

Risk Factors Contributing to Overweight among Preschool Children

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Abstract: The aims of this case control study were to investigate host, agent and environmental factors, based on an Ecological- Epidemiological conceptual framework, as determinants of overweight among preschool children. Data were collected by measuring height and weight of preschool children, 36-60 months old, to identify their nutritional status according to growth charts for 2 to 7 year old Thais. All primary caregivers of 102 overweight children (case), and 513 normal weight children (control), provided personal and family data.

Multivariate analysis demonstrated predictive risk factors for children being overweight included: being male; scoring high in food responsiveness; enjoying food; eating food high in fruit fiber; drinking yogurt; watching television more than 2 hours every weekday; and/or, having a mother who was obese or used low pressure feeding techniques. In addition, two healthy behaviors (low intake of sweetened fresh milk/cocoa/yogurt and playing ball) were found to be associated with overweight children; suggesting overweight children engage in some form of healthy behavior. The results may be used to guide the development of health promotion intervention programs, increase awareness of the risk of preschool children becoming overweight and educate families regarding healthier activities and dietary practices.

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Background

An increase in the number of overweight children, worldwide, over the past three decades, indicates this phenomenon has become a global epidemic.¹ The prevalence of overweight preschoolers in Thailand increased from 1.2% in 1995,² to 5.8% in 1996-1997 to 7.9 % in 2004.³ Most strikingly, in 2006, 6.9% of Thais under the age of 5 were found to be overweight. In Thailand, the definition of an overweight child is one who has a

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weight-for-height greater than the median, plus two standard deviations, according to age and sex specific growth charts for 2 to 7 year olds.⁴

The largest percentage of overweight children, throughout Thailand, have been found in homes in municipal areas (10.4%), compared to non-municipal areas (5.5%), with the largest proportion (10.8 %) of overweight Thai children being in the Central Region (Bangkok area).⁵ Given the Nutrition Planning Sub-Committee, under the 9th National Economic and Social Development Plan (2002–2006), stated no more than 10% of Thai children should be overweight, these findings have brought national attention to the problem of overweight Thai children.⁶

Childhood overweight has been recognized as resulting from an interaction between one's environment and genetic propensity for becoming overweight.⁷ However, it appears it is one's environment (i.e. relationships and activities with family, peers, community members and society at large), rather than his/her genetics, that has changed over time.⁸ The nature of these relationships and their related activities have been found to contribute to one's eating behaviors.

A significant concern is that being overweight during childhood is likely to lead to being overweight as an adolescent, as well as during adulthood. Being overweight increases the risk of a number of chronic conditions, such as diabetes mellitus, hypertension, dyslipidemia, coronary heart disease and some cancers.⁹ All of these risk factors have been identified in overweight children as young as five years of age.¹⁰

The preschool years have been identified as a crucial time to study determinants of childhood overweight. Not only is it a time when eating habits are becoming established, this is the period of time that immediately precedes the upswing in body mass index known as adiposity rebound.¹¹ Moreover, the

preschool age has been recognized as the most effective period to promote self-care for successful prevention of adulthood overweight.¹²

Prior studies regarding risk factors for overweight among preschool children have identified risk factors for overweight, including: having a birth weight ≥ 4.0 kilograms; engaging in rapid eating; having overweight parents and relatives;¹³ being male; having parents with a high level of education; being breast feed for a short period of time; and, having a short duration of sleep.¹⁴ In resource-rich countries, risks factors for overweight among children have been found to include: maternal pre-pregnancy body size; maternal smoking during pregnancy; a child's high usage of television/media; a child's short length of time being breastfeed; and a child's limited engagement in physical activity.¹⁵ However, limited research, based upon a theoretical model, has been conducted regarding multi-level factors that influence overweight, or risk factors for overweight.¹⁶

Although much of the current knowledge regarding predictors of overweight among children has come from research conducted in Western countries, a limited number of studies have focused on predictors of overweight among preschoolers in Thailand. These studies have found parental body mass index, family history of overweight, level of family income, lower level of exercise than one's peers, parent's educational level and household income to be predictors of overweight among Thai preschoolers.^{17, 18} In addition, children who: were not breast feed during the first 4 months of life; had a mother with a BMI $> 23 \text{ kg/m}^2$; and, consumed fried sausage and prawn crackers, on a daily basis, have been found to be overweight.¹⁹

Though the etiology of childhood overweight appears common throughout the world, the development of overweight among children may vary among populations that have different cultural

and social backgrounds.¹² Thus, based upon prior research and the fact that limited research has been conducted using a theoretical model, the aims of this case control study were to investigate host, agent

and family environmental factors, based on an Ecological-Epidemiological conceptual framework, as determinants of overweight among preschool children (See **Figure 1**).

