

The Analysis of Factors Causing the High Prevalence of Child Obesity in Jeju Island

Eun Hye Park, Min-Su Oh, Sorina Kim, Juyeon Lee, and Ki Soo Kang

Department of Pediatrics, Jeju National University School of Medicine, Jeju, Korea

Purpose: For 3 consecutive years from 2012-2014, we analyzed the causative factors for why the Jeju Island had the highest obesity prevalences of school children among the 15 provinces in Korea.

Methods: From our analysis of 28,026 elementary school children with obesity or normal weight in the 15 provinces, we analyzed 12 factors related to eating habits, exercise habits, lifestyle, and mental health. The differences between the obese and normal weight children were researched. Finally, Jeju was compared with Seoul, which has the lowest obesity prevalence in school age children. Statistical analysis was performed using the chi square test of PASW Statistics ver. 18.0.

Results: Compared to the normal weight group, the obese group had significantly higher rates of consuming soft drinks ($p < 0.001$), fast food intake ($p = 0.019$), skipping breakfast ($p < 0.001$), insufficient sleep ($p < 0.001$), bullying experiences ($p = 0.001$) and runaway impulses ($p = 0.012$). Compared to Seoul, Jeju Island had significantly higher rates of Ramen intake (3.4% vs. 5.4%, $p = 0.021$) and meat intake (46.0% vs. 52.9%, $p = 0.003$). On the other hand, Jeju Island was significantly lower than was Seoul in their fruit intake (83.4% vs. 67.1%, $p < 0.001$), vegetable intake (71.4% vs. 64.2%, $p = 0.001$), and intense physical activity (63.4% vs. 47.7%, $p < 0.001$). Meanwhile, insufficient sleep (15.4% vs. 9.6%, $p < 0.001$) and runaway impulses (5.6% vs. 3.3%, $p = 0.027$) in children were significantly lower in Jeju Island than in Seoul.

Conclusion: The results of the obesity factor analysis of elementary school students in Jeju Island can be used as useful educational material for lowering the obesity prevalence in Jeju community.

Key Words: Child, Obesity, Prevalence

INTRODUCTION

Obesity is a disease which has long been regarded as an important social problem in Korea. Among

them, child obesity is receiving more attention because it causes children to be highly likely to develop chronic metabolic diseases such as hypertension, hypertriglyceridemia, hyperinsulinemia, nonalcoholic

Received : October 21, 2017, Revised : December 1, 2017, Accepted : December 8, 2017

Corresponding author: Ki Soo Kang, Division of Pediatric Gastroenterology, Hepatology and Nutrition, Department of Pediatrics, Jeju National University Hospital, 15 Aran 13-gil, Jeju 63241, Korea. Tel: +82-64-754-8146, Fax: +82-64-717-1131, E-mail: kskang@jeju.ac.kr

Copyright © 2018 by The Korean Society of Pediatric Gastroenterology, Hepatology and Nutrition

This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/4.0/>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

fatty liver disease, diabetes, and et Cetra [1,2]. Recently, Jeju Island had the highest student obesity prevalence, with 14.8% in the national elementary, middle and high school students' health examination data as conducted by the Korea Educational Development Institute in 2012 [3]. The prevalence of the national student obesity was 12.3% in 2012. Jeju Island showed the highest obesity rate for 3 consecutive years. From 2012, it showed 15.9% in 2013 [4] and 16.7% in 2014 [5]. It became a big issue in the community of Jeju Island. This study was designed to find out why Jeju Island had a higher obesity rate than did other regions.

MATERIALS AND METHODS

This study used original data from the 82,581 sample data of nationwide elementary, middle, and high school health examinations, conducted by the Ministry of Education in 2014. It selected 33,488 elementary school students' data from this data set.

This study included 28,026 elementary students who belonged to the normal and obesity groups. It excluded underweight and overweight groups among the 33,488 elementary students in 15 provinces, nationwide, based on body mass index. This classification is based on the percentile of body mass index by sex and age. The underweight group is less than the 5th percentile. The normal group is more than the 5th and less than the 85th percentile. The overweight group is more than the 85th and less than the 95th percentile. The obesity group is more than the 95th percentile or weighs more than 25 kg/m² regardless of percentile.

