Original Article

Influential Factors of School-Aged Childhood Obesity and Normal-Weighted Children: A Case-Control Study

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Objective: To find influential factors of obesity in terms of eating behavior, daily activities, and family factors of school-aged childhood obesity compared to healthy and normal-weighted children.

Materials and Methods: The case-control study of 112 participants (56 from the obesity cases in Childhood obesity Clinic, Phra Nakhon Si Ayutthaya Hospital, compared with 56 control from normal-weighted children from Anuban Phra Nakhon Si Ayutthaya Elementary school, matched age and gender in a ratio of 1: 1. The participants had completed the questionnaire survey. The data was analyzed in the domains of patient factors, nutritional factors, physical activity, and parent-child relationships such as encouragement of eating and preparing and cooking among caregivers.

Results: The obesity ages started from an average of 2.32 years old, with no statistically significant difference between gender (2.16 + 1.1 v.s 2.66 + 1.0 years old, p-value < 0.054), male and female respectively. Domain of nutritional status/diets, the obese children group (case) overall average food intake consumed more than normal-weight children group (control), 3.15+0.19 v.s.2.31+0.14, respectively (p-value < 0.001). Most obese cases ate more vegetables on average than the normal-weight group, 2.55.+0.19 v.s. 2.08 +0.21, p-value=0.038). The physical activities had at least one active physical exercise; significantly fewer sports were played in the obesity group than in the normal-weight group (2.10+1.08 vs. 2.69+1.00, p-value= 0.003). But, the other physical activities had not shown significance, jogging (2.13+0.75 vs. 2.28+0.8 and swimming (1.28+0.49 vs.1.31+0.46), with p-values of 0.308 and 0.739 respectively. TV watching and time-screen showed statistically significantly higher in the case group than in the control group. The results showed 4.95+2.10 vs. 3.40+1.30 in TV watching (p-value < 0.001), and 4.25+1.08 vs. 3.70+1.43 in time-screen playing (p-value=0.023). Related genetic factors (obesity/metabolic syndrome, Diabetes Mellitus, and abnormal cholesterol in family members), We found only Family DM was statistically more significant in the obese group than in normal-weight children (OR: 2.68,95 % CI 1.09-6.61, p-value = 0.03).

Conclusion: Obesity is significantly present in pre-school and school-age children. We found multifactorial problems are causes, combined with nutrition factors and genetics vulnerable to metabolic disease and encouragement of eating, preparing, and cooking. The key to successfully treating and preventing childhood obesity lies in two main factors: patient and family/or caregivers; coordinate and synchronize among these factors to prevention.

Keywords: Childhood obesity, Overweight, Family factor, Diet therapy, Physical activity

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INTRODUCTION

Nowadays, non-communicable diseases (NCDs), especially obesity in children, are frequently found in the top five non-communicable diseases. The World Health Organization (WHO). The Center for Disease Control (CDC) reported adults with obesity were reported around 1.9 billion, and among children under five years, obesity was 39 million (2020) [1,2]. Over 340 million children and adolescents aged 5-19 were overweight or obese in 2016. In the United States of America (USA) in 2011, The data about obesity in children reported about 15.2 – 16.8% [3]. The American Academy of Family Physician (AFP) reported incidence of obesity in children were 13.8% in 2008 and increased with age [4]. According to the Ayutthaya Hospital, it is found that the increasing trend of incidence of obesity in children was 11.9 to 18.7 percent; during the years 2011 to 2015. The number of pediatric patients in the out-patient units is a significant growing trend [5-7].

Recently evidence suggested that children's nutrition status mainly depends on the environment, eating behaviors, and caregiver's or parent's nourishment. Childhood obesity is primarily caused by food types, e.g., unbalanced to consume the unhealthy foods, such as fast food or junks-food. Which is convenient for both sellers and consumers, and cultural beliefs that these foods are suitable for such a hectic society today. Therefore, we can more frequently find obesity cases in school-age children, which brings a critical problem in Thailand.

For this reason, the researcher in Phranakhon Sri Ayutthaya hospital recognized that NCDs problems in children might associate with childhood obesity. Then we initiated Children Diabetic and Nutrition Clinic for children. The authors were interested in the influential factors that make our patients obese more than average children, so we collected data by questionnaire and clinical records and analyzed to find the various significant aspects related to childhood obesity causes and aimed to correct this problem.