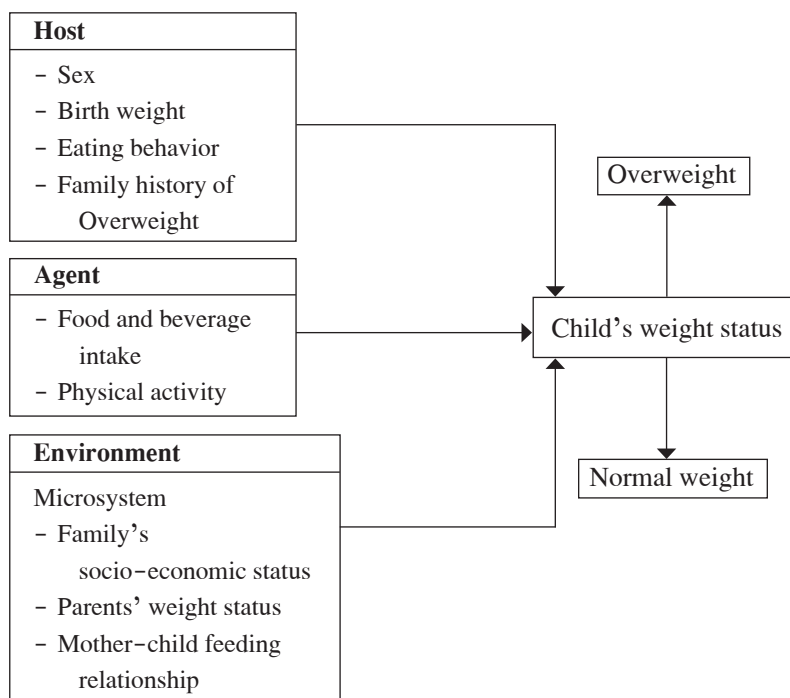


Figure 1 Conceptual Framework for the Study

Method

Design: A retrospective, epidemiological clinical design (case-control) was used, wherein individuals with a specific health care problem (i.e. overweight) were matched with individuals who did not have the same health care problem (i.e. normal weight).²⁰

Ethical considerations: Prior to data collection, approval to conduct the study was obtained from the Research Ethical Review Committee, Faculty of Nursing, Chiang Mai University, and

Directors or Principals of the schools chosen to be study sites. Potential subjects were provided information, via a letter, regarding: the purpose of the study; voluntary involvement; activities related to participation; potential risks and benefits of participation; anonymity and confidentiality; and, the right to decline to answer questions or withdraw from the study at any time. All participants gave signed consent prior to taking part in the study.

Sample size calculations: Sample size calculations were performed to determine the minimum sample size needed for a case control study in which

exposure to potential factors related to overweight among preschool children was proportional. The total number of preschoolers in the study province, on June 10, 2007, was used as the study's sample frame.^{21, 22} Based on information available from previous studies, which presented the significant odds ratio and proportion of exposure to potential factors related to overweight among preschool children, two equations were performed.^{23,24} With a two-tailed alpha level of 0.05 and power of 0.8, a minimum of 77 cases (caregivers of overweight preschoolers) and 385 matched controls (caregivers of normal weight preschoolers) were determined to be an adequate sample size to detect statistically significant relationships among the variables. However, according to the likely number of eligible participants, and adjusting for response rate and missing data, caregivers of 120 overweight preschoolers (cases) and 600 normal weight preschoolers (controls) were recruited. Multi-stage sampling was employed using the following steps:

Step I. Preschools in the selected province were divided, by the Ministry of Education (MOE), into two educational service areas (ESA) ESA 1 and ESA 2.

Step II. Preschools in each ESA were stratified by type (public school and private school). The sample size for each stratum was calculated based on the proportion to size between strata to detect the minimum sample size needed.

Step III. Preschools in each stratum were simple random selected. Cases and controls then were randomly selected from each school. The final sampling included 5 public schools (n of overweight/normal weight = 11/112, 12/63, 2/10, 7/44, and 11/48) and 6 private schools (n of overweight/normal weight = 11/31, 2/15, 8/ 23, 12/57, 15/73, and 11/47) from the two ESAs.