This study selected twelve questions which were known to be factors related to obesity; these were selected from among the health survey questionnaire of the original data. Twelve questions were composed of 7 eating habits (Ramen intake rate ≥ 3 times a week, consuming soft drinks rate ≥ 3 times a week, fast food intake rate ≥ 3 times a week, skipped breakfast rate, meat intake rate ≥ 3 times a week, fruit intake rate ≥ 3 times a week, and vegetable intake rate (not including Kimchi) ≥ 3 times a week),

1 exercise habit (intense physical activity practice rate ≥ 3 times a week), 2 lifestyle habits (sleeping time ≤ 7 hours and using computer ≥ 2 hours a day) and 2 mental health areas (bullying experience within the past year and experience of runaway impulse) (Table 1).

From our analysis of 28,026 elementary school children with obesity or normal weight in the 15 provinces, we analyzed 12 factors related to eating habits, exercise habits, lifestyle, and mental health. The differences related to 12 factors between the obese and normal weight children were researched. Finally, Jeju was compared with Seoul, which has the lowest obesity prevalence in school age children.

Statistical analysis was performed with PASW Statistics ver. 18.0 (IBM Co., Armonk, NY, USA). The chi square was used to clarify factors related to child obesity, as well as to compare Jeju Island to Seoul.

RESULTS

Cross-sectional analysis of obesity factors in normal and obese group

In the cross-sectional analysis of the normal group and the obesity group, several factors were significantly higher in the obese group; these include the following: consuming soft drinks rate more than 3 times a week (12.90% vs. 16.23%, $p < 0.001$), fast

Table 1. The 12 Factors Which Can Cause Child Obesity in 4 Types of Habits

Type of habits	Factors
Eating habits	Ramen intake rate ≥ 3 times/wk Consuming soft drinks rate ≥ 3 times/wk Fast food intake rate ≥ 3 times/wk Skipped breakfast rate Meat intake rate ≥ 3 times/wk Fruit intake rate ≥ 3 times/wk Vegetable* intake rate ≥ 3 times/wk
Exercise habit	Intense physical activity rate ≥ 3 times/wk
Lifestyle habits	Sleeping time ≤ 7 h/d Using computer ≥ 2 h/d
Mental health	Bullying experience within past 1 year Experience of runaway impulse

*Vegetable not including Kimchi.

food intake rate more than 3 times a week (3.0% vs. 3.7%, $p=0.019$), and skipped breakfast rate (10.1% vs 12.5%, $p < 0.001$), which are non-healthy eating habits among the eating habits. Fruit intake rate more than 3 times a week (75.8% vs. 67.5%, $p < 0.001$) and vegetable intake rate of 3 times a week (67.4% vs. 63.8%, $p < 0.001$) that correspond to healthy eating habits among the eating habits are significantly lower in the obesity group (Table 2). Sleep habits less than 7 hours a day (11.5% vs. 15.9%, $p < 0.001$) and computer use rate of more than 2 hours a day (12.6% vs. 19.6%, $p < 0.001$), which are non-healthy lifestyle habits among the lifestyle habits, are significantly higher in the obese group. Bullying experience within the past year (4.2% vs. 5.5%, $p=0.001$) and an experience of a runaway impulse (4.4% vs. 5.4%, $p=0.012$), which are non-healthy mental health conditions among the mental health conditions, are significantly higher in the obese group (Table 2).

Non-healthy eating habits (consuming soft drinks rate more than 3 times a week, fast food intake rate more than 3 times a week, skipped breakfast rate), a non-healthy lifestyle (sleeping time less than 7 hours a day, using computer more than 2 hours a day), and a non-healthy mental health experience (bullying experience within past 1 year, experience of runaway impulse) were significantly higher in the

obesity group. There was no significant difference between the two groups in Ramen intake rate more than 3 times a week and Intense physical activity rate more than 3 times a week (Fig. 1).

