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Variation in Meal-skipping Rates of Korean Adolescents According to Socio-economic Status: Results of the Korea Youth Risk Behavior Web-based Survey

Seri Hong[1,2], Hong Chul Bae[2,3], Hyun Soo Kim[2,3], Eun-Cheol Park[1-3]

[1]*Graduate School of Public Health, Yonsei University, Seoul;* [2]*Institute of Health Services Research, Yonsei University, Seoul;*
[3]*Department of Preventive Medicine, Yonsei University College of Medicine, Seoul, Korea*

Objectives: To identify and evaluate the trend of meal-skipping rates among Korean adolescents with their contributing causes and the influence of household income level on meal skipping.
Methods: Using 2008, 2010, and 2012 data from the Korea Youth Risk Behavior Web-based Survey of 222 662 students, a cross-sectional study with subgroup analysis was performed. We calculated odds ratios for skipping each meal 5 or more times in a week by household socio-economic status using a multiple logistic regression model. The secular change in the meal-skipping rates by the students' family affluence scale was analyzed by comparing the meal-skipping students within each subgroup and odds ratios for the same event over time.
Results: Through 2008 to 2012, most of the meal-skipping rates generally showed a continuous increase or were almost unchanged in both sexes, except for breakfast skipping in several subgroups. Students in low-income households not living with both parents had the highest meal-skipping rates and odds ratios for frequent meal skipping. In a time-series subgroup analysis, the overall odds ratios for the same event increased during 2008 to 2012, with a slight reduction in the gap between low and higher income levels with regard to meal skipping during 2010 to 2012.
Conclusions: Household socio-economic status and several other factors had a significant influence on Korean adolescent meal-skipping rates. Although the gap in eating behavior associated with household socio-economic differences is currently decreasing, further study and appropriate interventions are needed.

Key words: Meal skipping, Social class, Adolescent, Eating habits

INTRODUCTION

Nutrition and eating habits are important factors affecting the health of a population. Among related indicators, the meal-skipping rate is a simple but meaningful measure for evaluating the eating habits of a particular group. Indeed, many researchers have investigated the number of food consumption periods per day or meal skipping to understand the dietary patterns of a population [1-4]. These studies have usually demonstrated a relationship between a higher household socio-economic status (SES) and a higher total number of eating occasions or maintenance of good eating habits in children and adolescents [1,4]. In addition, these outcomes were connected to a high intake of nutritious food and overall good health.

Given the important role of dietary intake and nutrition during adolescence in the prevention of disease and the prediction of health status in adulthood, numerous national policies

and guidelines on food intake have been established [5] in many countries. Many studies have demonstrated a positive association between low household SES or a high poverty ratio and undesirable dietary behaviors such as meal skipping or poor nutritional intake [6-11]. On the other hand, however, a number of long-term studies regarding the trend of change in eating habits over time within a specific society have generally demonstrated that the number of eating episodes and the quality of food eaten have shown improvement over time, with a decrease in the dietary behavioral gap among different social or economic classes [2,3,7,9].

Evidence also suggests that eating regularly and not skipping meals have a positive effect on overall quality of life and achievement, including academic performance, energy, and emotional functioning [12,13]. This is an especially important matter for those who are more vulnerable in society, such as adolescents from low-income families, because meal skipping can itself act as a social signal of impoverishment, as well as have secondary adverse effects or even an association with the inheritance of poverty. On this matter, some research has focused specifically on the meal skipping of adolescents from low-income households, searching for policy alternatives as well as analyzing related other problems [14-16].

Proper nutrition has a tremendous impact on a child's well-being, making it a fundamental human right [14]. Therefore, many studies of meal skipping among Korean children and adolescents have been conducted [17-19]. To address the problem of individual food insecurity among children in Korea, the Korean government has conducted school meal programs during school vacations since 2000, and has provided financial support to the children of low-income households for school meals. Beyond these two major national school feeding support systems, a free school lunch service was established in 2011, aiming for nationwide implementation. By gradually adding educational institutions receiving support, it has already been expanded to include almost all middle and high schools.