Sample: The final sample consisted of primary caregivers (593 mothers and 22 grandmothers) of 102 overweight children (cases) and 513 normal weight children (controls) who were 36 to 60 months of age and attending preschool classes in 6 private and 5 public schools in a central Thai province known to have a overweight-to-normal weight ratio of 1:5. Inclusion criteria were primary caregivers (mothers or grandmothers) who resided in the same household as overweight preschoolers (weight-to-height above the median range, +2 standard deviations, according to age and gender specific growth charts for 2 to 7 year old Thais)⁴ and normal weight preschoolers (weight-to-height within the median range, \pm 2 standard deviations, according to age and gender specific growth charts for 2 to 7 year old Thais).⁴ Primary caregivers of preschoolers, who suffered from endocrine, metabolic or chronic diseases that may have affected their growth or were underweight (weight-to-height more than 2 standard deviations below the median range according to age and gender specific growth charts for 2 to 7 year old Thais)⁴ were excluded from the study.

Instruments: Data were collected through use of five instruments, including the: Demographic Data Collection Form; Children's Eating Behaviour Questionnaire (CEBQ);²⁵ modified Food Frequency Questionnaire (FFQ);²⁶ modified Physical Activity Questionnaire (PAQ);²⁷ and, Food Parenting Practice (FPP).²⁸ Permission for use and translation of all copyrighted instruments was obtained from the owners of the instruments. The CEBQ and FPP, which had no existing Thai version, were translated into Thai, and then back-translated into English, to make certain no changes in meaning occurred, using the technique suggested by Hilton and Skrutkowski.²⁹

The Demographic Data Collection Form was developed by the primary investigator (PI) to obtain information regarding each preschooler's: class level; gender; age; type of birth; duration of breast feeding; birth order; number of siblings; relationship with any overweight person in the family; and, mother's and father's weight and height. It took approximately 10 minutes to complete the questionnaire.

The Children's Eating Behaviour Questionnaire (CEBQ)²⁵ was a 35-item questionnaire for assessing eating style in young children. It covered seven main dimensions of eating style, including: (a) satiety responsiveness/slowness in eating (i.e. "My child gets full easily"); (b) fussiness (i.e. "My child enjoys tasting new foods"); (c) food responsiveness (i.e. "My child always is asking for food"); (d) enjoyment of food (i.e. "My child enjoys eating"); (e) desire to drink (i.e. "If given the chance, my child always would be having a drink"); (f) emotional under eating (i.e. "My child eats less when she/he is upset"); and, (g) emotional overeating (i.e. "My child eats more when he/she is anxious"). Possible responses included: 1 = never; 2 = seldom; 3 = sometimes; 4 = often; and, 5 = always. The range of scores for each eating style were: 9 to 45 for satiety responsiveness/slowness in eating; 6 to 30 for fussiness; 5 to 25 for food responsiveness; 4 to 20 for enjoyment of food; 3 to 15 for desire to drink; 4 to 20 for emotional undereating; and, 4 to 20 for emotional overeating. A total score, which could range from 35 to 175, was computed by summing the response scores across all items. In this study, preschoolers who received a total score above the median score, for each eating behavior, were identified as being "high" for that behavior. On the other hand, those who received a total score less than, or equal to, the median score were identified as being "low" for that behavior. It took approximately 15 minutes to complete the questionnaire. The original test-retest reliabilities of

the seven subscales ranged from 0.52 – 0.87.²⁵ In this study, a two-week test-retest reliability was conducted on the instrument with the mothers of 30 preschoolers who were representative of the sample, but were not part of the study. Test-retest reliabilities of this instrument were found to range from 0.63 – 0.84.

A revised version of the Food Frequency Questionnaire (FFQ), one part of the Child Rearing Practice 2 (CR2) instrument,²⁶ was used, in this study, to explore, among preschoolers: the type and frequency of foods eaten (n = 35 items); how foods were prepared (n = 6 items); the source of foods eaten (n = 3 items); and, the type of oil used for cooking (n = 3 items). For the type and frequency of foods eaten, foods were classified into two groups: "appropriate" and "inappropriate." "Appropriate" foods were those that did not markedly affect an increase in a child's body weight (i.e. rice, noodles, green vegetables, lean meat, poultry and fish). On the other hand, "inappropriate" foods were those that could greatly affect an increase in body weight (i.e. sweet fruits, sweetened fresh milk, soda/soft drinks, fried potatoes and popcorn). For this study, the PI revised the original questionnaire by adding 25 items, which addressed the types of foods preferred and eaten by preschoolers, to the original 10 items. The 35 food items addressed the type and frequency of foods fed to a child within one year (i.e. "Within the previous year, how often did you feed your child each of the following foods [i.e. green vegetables, lean meats, poultry, yogurt, fish, sweetened condensed milk, soda/soft drinks or popcorn]?"). Responses to the items for "appropriate" foods were coded on a dichotomous scale, where 0 = 3 to 7 times per week and 1 = 0 to 2 times per week, while responses to the "inappropriate" food items were coded on a dichotomous scale, where 0 = 0 to 2 times per week and 1 = 3 to 7 times per week. In addition to the 35 items about the type and

