy of a family-based intervention to promote a healthy home environment among overweight/obese children. Third, using participatory action research in implementing the effective intervention to improve teacher knowledge, attitudes, and practices towards healthy eating and physical activity for children and create new practices integrated in the school health policy and teaching curriculum.

Limitations

The study's limitations were determining the relationship between family environmental factors and overweight status among children by modifying items in the original manual from interviewing parents to complete items upon children's perception and the adaptation of some scales may have missed important variables in this population. Hence, the study would be more complete if data were collected directly from parents with the original instrument. Moreover, the association of school environmental factors with overweight status among children in this study could not be generalized because the design of this study was conducted with homogeneous schools, locations, and school teachers. Therefore, school environmental factors should be more

investigated in future studies by comparing between the different social and economic status in a variety of school types, school sizes, and school locations in rural and urban areas or other regions of the country.

Conclusions

This study revealed that individual and family environmental factors were significantly influential factors associated with overweight status among primary school children in Bangkok, particularly in the differences in sex, parenting practices with coercive control in food eating and physical activity, and autonomy support in food eating. Meanwhile, the physical home environment, and social and physical school environments were not significantly associated with overweight status. Therefore, the health care system should develop multifactorial overweight preventive strategies and implement effective childhood overweight management programs taking into consideration the differences in sex and social home environments.

Acknowledgments

The authors are deeply thankful to all the participants and their parents, the principals, and school teachers for their cooperation and gratefully acknowledge the Cerebos Health Research Foundation for Thai Society for granting research funding, and BRAND'S Health Research Awards 2017.

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