In this investigation, we focused on and analyzed the pattern and associated factors of Korean adolescent rates of skipping each of the three daily meals, especially the differences related to variation in household SES. We also conducted a subgroup analysis in order to compare these differences before and after the expansion of free meal services for lunch in Korea, and to evaluate the effectiveness of this policy.

METHODS

Study Design and Participants

We analyzed three years of survey data through a three-time cross-sectional study. The data for this study were obtained from the Korea Youth Risk Behavior Web-based Survey 2008, 2010, and 2012 (KYRBWS-IV/VI/VIII) [20]. The KYRBWS is a nationwide web-based survey regarding health behaviors of Korean adolescents (middle and high school students) conducted jointly by the Korea Centers for Disease Control and Prevention, the Ministry of Health and Welfare, and the Ministry of Education, Science, and Technology.

The study samples included 79 099 students in 2008, 74 980 students in 2010, and 76 980 students in 2012 from 400 middle schools and 400 high schools, selected by using a two-stage stratified cluster sampling method from all middle and high school students in Korea. A population was stratified by 43 regional and school-type variables, and then the sample was selected through two stages of school (the first sampling unit) and class (the second sampling unit). The total number of respondents was 222 662, consisting of 75 238 individuals in 2008, 73 238 individuals in 2010, and 74 186 individuals in 2012. The response rates of each year were 95.1% (75 238/79 099) in 2008, 97.7% (73 238/74 980) in 2010, and 96.4% (74 186/76 980) in 2012.

Measurement of Variables

The dependent variable of our research was the rate of skipping each meal in Korean adolescents. The nine independent variables were as follows: student's grade level, body mass index (BMI), family affluence scale as a representation of household income level, average spending money per week, household members, perceived body image, effort towards changing body weight during the last month, stress awareness, and research year. In addition to the demographic factors and variables of direct interest to this study, other variables were mostly selected based on the factors reported in previous research to be associated with adolescents' eating habits [14, 15,21]. The average amount of spending money per week was also chosen as one of the independent variables in order to examine the effect of being able to afford consuming meal substitutes, such as fast foods or other snacks. All variables were measured through responses to multiple-choice or combination questions, except BMI, which was calculated from reported height and weight.

The data was analyzed separately for males and females ex-

cept for the subgroup analysis, because meal skipping reveals sex-dependent differences in itself, and is often closely related to the variables that are dependent upon sex, such as efforts to change body weight or self-perception of body image [15,22-24]. For most of the variables, we undertook recategorization of choices or created new variables. Groups were categorized according to BMI (obesity, overweight, normal body weight, and low body weight groups), according to the standard growth chart for adolescents published by the Korea Centers for Disease Control and Prevention in 2007 [25]. As an indicator of the SES of the household, the Family Affluence Scale (FAS) was used, which was first developed from an international cooperative study of the World Health Organization and then adopted by the KYRBWS [20]. The FAS is a four-item questionnaire that helps students report their family income objectively: It evaluates the sum of scores regarding whether the family owns a car, whether the student has his/her own bedroom, the number of family vacations during the past 12 months, and the number of computers the family owns [26-29]. Comparison with other socioeconomic indicators, such as father's education level or student's perceived SES, will be discussed later. In addition, the responses regarding average spending money per week were divided into a total of six groups, by combining several groups together that were too small for analysis. The variable of family members, which consists of selected combination-type responses, was transformed to a binary variable with reclassified groups divided by whether a student lives with both parents or not. Those who did not attempt to control body weight in any way and those who attempted to maintain body weight were combined into one group, while stress awareness, which had been measured on a five-point scale, was reclassified into three groups.

As a dependent variable, the rates of skipping each meal were defined as a proportion of students who ate their breakfast, lunch, or dinner less than three times during the previous seven days (skipping a meal five or more times per week) in each subgroup of all independent variables, according to the equation in the guidelines of the KYRBWS 2012 for using primitive data [20]. The denominator would be the total numbers of students in each specific subgroup, for example, total female students, or male students, who responded that their family affluence scale was high.