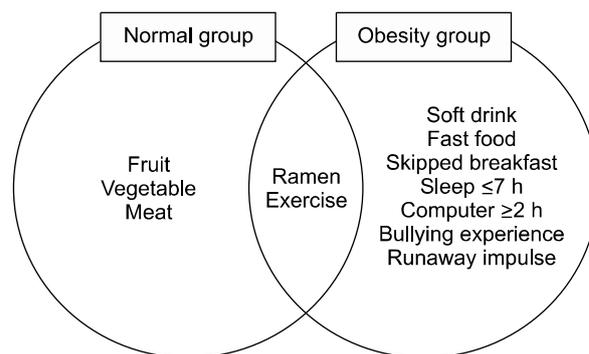


Fig. 1. The diagram of 12 factors causing child obesity in the normal and obese group. Non-healthy eating habits (consuming soft drinks rate more than 3 times a week, fast food intake rate more than 3 times a week, skipped breakfast rate), non-healthy lifestyle (sleeping time less than 7 hours a day, using computer more than 2 hours a day), and non-healthy mental health (bullying experience within past 1 year, Experience of runaway impulse) were significantly higher in the obese group, and there was no significant difference between the two groups in Ramen intake rate more than 3 times a week and Intense physical activity rate more than 3 times a week.

Table 2. Cross-Sectional Analysis of the 12 Factors Which Can Cause Child Obesity in 4 Types of Habits in the Normal and Obese Group

Type of habits	Factors	Normal group (%, n=24,957)	Obesity group (%, n=3,069)	p-value
Eating habits	Ramen intake rate ≥ 3 times/wk	3.9	4.4	0.114
	Consuming soft drinks rate ≥ 3 times/wk	12.9	16.2	< 0.001
	Fast food intake rate ≥ 3 times/wk	3.0	3.7	0.019
	Skipped breakfast rate	10.1	12.5	< 0.001
	Meat intake rate ≥ 3 times/wk	38.4	34.6	< 0.001
	Fruit intake rate ≥ 3 times/wk	75.8	67.5	< 0.001
	Vegetable* intake rate ≥ 3 times/wk	67.4	63.8	< 0.001
Exercise habit	Intense physical activity rate ≥ 3 times/wk	54.8	55.2	0.732
Lifestyle habits	Sleeping time ≤ 7 h/d	11.5	15.9	< 0.001
	Using computer ≥ 2 h/d	12.6	19.6	< 0.001
Mental health	Bullying experience within past 1 year	4.2	5.5	0.001
	Experience of runaway impulse	4.4	5.4	0.012

*Vegetable not including Kimchi.
p-value by χ^2 test.

Cross-sectional analysis of obesity factors in elementary school students in Seoul and Jeju Island

In the obesity rate of elementary school students in the 15 provinces, Jeju Island was 14.8% (97/657) which was the highest obesity rate. The cities which had the lowest obesity rates were Daejeon and Seoul 5.4% (229/4,210), which was the second lowest city. In order to analyze the causes of the high obesity rate in Jeju Island, this study compared Jeju Island with Seoul, which had the second lowest obesity rate of the elementary school students but the lowest obesity rate in elementary, middle and high school students.

In a cross-sectional analysis of Seoul and Jeju Island, Jeju Island was significantly higher than Seoul in terms of its Ramen intake rate of more than 3 times a week (3.4% vs. 5.4%, $p=0.021$) and meat intake rate of more than 3 times a week (46.0% vs. 52.9%, $p=0.003$); these are non-healthy eating habits among the eating habits. Jeju Island was significantly lower than Seoul in terms of its fruit intake rate of more than 3 times a week (83.4% vs. 67.1%, $p < 0.001$) and vegetable intake rate of more than 3 times a week (71.4% vs. 64.2%, $p=0.001$), which are healthy eating habits among the eating habits (Table 3).

An intense physical activity rate of more than 3 times a week (63.4% vs. 47.7%, $p < 0.001$), which is a healthy exercise habit, was significantly lower for Jeju Island. On the other hand, having a sleeping time of less than 7 hours a day (15.4% vs. 9.6%, $p < 0.001$), which is a non-healthy lifestyle habit, and the experience of having a runaway impulse (5.6% vs. 3.3%, $p=0.027$), which is a non-healthy mental health condition, were significantly higher in Seoul (Table 3).