frequency of foods eaten, six cooking items addressed how foods were prepared over the past year (i.e. “Within the previous year, how often did you cook food for your child using each of these types of cooking methods [boiling, steaming, grilling, toasting, baking and deep frying]?”). Responses to the items were coded on a dichotomous scale where 0 = 3 to 7 times per week and 1 = 0 to 2 times per week. Three items addressed the source of food fed to the child over the past year (i.e. “Within the previous year, how often did you provide food for your child from each of these sources [cook at home, buy ready cooked foods or ate at a restaurant]?”). Responses were coded on a dichotomous scale where 0 = 3 to 7 times per week and 1 = 0 to 2 times per week. Lastly, three items addressed the type of oil used for preparing food (i.e. “Within the previous year, how often did you use these types of oils [soy bean/rice bran/sunflower oil, palm/palm-oleine and animal]?”). Responses to the items were coded on a dichotomous scale, where 0 = 3 to 7 times per week and 1 = 0 to 2 times per week. The score for each food item, cooking item, source of the food provided and type of oil used for cooking was independently used in the analysis to determine risk factors. Prior to use, the revised version of the FFQ was reviewed by five experts (1 nutritionist, 1 biochemist, 1 pediatric nursing instructor and 2 nurses knowledgeable in nursing and nutrition). Results of the experts’ review yielded an item-level content validity of 0.80 –1.0 and a scale content validity index average of 0.98. It took approximately 15 minutes for respondents to complete the questionnaire. As part of this study, a two-week test-retest reliability was conducted on the instrument with 30 mothers of preschoolers who were representatives of the sample, but not part of the study. The test-retest reliabilities ranged from 0.79 – 0.86.

The Physical Activity Questionnaire (PAQ)²⁷ was a 19-item questionnaire developed to investigate type, frequency and time used for physical activity of overweight adolescents. Since the instrument was originally developed for adolescents, the PI modified wording in the questionnaire items to more appropriately address preschoolers’ favorite physical (i.e. riding a bicycle, running, playing ball, going down a slide, climbing, dancing and walking) and sedentary (i.e. watching TV, singing, drawing/painting, reading/ listening to a story, playing with blocks/jigsaw puzzles/dolls or playing a board game) activities. For example, “playing football” was changed to “playing ball” and “aerobic dancing” was changed to “dancing and walking.” Examples of items included: (a) “What is the level of your child’s activity compared to other children his/her age?” (responses included: 0 = less than other children; 1 = equal to other children; and, 2 = more than other children); (b) “How long does your child spend watching TV during weekdays/weekends?” (responses included: 0 = ≤ 2 hr/day; and, 1 = > 2 hr/day); (c) “Does your child eat while watching TV?” (responses included: 0 = no; and, 1 = yes); and, (d) “What are your child’s favorite physical/sedentary activities[i.e. playing ball, riding a bicycle, running, going down a slide, climbing, dancing, walking, watching TV, singing, drawing/painting, reading/ listening to a story, playing with blocks/jigsaw puzzles/dolls or playing a board game]?” The primary caregiver could identify more than one activity (physical or sedentary) with responses being coded on a dichotomous scale, where 0 = yes and 1 = no for physical activities, and 0 = no and 1 = yes for sedentary activities. The score for each item response was independently used in the analysis to determine risk factors. Prior to usage, the modified instrument was assessed for content validity by the same five experts that examined the

revised FFQ. The item content validity ranged from 0.60–1.0 and the scale content validity index average was found to be 0.97. One item that yielded a content validity of 0.60 was determined, by two of the experts, to be irrelevant as stated. Thus, based upon the experts' suggestions, the item was restated. Test-retest reliability was not conducted on the instrument, since prior research had found the instrument's reliability to be acceptable.²⁷ It took approximately 5 minutes for respondents to complete the questionnaire.