MATERIALS AND METHODS

Study Design

The case-control study was conducted on the 56 obese children from Obese children of Children Diabetes and Nutrition Clinic, Phra Nakhon Si Ayutthaya Hospital, and the 56 in the control group, normal children from Anuban Phra Nakhon Si Ayutthaya School, Phra Nakhon Si Ayutthaya Province, Thailand. Finally, 112 cases and control were enrolled by matched gender and age with a ratio of 1:1.

Populations

We enrolled cases with inclusion criteria. "Children under the age of 15 years old were selected from the diagnosed obese child from the Obese children of Children Diabetes and Nutrition Clinic of Phra Nakhorn Sri Ayutthaya hospital. The criteria for childhood obesity are children with body weight greater than 3 Standard Deviations (> +3 SD) above the WHO Growth Reference median or weight for height above 140 percent of normal. The Body Mass Index (BMI) criteria to diagnose obesity in children has differed from adult criteria, BMI > 30 is used to diagnose, and BMI above 40 is indicated severe morbid obesity. The control group was enrolled with the requirements of normal-weighted children under 15 years old from elementary school, Anuban Phra Nakhon Si Ayutthaya (0-15 years old), Phra Nakhon Si Ayutthaya Province, Thailand. The children who had other underlying diseases were excluded. The researcher matched the case and control with age and sex with a ratio of 1:1. The population who lost follow-up and could not complete data were excluded from the study.

Questionnaire and Clinical records

The clinical record form and a questionnaire were collected about demographic data, food amount, physical activities, and cooking and preparing food of caregivers or parents. The researcher collected that data from all obese patients in the Children Diabetes and Nutrition Clinic of Phra Nakhorn Sri Ayutthaya hospital. We used the same questionnaires to gather the categorized interested factors and information among normal-weight children in Anuban Phra Nakhon Si Ayutthaya Elementary School and the obese group in the Children Diabetes and Nutrition Clinic of Phra Nakhorn Sri Ayutthaya hospital. All children who answered the questionnaire survey were informed consent from their parents. Children younger than nine years old or who do not understand the language or question will use reading aloud to explain the meaning and understand the questions and interesting factors. The researcher will collect and input answers to the clinical record form (CRF)/questionnaires answer sheet. This study has been approved by the Human Ethical Committee, Institutional Review Board (IRB) at Phra Nakhon Si Ayutthaya Hospital.

Table 1. Amount of food intake by cases of obese children in Children Diabetes and Nutrition Clinic compared with the control group, the normal-weighted children, according to data collected by Anuban Phra Nakhon Si Ayutthaya Elementary School.

Factors	Case (n= 56), Mean			Control (n= 56), Mean			*p*-value (adjusted age)
	Boy	Girl	All	Boy	Girl	All	
Soft drinks & Snacks							
Aerated soft drinks (bottle/week)	2.85	1.63	2.45	1.76	1.47	1.63	0.946
Sweetened green tea (bottle/week)	3.00	2.10	2.30	1.26	1.09	1.18	0.946
Flavoured syrup drinks (glass/week)	2.48	2.19	2.38	1.50	1.47	1.48	0.934
Snacks (bag/week)	4.92	5.03	4.96	3.20	3.19	3.19	0.926
Milk and Related Milk Products							
Whole milk (box/week)	4.67	4.42	4.58	6.70	6.26	6.50	0.237
Drinking yogurt/ sweetened milk(box/week)	4.16	3.11	3.83	2.36	2.28	2.32	0.686
Food& Vegetatbles							
Steamed rice (scoopful/day)	5.35	2.80	4.52	2.53	2.52	2.52	0.712
Fried meat (piece/day)	4.92	5.03	4.96	3.04	2.47	2.78	0.136
Green vegetables (meal/day)	2.75	2.86	2.78	1.82	2.78	2.26	< 0.05*
Other colours vegetables (meal/day)	2.46	2.00	2.32	1.58	2.30	1.91	< 0.05*
Overall vegetables (meal/day)	2.61	2.43	2.55	1.70	2.54	2.08	0.038*
Egg (unit/day)	2.83	2.30	2.66	2.28	1.52	1.93	0.928
Pork liver blood (meal/day)	2.72	2.30	2.66	1.86	1.92	1.89	0.152
Overall	3.37	2.79	3.15	2.34	2.28	2.31	< 0.01*