In Jeju Island, the Ramen intake rate of more than 3 times a week, which is a non-healthy eating habit, was significantly higher, and the meat intake rate of more than 3 times a week was also higher than those in Seoul. In Seoul, the fruit intake rate more than 3 times a week and the vegetable intake rate more than 3 times a week, which are healthy eating habits, and the intense physical activity rate more than 3 times a week, which is a healthy exercise habit, were significantly higher than Jeju Island. However, Seoul was significantly higher than Jeju in terms of having a sleeping time of less than 7 hours a day, which is a non-healthy lifestyle habit; it was also higher for children having the experience of a runaway impulse, which is a non-healthy mental health habit (Fig. 2).

Table 3. Cross-Sectional Analysis of the 12 Factors Which Can Cause Child Obesity in 4 Types of Habits in Seoul and Jeju Island

Type of habits	Factors	Seoul (%, n=4,210)	Jeju Island (%, n=657)	p-value
Eating habits	Ramen intake rate ≥ 3 times/wk	3.4	5.4	0.021
	Consuming soft drinks rate ≥ 3 times/wk	12.4	14.4	0.201
	Fast food intake rate ≥ 3 times/wk	2.9	4.0	0.150
	Skipped breakfast rate	9.4	11.2	0.207
	Meat intake rate ≥ 3 times/wk	46.0	52.9	0.003
	Fruit intake rate ≥ 3 times/wk	83.4	67.1	<0.001
Exercise habit	Vegetable* intake rate ≥ 3 times/wk	71.4	64.2	0.001
	Intense physical activity rate ≥ 3 times/wk	63.4	47.7	<0.001
Lifestyle habits	Sleeping time ≤ 7 h/d	15.4	9.6	<0.001
	Using computer ≥ 2 h/d	9.9	8.5	0.315
Mental health	Bullying experience within past 1 year	4.6	3.7	0.356
	Experience of runaway impulse	5.6	3.3	0.027

*Vegetable not including Kimchi.

p-value by χ^2 test.

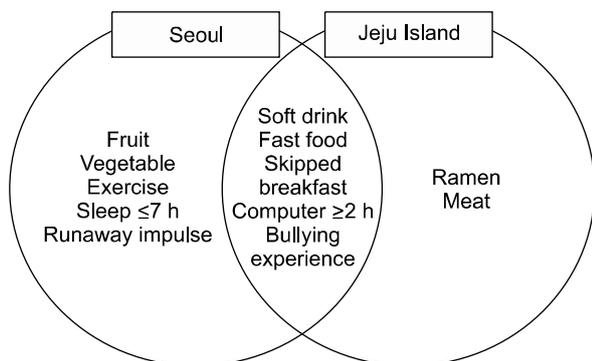


Fig. 2. The diagram of 12 factors causing child obesity in Seoul and Jeju Island. In Jeju Island, the Ramen intake rate more than 3 times a week, which is non-healthy eating habit, was significantly higher and meat intake rate more than 3 times a week also higher than those in Seoul. In Seoul, fruit intake rate more than 3 times a week and vegetable intake rate more than 3 times a week, which are healthy eating habits, and intense physical activity rate more than 3 times a week, which is healthy exercise habit, were significantly higher than Jeju Island. However, Seoul was significantly higher than Jeju in terms of sleeping time less than 7 hours a day, which is non-healthy lifestyle, and experience of runaway impulse, which is non-healthy mental health.

DISCUSSION

This study was designed to analyze why Jeju Island has had the highest obesity rate since 2012. According to the study of Seo [6], the obesity prevalence of school age children on Jeju Island in 2002 was 9.9%. But in 2014, it was 16.7% [5]. Therefore, we tried to discover what made the school age children of Jeju Island become obese. This study utilized the raw data of the health examination and survey conducted by the Ministry of Education in 2014. Among the several questions in the survey, we selected 12 factors known to be related to obesity (Table 1). First, we compared the normal group with the obesity group to confirm the correlation between the 12 factors and obesity (Table 2). Then, we compared Jeju Island to Seoul (Table 3).