The Food Parenting Practices (FPP)²⁸ questionnaire consisted of 43 items that measured the primary caregivers' food practices and frequency of those practices in terms of being: (a) permissive (permissive/restriction rules); (b) authoritarian (pressure and encouragement through material reward); and, (c) authoritative (verbal praise and encouragement/discouragement through rationale). Items addressing the type of practice included statements such as: "If my child asks for sweets or biscuits, I will give them to him/her"; and, "My child has to finish the food on his/her plate." All items were measured using a five-point Likert-type scale: 1 = never; 2 = mostly not; 3 = sometimes/sometimes not; 4 = mostly; and 5 = always. Items addressing the frequency of the type of food practices included statements such as: "How often do you tell your child fruit is good for you"; and, "When I compose a meal, I consider the preferences of my child." All items measuring frequency of food practices were assessed on a five-point Likert-type scale: 1 = less than once a week; 2 = once a week; 3 = several times a week; 4 = daily; and, 5 = several times a day. A total score for each of the three types of feeding practices, and the frequency of use, was obtained by summing across all relevant items. In this study, caregivers who obtained a total score, for the specific type of feeding practice and the frequency of its use, above the mean were identified

as being "high" in that specific practice, while those who obtained a total score less than or equal to the median were identified as "low" for that feeding practice and the frequency of its use. In prior research, the internal consistency of the instrument has been found to be 0.71–0.94.²⁸ As part of this study, a two week test-retest reliability was conducted on the instrument with 30 mothers of preschoolers who were representative of the sample, but not part of the study. The test-retest reliabilities ranged from 0.82–0.92. It took approximately 15 minutes for respondents to complete the questionnaire.

Procedure: One month prior to the beginning of data collection, the PI reviewed the health records of all preschoolers within each study site school, for the purpose of classifying the overweight children. Then random selection was performed to obtain the eligible sample. Following random selection, the PI and a research assistant measured the children's heights and body weights, once, in a private setting at each school, to determine the children's weight status.

Preschoolers were weighed wearing school uniforms with empty pockets and without shoes, while their standing heights were measured without shoes. Each preschooler's weight and height was measured, via use of the standard recommended technique (beam balance scale and stadiometer),³⁰ to the nearest 0.1 kg and 0.1 cm, respectively. Weight status was classified via use of a Ministry of Public Health growth reference for 2 to 7 years old Thais.⁴ The PI then classified the children into specific groups as either case or control subjects. One hundred and twenty overweight preschoolers (case) and 600 normal weight preschoolers (control) were identified among the schools.

The selected preschoolers were given a consent form and letter, to take to their primary caregivers. The letter described the study and all related ethical considerations. Primary caregivers interested in taking part in the study were asked to have their

respective preschooler return, to their respective classroom teacher, the signed consent form, along with their names and contact information (i.e. address and phone number). The PI retrieved the caregivers' information and consent forms from the teachers. All interested caregivers then were sent, by whatever means each school used to communicate with parents, an envelope containing the study questionnaires and an explanatory letter in which the primary caregivers were asked to complete and return the questionnaires, within one week, in the sealed envelopes provided, to their respective preschooler's teacher.

A total of 720 questionnaires were distributed (120 to primary caregivers of overweight children and 600 to primary caregivers of normal weight children). One-hundred and two questionnaires (85%) were returned from primary caregivers of overweight preschoolers, while 519 (86.5%) were returned from primary caregivers of normal weight preschoolers. Six (1%) of the questionnaires returned from the normal weight children were excluded because, after a second examination of their height and weight, the children were found to be underweight. Therefore, data from 513 questionnaires (85.5%) from mothers of normal weight children were analyzed.

Data Analysis: Descriptive statistics (i.e. frequencies, percentages, means and standard deviations) were used to assess the characteristics of the study variables. Potential risk factors from overweight children were compared, using Fisher's exact test ($p < .05$), with those of normal weight children. Univariate logistic regression analysis was performed to calculate the odds ratio (OR) and examine the predictive effect of each factor classified in host, agent and environment characteristics on the

risk for overweight. Important risk factors for preschool overweight were further identified by a multivariate logistic regression analysis. All potential risk factors, yielding a significant level ($p < .10$) from the univariate analyses, were simultaneously entered into a multivariate logistic regression analysis. Missing data were excluded from the analyses.

Results

Most overweight and normal-weight children ($n = 77$; 75.5%; and, $n = 419$; 81.7%, respectively) were attending kindergarten. Almost twice as many boys ($n = 64$; 62.8%) as girls ($n = 38$; 37.2%) were overweight, whereas the normal weight group was nearly equally divided between boys ($n = 272$; 53%) and girls ($n = 241$; 47%). Most of the children: were 49 to 60 months old; had been born by normal labor; and, had breastfed for 1 to 3 months. More than half ($n = 352$; 57.2 %) of the children were the first and only child of their parents. The overweight person in the child's family often was the mother for overweight children ($n = 18$ [from 42]; 42.9%), as well as for normal-weight children ($n = 47$ [from 139]; 33.8%).