Abbreviation : * *Statisticall significance at P-value < 0.05.*

Data collection

All interested influential factors from 112 obese children aged 0 – 15 years old. Fifty-six cases from the case group who had been in the treatment process from October 2015 to October 2016 were collected. These participants were all body weight over 140% of Weight for Height (WH) and had completed the questionnaire. In case of missing or incomplete answers, the questionnaire will be discarded. Fifty-six subjects were enrolled from the control group data were collected from Anuban Phra Nakhon Si Ayutthaya School under the parent's and headmaster's permission. In the first step of selecting the control group, the teacher will evaluate from a normal height and weight chart that is routinely recorded on the school's health check-up book. Secondly, medical personnel will screen those children's data records to ensure that they meet the definition of normal weight. The control group samples will be collected based on the same influential factors/parameters, i.e., age and gender, Lifestyle, time screen, and physical activity. Both case and control groups had to fill the same questionnaire sheet from August 2016 to September 2016.

Statistical analysis

The STATA software version 15, Educational licensed (Chicago, IL) was used for data analysis. The descriptive statistics were reported by Mean ± Standard Deviation (SD) and/or median (ranges) depending on data distribution. The count numbers were reported in numerical data and percentages. The p-value < 0.05 was assigned as statistical significance. The comparison between case and control use command inside the STATA software and reports as Odds ratio (OR) and 95% confidence interval (95% CI) and p-values.

RESULTS

Totally 112 cases were enrolled, and each of 56 cases and controlled matched with age and gender were enrolled and collected data. The initial eligible 60 cases

Table 2. Daily activities factor compared obese patients in Children Diabetes and Nutrition Clinic compared with a control group, normal-weighted children.

Daily Activity Factors***	Case (n= 56), Mean±SD			Control (n=56), Mean+SD			p-value
	Boy	Girl	All	Boy	Girl	All	
Physical activities* **							
Jogging	2.24	1.95	2.13±0.75	2.76	1.74	2.28±0.80	0.308
Swimming	1.00	1.88	1.28±0.49	1.30	1.33	1.31±0.46	0.739
Sports playing **	2.09	2.11	2.10±1.08	3.28	2.09	2.69±1.00	0.003*
Sedentary activities							
Television watching	5.07	4.69	4.95±2.10	3.78	3.00	3.40±1.30	< 0.001*
Time screen, Gaming/ playing on a smartphone or laptops	4.85	3.00	4.25±1.08	4.06	3.28	3.70±1.43	0.023 *

*Abbreviation: *** Daily activity: All factors counted >30 minutes of spending time.*

*** Sports playing are Football, Basketball, or other outdoor activity and games.*

** Statistically significance at p-value<0.05.*

and controls are registered for this study, after enrolling, checking, and cleaning data of surveyed records. The data remained completed and met inclusion criteria in 56 cases and control by matched to ratio 1:1 by age and gender. The study excluded 4 patients (cases), 5 subjects of the controls group were missing and incomplete data, and one of the controls had an underlying disease that could affect weight. The present study found the beginning age of obesity started from an average of 2.32 years old. There were no statistically significant differences between male and female gender, the average starting ages of obesity were 2.16 ± 1.1 vs. 2.66 ± 1.0 years old (p-value < 0.054), respectively.

In terms of nutritional status/diets, the obese children group(case) overall average food intake consumed more than normal weight children group (control), 3.15 ± 0.19 vs. 2.31 ± 0.14, respectively (p-value < 0.001). Overall, most obesity cases took more vegetable average than normal-weight group, 2.55 ± 0.19 vs. 2.08 ± 0.21, p-value=0.038). Green vegetables both within groups showed a significant trend of girl's consumption more than the boy, 2.86 ± 0.14 vs. 2.75 ± 0.14 for the obese group and 2.78 ± 0.13 vs. 1.82 ± 0.09, p-value <0.001) in normal-weight children. But, for color vegetables consumption showed attractive eaten more in the boy of the obese group (boy vs. girl: 2.46 ± 0.12 vs. 2.00 ± 0.10, p-value <0.001) more than normal-weight group (boy vs. girl: 1.58 ± 0.08 vs. 2.30 ± 0.12, p<0.001, see table 1).

The study focuses on active physical activities and the sedentary activities domain for daily activity. The present study found that the category of physical activities had at least one active physical exercise. Sports playing was significantly reduced in the obesity group than in the normal-weighted group. The results showed no significant differences among physical activities such as jogging (2.13 ± 0.75 vs. 2.28 ± 0.8) and swimming (1.28 ± 0.49 vs.1.31 ± 0.46), with p-values 0.308 and 0.739 respectively. Except for sports playing such as Football and Basketball, this seems to be higher and more significant in normal-weighted children than in obese children group (2.10 ± 1.08 vs. 2.69 ± 1.0, p-value=0.003). In sedentary lifestyle activities, television watching and time screen playing for more than 30 minutes showed statistically significant in the cases group higher than the control. The results showed 4.95 ± 2.10 vs. 3.40 ± 1.30 in television watching (p-value <0.001), and 4.25 ± 1.08 vs. 3.70 ± 1.43 in time-screen playing (p-value=0.023), respectively, see table 2.