For the eating habits, the present study showed that the frequency of consuming soft drinks, fast food intake, and skipping breakfast are associated with obesity. However, the frequency of Ramen intake is not associated with obesity (Table 2). Jee and Kim [7] showed the same result about the frequency

of Ramen intake. Camargo and Marín-León [8] reported the frequency of fast food intake is related to obesity, but consumption of soft drinks and Ramen are not. And Janssen et al. [9] also demonstrated that there was no significant finding between soft drink intake and being overweight in 34 western countries. Maddah and Nikooyeh [10] discovered that obesity may develop easily in those who skipped breakfast. Szajewska and Ruszczynski [11] proved the importance of breakfast consumption in children and adolescents in Europe. They showed eating breakfast helps individuals not become obese.

For the exercise habit, the present study showed that the rate of practicing an intense physical activity in the obesity group was not significantly different from that in the normal group (Table 2). But other studies showed different results. Kim et al. [12] showed that physical activity is significantly associated with the reduction of obesity, by increasing heart rate and respiratory rate. Janssen et al.'s results [9] demonstrated a negative relationship between physical activity and body mass index (BMI) classification.

For the lifestyle habit, the present study showed that having a sleeping time of less than 7 hours and using computers more than 2 hours are strongly associated with the risk of obesity (Table 2) Chronic partial sleep loss may increase the risk of obesity [13]. Li et al. [14] showed that children who had screen time of more than 2 hours are more likely to become obese. Park et al. [15] also presented the idea that watching TV more than 2 hours can make a child obese.

For the mental health area, having a bullying experience within the past year, and having the experience of a runaway impulse, are associated with the risk of obesity (Table 2). However, Peltzer and Pengpid [16] showed that a bullying experience within the past 30 days did not affect children's weight gain. In addition, Janssen et al. [17] pointed out an important part of the bullying experience. Overweight children are significantly more likely to be victims of bullying than are normal weight children.

In our cross-sectional analysis between the nor-

mal group and the obesity group, we confirmed that seven non-healthy behaviors (soft drink, fast food, skipped breakfast, sleep ≤ 7 hours a day, computer ≥ 2 hours a day, bullying experience, and runaway impulse) and two healthy behaviors (fruit intake, vegetable intake) had a significant relationship with obesity (Table 2). Compared to Seoul, only the Ramen intake rate and meat intake rate of Jeju Island were significantly higher (Table 3). Among the seven confirmed obesity factors, five factors (soft drink, fast food, skipped breakfast, computer ≥ 2 hours a day, bully experience) have no significant differences between them (Table 3). In addition, the two confirmed obesity factors (sleep ≤ 7 hours a day, runaway impulse) are significantly higher in Seoul (Table 3). Finally, the authors concluded that the main cause of a high obesity rate in Jeju Island was the low level of a healthy food intake rate such as the children's fruit and vegetable intake. It is ironic that Jeju Island has a lower fruit intake rate than Seoul, considering that Jeju Island is the place to sell various fruits especially mandarins to Seoul.

This study has several limitations. First is that all of the results, except for the BMI, were obtained through a survey with a questionnaire. In the case of the first grade students in elementary school, their guardian responded to the survey. In the case of 4th grade students in elementary school, students responded to the survey with their guardian. Therefore, the result of a survey might not reflect the actual eating habits, physical activity, lifestyle and mental health of the student. Second, the present study did not include other obesity factors such as socioeconomic status, educational status of a parent, and the distance of commuting because this study utilized the raw data which was designed not for analyzing obesity but for checking overall health. The third is that the present study cannot discover the impact of compounded factors which could occur between the twelve obesity factors. Regardless of these limitations, the present study has several strengths. First, this study analyzed 28,206 elementary students in Korea nationwide. Second, the present study is designed to focus on specific local health is-

suess in Jeju Island. Third, the result of study can be applied directly to solve the problem of obesity in elementary school students in the community of Jeju Island.