No significant association was found between any of the demographic characteristics and being an overweight preschooler. **Table 1** lists risk factor variables used in the univariate analysis ($p \leq .10$) and selected for multivariate logistic regression. However, the father's BMI was excluded from the multivariate logistic regression because only 463 cases (75.3%) reported data for this factor. Multivariate analysis yielded 3 host, 5 agent and 2 environmental factors that were predictive of overweight status (see **Table 2**).

Table 1 Potential Risk Factors Significantly ($p \leq .10$) Associated with Being Overweight in Univariate Analysis

Variables	Odds ratio	95% Confidence interval	<i>p</i> value
Host			
Male sex	1.5	0.9–2.4	.081
Eating behavior			
Food responsiveness: high	3.8	2.3–6.4	<.001
Enjoyment of food: high	2.9	1.8–4.7	<.001
Desire to drink: high	1.5	1.0–2.4	.064
Emotional overeating: high	1.5	1.0–2.4	.058
Family history of overweight: Yes	1.8	1.1–2.9	.009
Agent			
Physical activity			
Watching TV during weekday: > 2 hr/day	2.5	1.6–3.9	<.001
Watching TV during weekend: > 2 hr/day	1.8	1.1–2.9	.019
Playing with ball: yes	1.9	1.2–3.1	.005
Food and beverage intake			
High fiber fruits (the lowest sweet):			
0–2 times/week	1.6	1.0–2.5	.039
Sweetened fresh milk and other			
taste/cocoa/yogurt: 0–2 times/week	2.1	1.3–3.3	<.001
Drinking yogurt: 3–7 times/week	1.5	0.9–2.3	.083
Sweets, candy, toffees, chocolate: 3–7			
times/week	0.5	0.2–0.9	.047
Ice cream: 3–7 times/week	0.5	0.3–0.9	.011
Type of cooking			
Boiling (3–7 times/week)	1.6	1.0–2.6	.026
Environment			
Microsystem			
Father's BMI*: >30†	3.1	1.2–7.5	.014
Mother's BMI: >30	4.7	1.9–10.9	<.001
Mother–child feeding relationship			
Pressure: low	1.8	1.0–2.9	.009
Encouragement through material reward: low	1.6	1.0–2.6	.029
Encouragement through negotiation: low	1.5	1.0–2.4	.065

Body mass index, calculated as the weight in kilograms divided by height in meters squared.

† Excluded from multivariate analysis

Table 2 Risk Factors Significantly Associated with Being Overweight in Multivariate Analysis

Variables	Odds ratio	95% Confidence interval	p value
Host			
Male sex	1.8	1.0–3.0	.043
Eating behavior: food responsiveness	3.3	1.7–6.5	<.001
Eating behavior: enjoyment of food	2.1	1.1–3.9	.026
Agent			
Watching television during weekday:			
> 2 hr/day	2.4	1.4–4.2	.001
Playing ball: yes	1.9	1.1–3.3	.026
High-fiber fruit (the lowest sweet):			
0–2 times/week	2.0	1.1–3.4	.015
Sweeten fresh milk and other taste/			
cocoa/yogurt: 0–2 times/week	2.7	1.5–4.7	.001
Drinking yogurt: 3–7 times/week	2.3	1.3–4.0	.004
Environment			
Microsystem			
Mother's BMI*			
<18.5	0.9	0.4–2.3	.876
25–29.9	1.9	0.9–3.9	.068
>30	4.7	1.9–11.4	.001
Mother-child feeding relationship:			
Pressure: low	1.8	1.0–3.0	.045

* Body mass index, calculated as the weight in kilograms divided by height in meters squared.

Discussion

Risk factors for being overweight among preschool children are complex and include factors related to individual children, families and society. These risk factors depend on cultural patterns in each society. Univariate analysis revealed no association between the sex of the preschooler and overweight status. However, multivariate analysis indicated that boys were at a 1.8 times higher risk for being overweight than were girls. The findings were consistent with prior research.¹⁴ There are studies, however, that have found preschool girls are

more at risk for being overweight than are preschool boys.³¹ This difference in risk between boys and girls may be culturally bound. For example, Hispanic and Asian families traditionally place higher value on sons, which may account for early differences in parenting practices to ensure the sons' health and survival.³²

Results of this study show that most overweight children (n = 93; 91.2%) and normal-weight children (n = 463; 90.3%) had normal birth weights. The analyses showed no statistically significant association between preschool overweight and either high or low birth weight. This finding is in contrast

to the results of a number of studies that indicate high birth weight is a significant factor associated with childhood obesity,^{14, 24} although other studies have shown no relationship exists.^{19, 33} Thus, birth weight might be a conditioned factor in the development of obesity in young children.³⁴

This study revealed two risky eating behaviors: high level of food responsiveness and enjoyment of food. Results of a number of previous studies suggest that obese individuals have greater responsiveness to food cues in the external environment and lower sensitivity to internal signals of hunger and satiety.³⁵ However, eating behavior is by and large learned behavior.³⁶ Furthermore, children can self-regulate the amount of food and energy consumed.³⁷ Therefore, results of this study suggest that parents, especially mothers, play an important role in promoting a healthy eating environment for their children.