Related genetic factors, obesity/metabolic syndrome, Diabetes Mellitus, and abnormal cholesterol in family members were explored to determine the association with obese children. The study found 9 cases (16.1%) had obesity in the family vs. 12 cases of a control group (21.4%) who reported obesity in the family. It was not significantly different (OR=0.70, 95%CI: 0.27 – 1.83, p-value = 0.47). History of DM in the family was found 19 cases in the obese children group (33.9%) and 9 cases in the normal-weighted children group (16.10%). DM in

Table 3 Genetic factors of obese patients in case of children Obesity(case) compared with the control group, normal-weighted children.

Factors	Case (n=56)		Control (n=56)		Odds Ratio (95% CI)	p-value
	Number	%	Number	%		
Obesity in family	9	16.1	12	21.4	0.70 (0.27-1.83)	0.47
DM in family	19	33.9	9	16.1	2.68 (1.09-6.61)	**0.03***
Abnormal Cholesterol	14	25.0	13	23.2	1.10 (0.46-2.62)	0.83
No any related risks	14	25.0	22	39.3	1	-

*Abbreviation : DM; Diabetes Mellitus, 95%CI; 95 % Confidence interval, * Statistically significance is p-value < 0.05*

the family was statistically significant in the obese group than in normal-weight children (OR=2.68, 95%CI: 1.09 – 6.61, p-value = 0.03). 14 cases of abnormal cholesterol were found in the obese children group (25.0%) vs.13 cases (23.20%) of abnormal cholesterol in the normal-weighted children group (OR=1.10, 95%CI: 0.46 – 2.62, p-value=0.83). Combining all related genetic factors as composite factors showed a significant difference between the case and control (OR=1.94, 95%CI: 0.87 – 4.35, p-value=0.1078), see table 3.

DISCUSSION

Totally 112 cases were enrolled in the obese group (56 cases), and the control group (56 cases). Fifty-six cases were obese children enrolled from Children Diabetes and Nutrition Clinic, Phra Nakhon Si Ayutthaya Hospital, and the 56 of the control group, normal children from Anuban Phra Nakhon Si Ayutthaya Elementary School, Phra Nakhon Si Ayutthaya Province, Thailand. This case-control study aimed to compare the risk factors among obese children to those of normal-weighted children with a ratio of 1:1 matched with gender and age.

From the study results, the authors found that the majority of the obese children group almost consumed unhealthy food categories such as aerated soft drinks (2.45% vs. 1.63%), drinking yogurt/Sweetened milk (3.83% vs. 2.32%), sweetened green tea (2.30% vs. 1.18%), snacks (4.96 vs. 3.19), see results table 1. Furthermore, the study also found a higher consumption trend of ordinary food consumption such as steamed rice, eggs, and meat in more amounts in the obese children group except for whole milk (table 1). The data shows that normal-weighted children drink more quantities of whole milk than obese children do. However, the number of dairy products consumed between the two groups is not significant differences except in green and colors vegetables (meal/day), which also were consumed more in the obese children group than normal-weight children (p-value<0.05). Therefore, whole milk consumption was on average at 4.58 vs. 6.50 in obese and normal-weight children's groups, respectively (p-value=0.237). They show the amount of whole milk consumption found less in the obesity group than other dairy products and sweetened soft drinks. Most importantly, the dairy product types are often chosen by children and consumed by themself, so interventions such as educating both children and their parents should effectively create a good attitude toward eating and maybe prevent obesity in children.

In summary, obese children tend to consume higher unhealthy food such as soft drinks & snacks, milk & related milk products (except unsweetened whole milk that consumed higher in the normal-weight children group). Ordinary foods such as steamed rice, Fried meat, eggs, and pork were consumed higher in the obese children group, except in the vegetable group. To prevent child obesity, they should be suggested to consume less unhealthy food, manage to consume ordinary food properly, and drink whole milk rather than drinking yogurt/ sweetened milk.