Statistical Analysis

For all categorical variables, data are presented as the number of cases and their respective proportions. The statistical analysis was done on weighted data using the SURVEYFREQ and SURVEYLOGISTIC procedures, so that the population and the sample were consistent with each other in demographic composition. In order to see the differences in meal-skipping rates among different responding subgroups of the variables for each single factor, a chi-squared test was performed. Logistic regression analysis was performed with the trend test to determine the odds ratios of skipping each meal five or more times per week due to the change in each variable while controlling for the effect of the other variables. In addition, particularly for the purpose of examining the patterns of change in the effect of household economic conditions over time on a student's meal-skipping rate, a subgroup analysis according to family affluence scale was conducted for each year, as a variable of interest among the eight variables originally selected. The results have also been presented as an every-other-year change in meal-skipping rates and odds ratios for skipping each meal. Trend tests for these changing patterns were also conducted. In every logistic regression analysis including all dependent and independent variables, we confirmed that there was no multicollinearity between these variables using the VIF (variance inflation factor). A p-value of <0.05 was considered to indicate significance and all statistical analyses were performed using SAS version 9.2 (SAS Inc., Cary, NC, USA).

RESULTS

Surveys were conducted in 2008, 2010, and 2012 in order to target the entire sample group consisting of 115 890 male and 106 772 female students.

Breakfast-skipping rates were lowest in 2012, but lunch- and dinner-skipping rates increased continuously or remained nearly unchanged during 2010 and 2012 for both sexes. This prevalence of frequent meal skipping increased from 5.7% to 12.8% in males and 3.9% to 8.8% in females for lunch, and from 6.4% to 12.6% in males and 8.1% to 9.8% in females for dinner. Meanwhile, the breakfast-skipping rates decreased steadily from 25.1% to 24.9% in males and 26.7% to 24.6% in females. We also observed that the group of students with low household SES had the highest meal-skipping rates among the entire research population, and paradoxically, students who received the largest amount of spending money also had the highest meal-skipping rate in both sexes. The same result was seen in the group of students reporting that at least one

Table 1. Overall distribution of study population and rates of skipping each meal