A significant association was found between childhood overweight and consuming certain foods: high-fiber, non-sweet fruit (0-2 times/week); drinking yogurt (3-7 times/week); sweets/candy/toffees/chocolate (3-7 times/week); and, ice cream (3-7 times/week). Interestingly, a reverse causation was observed for sweetened fresh milk and other taste/cocoa/yogurt (3-7 times/week). Furthermore, a significant association was found between childhood overweight and eating "boiled" food 3-7 times/week. However, for the final model, only 3 factors remained significant, consuming: high-fiber non-sweet fruit (0-2 times/week); drinking yogurt (3-7 times/week), and sweetened fresh milk and other taste/cocoa/yogurt (3-7 times/week).

The results are congruent with recommendations for obese children to reduce dietary fat and energy intake with a balanced, hypocaloric, diet. Specific recommendations include limiting beverages and foods with high caloric density and low nutritional value (i.e. sugary beverages, full-fat or sweetened milk, sweetened drinking yogurts, deep fried foods

or snacks, full-fat baked foods and candies) and encouraging consumption of whole grains, fruits and vegetables.³⁸

For the possible reverse causation factors, consuming sweetened fresh milk and other taste/cocoa/yogurt, it may be that mothers perceived sweetened milk was bad for children's weight and oral health or that they already knew their overweight child needed to limit intake of sweetened fresh milk. Unexpected, this study revealed that "playing ball" was the only significant activity (n=14) associated with overweight preschoolers. It is possible that the parents found it easy to promote this activity and readily encouraged it.

Television findings were largely consistent with previous research that watching television 2 hours or more daily, on both weekdays and weekends, is associated with overweight children.^{15, 21} However, only watching during weekdays remained in the final model. One possible explanation is that watching television on weekdays is part of the nature of preschoolers' daily life. On weekdays, the children spent their time in school around 6 to 8 hours a day. The structured nature of the school day, with scheduled exercise periods and limited opportunities to eat, probably decreased their active time, compared with weekends.

In this study, none of the parameters related to family socioeconomic status were associated with preschool overweight. This finding might be because the research setting was an urbanized province. In many places, the boundary between the study province and Bangkok, the capital of Thailand, is not noticeable, as both sides are equally urbanized. Parents of the preschoolers might also have similar lifestyles, with respect to both diet and physical activity, including eating more and being less active.

Fathers' and mothers' BMIs were significantly associated with overweight preschoolers, but only a mother's BMI of 30 or higher was a risk factor in

the multiple logistic regression analysis. This result was broadly persistent, with a number of studies confirming that a parent being overweight is the most potent risk factor for a child being overweight.^{14, 17} Parental obesity may increase the risk of obesity through genetic mechanisms or by shared familial characteristics in the environment.³⁹ Mothers, as the main caregivers, may have more opportunity to influence their children's activity and diet than do fathers. Even though the mechanisms generally are unclear, evidence is increasing that having an overweight parent is a potent risk factor for being an overweight child.

The results reveal three maternal feeding practices were significantly associated with preschool overweight: low pressure, low encouragement through material reward, and low negotiation. However, only low maternal pressure remained significantly associated with overweight in the final model. In the Thai culture, adults expect their child to be good, unruly and present a "krang chai" manner (be considerate of others). Moreover, in regard to development of the children's desirable characteristics in accord with the 3 to 5 year old age group, in Thai culture, the children need to be taught to distinguish between right and wrong. Children at this age must be trained in self-control and control of their anger and desires. In other words, they must learn how to wait, so they can be good.⁴⁰ Hence, preschool children, throughout Thailand, are taken care of more intensively than are older children.²⁶ Therefore, parents, in Thailand, may believe that pressuring a child to eat might reflect love and a high level of care, in order to teach the child how to be good; a positive aspect of Thai child-rearing practices. In this study, preschoolers who were subjected to high pressure were found to be less likely to become overweight than those who were exposed only to low pressure.