Because obesity causes do not only come from one factor in unhealthy food intake. But it can be caused by multifactorial factors consisting of inappropriate (unhealthy) food consumption conjuncts with other causes such as daily activities, exercise, and genetic factors. The parallel daily activities data showed that increasing daily activities or added-on exercise, jogging, and swimming do not result in significant outcomes. The data shows that obese children spend less time on physical activities/exercise. In Thailand, because of limited time after school ends in the evening, most schools finish late with very tight schedules learning all day long. Overall, normal-weighted children favor participating in indoor activities more than outdoor

activities. This is possible because indoor activities are more convenient and safer hence it is easier to join. Moreover, sedentary activities such as television watching and playing on a smartphone are significantly dominated by overweight children (case group). Therefore, parents should advise and encourage more physical activities in children and limit/reduce the screen time for children who participate in sedentary activity types. The present study showed that obese children joined in sports activities less but participated more in sedentary activities. These activities should be arranged to suit children's daily lives, understanding that school will end lately. For example, scheduling workout time and reducing sedentary activities to prevent/reduce obesity in children.

For the age factor, the average beginning age of child obesity started from pre-school age, 2.32 years old. The study found that the onset of obesity between the boys and girls was similar, with no statistically significant (p-value=0.054). This result is relevant to the study by Kelly et al. (2013) [7]. It seems reasonable to encourage the child obesity prevention strategy to be started during a pre-school period by educating children about nutrition facts and teaching them how to choose the proper food. There is a cultural belief that children who are obese are healthy. Our study also collected this information to analyze and found that grandparents are the main caregiver of obese children than normal-weight children (53.75% vs. 21.74%), believes and prefers chubby children. The grandparents believe that they are healthy when children look obese, which makes them intend to overfeed their grandchildren and leads to obesity in children. (OR=4.23, 95%CI: 1.85 – 9.67, p-value =0.0006).

For related genetic factors, table 3 shows that children of a family with a history of obesity/ metabolic syndromes, such as diabetes and high cholesterol, have a higher tendency to be obese than normal-weighted children. The Odds ratio of combined related genetic factors was 1.94 (95%CI: 0.87 – 4.35), p-value=0.1078. The result showed a positive trend of association of related genetic factors of obesity/ metabolic syndromes with obesity in children, but not statistically significant.

The family's proper eating lifestyle and adequate exercise behavior should be considered to solve and prevent childhood obesity sustainably. Therefore, family cooperation is an essential way to solve and prevent childhood obesity. In addition, the present study found that obese children almost have their grandparents cook for them, while normal-weighted ones have their parents do the cooking. One supporting reason is rather different from the caregiver factor: parents can access and learn about obesity prevention more than grandparents in this digital age. Therefore, they should be the key factor in looking after their obese children and educating their family members about obesity prevention strategies. The results show that parental care is a necessary factor for preventing obesity in children. Madeleine Sigman-Grant et al. (2015) reveal the key to future success in childhood obesity prevention and treatment. These may be found in the application of family resiliency [8].

From the study, it can be concluded that the causes of child obesity are multi-factor involvement. First is the patient factor, which is obese children are likely to eat more unhealthy foods (i.e., steamed rice (high carbohydrate), junk snacks, drinking sweetened yogurt, fried meats, sweetened green tea, etc.) than normal-weighted children do. Data showed that normal-weighted children often drink and consume whole milk. In addition, obese children do not favor participating in hyperactive activities and like to have sedentary activities/lifestyles such as watching TV or playing more screen time on smartphones. It is relevant to the report by Börnhorst C, et al. (2015) [9] and Wethington H, et al (2007) [10].

The second factor is a family factor, which is most obese patients are also found to be obese/diabetes and have high cholesterol levels in their families. It is relevant to the study of Park SH and working group (2015) [11] and given care by their grandparents responsible for cooking while normal-weighted children have their parents cook for them. This information may reflect those parents had more concern about a healthy lifestyle and healthy food for children than others. The study of Berge JM, et al. (2014) [12] and Halliday JA, et al. (2104) [13] reported that good family relationships decrease the risk of childhood obesity. It may imply that the parent cooker makes a comfortable and warm environment, but it needs more information to analyze beyond our study's scope.

Hence, the strategy to prevent and solve obesity should start before school age. Parents are likely a key factor in success in taking care of and encouraging children to eat right and appropriate healthy food and participate in more exercise and activities in children. Kelishadi R, et al. (2014) [14] supported this data about the solution of controlling childhood obesity using a multidisciplinary approach in the family and school. If overweight or obese relatives are in the family, the same intervention should be maintained sustainably. In reality, knowledge of obesity prevention is even more universal; however, accessibility to that knowledge is limited to working-age rather than the elderly who are caregivers. So, in an extended family, parents should educate their

parents on how to raise their children properly to avoid obesity caused by family eating behavior.