In conclusion, our obesity factor analysis showed that high soft drinks and fast food consumption rate, skipped breakfast, lack of sleep, excessive computer use, runaway urge, bullying experience rate and lower fruit, vegetable were the causes of obesity. As a result of factor analysis, the low rate of fruit and vegetable intake seemed to be the main obesity cause of the Jeju Island high obesity rate in children. It showed no significant difference, but high Ramen intake rate and insufficient physical activity were more prominent in elementary school students in Jeju than in Seoul. These results can be used as educational material for the Jeju elementary school health care project to lower the obesity rate of Jeju Island.

REFERENCES

1. Kang KS. Nutritional counseling for obese children with obesity-related metabolic abnormalities in Korea. *Pediatr Gastroenterol Hepatol Nutr* 2017;20:71-8.
2. Oh MS, Kim S, Jang JH, Park JY, Kang HS, Lee MS, et al. Associations among the degree of nonalcoholic fatty liver disease, metabolic syndrome, degree of obesity in children, and parental obesity. *Pediatr Gastroenterol Hepatol Nutr* 2016;19:199-206.
3. Ministry of Education, Republic of Korea. Report of student health test results 2012 [Internet]. Seoul: Ministry of Education; 2013 [cited 2017 Oct 6]. Available from: <https://goo.gl/BdKCcV>.
4. Ministry of Education, Republic of Korea. Report of student health test results 2013 [Internet]. Seoul: Ministry of Education; 2014 [cited 2017 Oct 6]. Available from: <https://goo.gl/xzaVwK>.
5. Ministry of Education, Republic of Korea. Report of student health test results 2014 [Internet]. Seoul: Ministry of Education; 2014 [cited 2017 Oct 6]. Available from: <https://goo.gl/mwWsKf>.
6. Seo JH. The prevalence of childhood and adolescent obesity in Jeju and clinical characteristics according to the degree of obesity. *Korean J Pediatr* 2004;47:362-7.
7. Jee YJ, Kim YH. Factors influencing obesity among adolescent: analysis of 2011 Korean youth risk behavior

- survey. *Korean J Obes* 2013;22:39-49.
8. Camargo JM, Marín-León L. Factors associated with overweight among elementary schoolchildren in Campinas, São Paulo, Brazil. *Revista De Nutrição* 2016; 29:401-13.
 9. Janssen I, Katzmarzyk PT, Boyce WF, Vereecken C, Mulvihill C, Roberts C, et al. Comparison of overweight and obesity prevalence in school-aged youth from 34 countries and their relationships with physical activity and dietary patterns. *Obes Rev* 2005;6:123-32.
 10. Maddah M, Nikooyeh B. Factors associated with overweight in children in Rasht, Iran: gender, maternal education, skipping breakfast and parental obesity. *Public Health Nutr* 2010;13:196-200.
 11. Szajewska H, Rusczyński M. Systematic review demonstrating that breakfast consumption influences body weight outcomes in children and adolescents in Europe. *Crit Rev Food Sci Nutr* 2010;50:113-9.
 12. Kim B, Lee CY, Kim HS, Ko IS, Park CG, Kim GS. Ecological risk factors of childhood obesity in Korean elementary school students. *West J Nurs Res* 2012;34: 952-72.
 13. Van Cauter E, Knutson KL. Sleep and the epidemic of obesity in children and adults. *Eur J Endocrinol* 2008;159 Suppl 1:S59-66.
 14. Li L, Shen T, Wen LM, Wu M, He P, Wang Y, et al. Lifestyle factors associated with childhood obesity: a cross-sectional study in Shanghai, China. *BMC Res Notes* 2015;8:6.
 15. Park KW, Lee K, Park TJ, Kwon ER, Ha SJ, Moon HJ, et al. The factors associated with becoming obese children: in 6th grade children of elementary schools in Busan. *J Korean Acad Fam Med* 2003;24:739-45.
 16. Peltzer K, Pengpid S. Overweight and obesity and associated factors among school-aged adolescents in Ghana and Uganda. *Int J Environ Res Public Health* 2011;8: 3859-70.
 17. Janssen I, Craig WM, Boyce WF, Pickett W. Associations between overweight and obesity with bullying behaviors in school-aged children. *Pediatrics* 2004;113:1187-94.