Limitations

The parents' weight and height were assessed though self-report. Only 75.3% of the fathers reported this information. Even though the results of univariate analysis showed the father's BMI was significantly related to preschool overweight, the variable was excluded from the multivariate analysis. In this regard, the risk factors obtained from multivariate analysis might be different if less than 20% of the data were missing. Therefore, in future studies, researchers need to measure participants' weights and heights so that all the data are collected and biases are eliminated. Future studies also should assess the mesosystem (eg. interaction between home and school), and the exosystem (eg. parents' work setting, safety of the neighborhood) as suggested by the Ecological-Epidemiological model. Lastly, longitudinal studies might better measure the predictors before children become overweight and control measurement bias.

Conclusions

In this study, 3 factors related to the host, 5 factors related to the agent and 2 factors related to the environment were identified as predictive of overweight status. The host factors were: being male; food responsiveness behavior; and, enjoyment of food behavior. The agent factors included watching television more than 2 hours a day on weekdays and eating high-fiber, non-sweet fruit less often, but drinking yogurt more often. In addition, environmental factors that related to preschool overweight included the mother's BMI and low-pressure feeding practices.

Limited research on this topic has been reported in Thai nursing publications. Therefore, results of this study could be used as baseline information for further research to increase nurses'

knowledge about ways to promote children's and families' health by reducing the risk of being overweight, as well as preventing obesity.

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ปัจจัยเสี่ยงต่อภาวะน้ำหนักเกินในเด็กก่อนวัยเรียน

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บทคัดย่อ: การศึกษาแบบย้อนหาสาเหตุครั้งนี้ มีวัตถุประสงค์เพื่อสำรวจปัจจัยเสี่ยงต่อภาวะน้ำหนักเกินในเด็กก่อนวัยเรียน ทั้งปัจจัยด้านมนุษย์ ปัจจัยด้านสิ่งแวดล้อมที่ทำให้เกิดโรค และปัจจัยด้านสิ่งแวดล้อม ตามกรอบแนวคิดนิเวศวิทยาและระบาดวิทยา (Ecological-Epidemiological) เก็บรวบรวมข้อมูลโดยการชั่งน้ำหนักและวัดส่วนสูงเด็กก่อนวัยเรียน อายุ 36-60 เดือน เพื่อประเมินภาวะน้ำหนักเกิน โดยเทียบกับกราฟแสดงเกณฑ์อ้างอิงการเจริญเติบโตของเด็ไทยอายุ 2-7 ปี เด็กที่มีภาวะน้ำหนักเกินจำนวน 102 คนเป็นกลุ่มศึกษา และเด็กที่มีน้ำหนักปกติ 513 คนเป็นกลุ่มควบคุม ผู้ดูแลหลักของเด็กก่อนวัยเรียนเป็นผู้ให้ข้อมูลในระดับบุคคล และครอบครัว

ปัจจัยเสี่ยงต่อภาวะน้ำหนักเกินในเด็กก่อนวัยเรียน ประกอบด้วย การเป็นเด็กเพศชาย มีพฤติกรรมชอบ/เพลิดเพลินกับการกิน รวมทั้งการสนใจการกินอาหาร เด็กที่กินผลไม้กากใยสูงที่มีความหวานต่ำสุด ตื่นนมเปรี้ยว ดูโทรทัศน์เกิน 2 ชั่วโมงต่อวัน ในวันธรรมดา และ/หรือมารดามีภาวะอ้วนหรือมารดามีพฤติกรรมการดูแลบุตรด้านอาหารแบบไม่ค่อยบังคับ อย่างไรก็ตามได้พบความสัมพันธ์ระหว่างภาวะน้ำหนักเกิน กับการต็มนมสูตรหวาน/ นมรสชาติอื่น ๆ/นมปั่น/โกโก้/โยเกิร์ตเป็นถ้วยในปริมาณที่ลดลง และการเล่นบอล ซึ่งแสดงให้เห็นว่าเด็กน้ำหนักเกินปฏิบัติพฤติกรรมสุขภาพที่เหมาะสมบางพฤติกรรม

ผลการวิจัยทำให้พยาบาลและบุคลากรทางสุขภาพ สามารถนำไปพัฒนาโครงการส่งเสริมสุขภาพและเพิ่มความตระหนักต่อปัจจัยเสี่ยงภาวะน้ำหนักเกินในเด็กก่อนวัยเรียน รวมทั้งให้ความรู้แก่ครอบครัวเด็กก่อนวัยเรียน ด้านกิจกรรมการเคลื่อนไหวร่างกายและพฤติกรรมการบริโภคอาหารที่เหมาะสม

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คำสำคัญ: ปัจจัยเสี่ยง ภาวะน้ำหนักเกิน เด็กก่อนวัยเรียน การศึกษาแบบย้อนหาสาเหตุ

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