CONCLUSION

Obesity is significantly present in pre-school and school-age children and quite poorly maintained treatment through prevention by healthcare personnel. The primary cause is malnourishment, i.e., overeating, inessential and unhealthy food easily accessible to the children, lacking exercise, and decreased physical activities. Obesity prevention can be promoted by reducing high-calorie inessential food and promoting adequate and proper exercise for children, especially parents who are essential key persons to help their children. The key to successfully treating and preventing childhood obesity lies in two main factors: patient and family/or caregivers; coordinate and synchronize among these factors.

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Institutional Review Board Statement: The study was conducted under the Declaration of Helsinki and approved by the Research Ethics Committee of Phra Nakhon Si Ayutthaya Hospital, Phra Nakhon Si Ayutthaya Province, Thailand.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study as well as to publish this paper

REFERENCES

1. World Health Organization. Obesity and overweight fact sheet; 2016 [cited 2022 Jan 9]. Available from: http://www.who.int/mediacentre/factsheets/fs311/en/
2. Centers for Disease Control and Prevention. Child Obesity Facts; 2017 [cited 2022 Jan 9] Available from: https://www.cdc.gov/healthyschools/obesity/facts.htm
3. Canoy D, Bundred P. Obesity in children. BMJ Clin Evid. 2011 Apr 4;2011:0325. PMID: 21463538; PMCID: PMC3217765.
4. Slyper AH. Childhood obesity, adipose tissue distribution, and the pediatric practitioner. Pediatrics. 1998;102(1):e4.
5. Phulkerd S, Nakraksa P, Mo-Suwan L, Lawrence M. Progress towards Achieving the Recommendations of the Commission on Ending Childhood Obesity: A Comprehensive Review and Analysis of Current Policies, Actions and Implementation Gaps in Thailand. Nutrients. 2021;13(6):1927.
6. Aekplakorn, W.; Puckcharern, H.; Thaigla, K.; Satheannoppakao, W. Report on the Fifth National Health Examination Survey (2014); Institute, H.S.R., Ed.; Health System Research Institute, Ministry of Public Health and Thai Health Promotion Foundation: Nonthaburi, Thailand, 2016.
7. Kelly AS, Barlow SE, Rao G, Inge TH, Hayman LL, Steinberger J, Urbina EM, Ewing LJ, Daniels SR; American Heart Association Atherosclerosis, Hypertension, and Obesity in the Young Committee of the Council on Cardiovascular Disease in the Young, Council on Nutrition, Physical Activity and Metabolism, and Council on Clinical Cardiology. Severe obesity in children and adolescents: identification, associated health risks, and treatment approaches: a scientific statement from the American Heart Association. Circulation. 2013;128(15):1689-712.
8. Sigman-Grant M, Hayes J, VanBrackle A, Fiese B. Family Resiliency: A Neglected Perspective in Addressing Obesity in Young Children. Child Obes. 2015;11(6):664-73.
9. Börnhorst, C., Wijnhoven, T.M., Kunešová, M. et al. WHO European Childhood Obesity Surveillance Initiative: associations between sleep duration, screen time and food consumption frequencies. BMC Public Health 15, 442 (2015).
10. Wethington H, Pan L, Sherry B. The association of screen time, television in the bedroom, and obesity among school-aged youth: 2007 National Survey of Children's Health. J Sch Health. 2013;83(8):573-81.
11. Park SH, Kim MJ, Park CG, McCreary L, Patil C, Norr KF. Family Factors and Body Mass Index Among Korean-American Preschoolers. J Pediatr Nurs. 2015;30(6):e101-11.

12. Berge JM, Rowley S, Trofholz A, Hanson C, Rueter M, MacLehose RF, Neumark-Sztainer D. Childhood obesity and interpersonal dynamics during family meals. Pediatrics. 2014;134(5):923-32.
13. Halliday JA, Palma CL, Mellor D, Green J, Renzaho AM. The relationship between family functioning and child and adolescent overweight and obesity: a systematic review. Int J Obes (Lond). 2014;38(4):480-93.
14. Kelishadi R, Azizi-Soleiman F. Controlling childhood obesity: A systematic review on strategies and challenges. J Res Med Sci. 2014;19(10):993-1008.