		Male (n=115 890)				Female (n=106 772)			
		Total	Breakfast-skip	Lunch-skip	Dinner-skip	Total	Breakfast-skip	Lunch-skip	Dinner-skip
Grade									
Middle school	1st year	19 776	4390 (21.7)	2623 (12.7)	2633 (12.6)	18 091	4171 (22.5)	1618 (8.6)	1795 (9.8)
	2nd year	19 952	4649 (23.0)	2231 (10.7)	2304 (11.1)	17 987	4462 (24.5)	1383 (7.1)	1804 (9.6)
	3rd year	20 242	5157 (25.3)	2003 (9.6)	2088 (10.1)	17 762	4556 (25.4)	1122 (6.0)	1743 (9.5)
High school	1st year	19 509	4726 (24.6)	1541 (7.7)	1612 (8.0)	17 683	4635 (26.2)	1054 (5.5)	1568 (8.5)
	2nd year	18 561	4927 (26.6)	1472 (7.7)	1588 (8.2)	18 253	4960 (27.6)	1071 (5.6)	1745 (9.6)
	3rd year	17 850	5187 (29.8)	1415 (8.1)	1511 (8.5)	16 996	4644 (27.7)	1022 (5.8)	1505 (8.6)
p-value			<0.001	<0.001	<0.001		<0.001	<0.001	0.004
Year									
2008		39 278	9679 (25.1)	2290 (5.7)	2604 (6.4)	35 960	9595 (26.7)	1584 (3.9)	3071 (8.1)
2010		38 391	9794 (25.5)	3950 (9.9)	4196 (10.4)	34 847	8940 (25.6)	2453 (6.7)	3530 (9.9)
2012		38 221	9563 (24.9)	5045 (12.8)	4936 (12.6)	35 965	8893 (24.6)	3233 (8.8)	3559 (9.8)
p-value			0.57	<0.001	<0.001		0.009	<0.001	<0.001
BMI[1]									
Underweight		7362	2010 (27.3)	738 (9.7)	752 (9.8)	7184	2016 (28.0)	513 (6.6)	617 (8.5)
Normal		89 330	21 954 (24.7)	8428 (9.1)	8681 (9.3)	84 921	21 322 (25.0)	5452 (6.0)	7871 (9.0)
Overweight or obesity		15 533	3869 (24.8)	1476 (9.1)	1637 (10.1)	11 411	3051 (26.7)	830 (6.9)	1117 (9.5)
p-value			0.001	0.32	0.03		<0.001	0.005	0.13
Family affluence scale									
High		38 197	8169 (21.3)	3548 (8.9)	3650 (9.1)	33 674	7400 (22.1)	2187 (6.3)	2874 (8.5)
Middle		63 049	15 902 (25.4)	5739 (8.8)	6011 (9.2)	58 924	15 219 (25.8)	3805 (6.0)	5492 (9.0)
Low		14 644	4965 (34.7)	1998 (13.4)	2075 (13.9)	14 174	4809 (34.3)	1278 (8.5)	1794 (12.4)
p-value			<0.001	<0.001	<0.001		<0.001	<0.001	<0.001
Average spending money per week (KRW)									
0-10 000		38 841	8504 (21.6)	3686 (9.1)	3717 (9.1)	36 558	7997 (21.6)	2319 (6.0)	3032 (8.1)
10 000-20 000		29 762	7281 (25.0)	2698 (8.7)	2841 (9.2)	27 772	7082 (25.2)	1858 (6.2)	2525 (8.7)
20 000-30 000		15 741	4125 (26.4)	1530 (9.5)	1585 (9.7)	14 905	3985 (26.8)	981 (6.2)	1444 (9.6)
30 000-40 000		10 945	2938 (27.0)	1059 (9.6)	1123 (10.0)	10 409	2932 (28.2)	711 (6.2)	1047 (9.7)
40 000-60 000		10 971	3018 (27.2)	1083 (8.9)	1135 (9.4)	10 476	3106 (29.7)	735 (6.8)	1148 (10.7)
60 000 or more		9630	3170 (33.0)	1229 (12.6)	1335 (13.7)	6652	2326 (35.9)	666 (9.7)	964 (14.3)
p-value			<0.001	<0.001	<0.001		<0.001	<0.001	<0.001
Family members									
Living with both parents[2]		95 188	21 737 (22.9)	8659 (8.8)	8892 (9.0)	88 021	20 583 (23.4)	5587 (6.0)	7670 (8.5)
Do not live with at least one parent		20 702	7299 (36.2)	2626 (12.5)	2844 (13.4)	18 751	6845 (36.9)	1683 (8.6)	2490 (13.5)
p-value			<0.001	<0.001	<0.001		<0.001	<0.001	<0.001
Perceived body image									
A little or very lean		40 571	10 029 (24.8)	3832 (9.2)	3952 (9.3)	22 847	5753 (25.0)	1543 (6.4)	1941 (8.4)
A little or very fat		38 853	9824 (25.4)	3699 (9.2)	3928 (9.7)	45 363	11 869 (26.1)	3099 (6.4)	4471 (9.7)
Fair		36 466	9183 (25.4)	3754 (9.9)	3856 (10.3)	38 562	9806 (25.5)	2628 (6.4)	3748 (9.3)
p-value			0.16	0.001	0.001		0.04	0.99	<0.001
Effort for changing BW during the last 1 mo									
Effort for gaining weight		12 461	3001 (23.9)	1166 (9.1)	1184 (9.2)	1810	480 (27.3)	219 (11.9)	252 (14.5)
Effort for losing weight		26 591	7050 (26.8)	2950 (10.8)	3308 (12.0)	45 143	12 187 (26.9)	3372 (7.0)	5374 (11.5)
No effort		56 768	13 936 (24.6)	6068 (10.3)	6042 (10.2)	44 743	10 870 (24.3)	3087 (6.6)	3615 (8.0)
p-value			<0.001	0.002	<0.001		<0.001	<0.001	<0.001
Stress awareness									
A lot of stress		42 747	12 197 (28.7)	4482 (10.3)	4810 (11.0)	53 788	15 786 (29.4)	4016 (7.1)	5851 (10.7)
A little bit of stress		50 252	11 755 (23.4)	4520 (8.6)	4627 (8.8)	40 517	9164 (22.6)	2473 (5.8)	3322 (8.0)
Almost no stress		22 891	5084 (22.3)	2283 (9.6)	2299 (9.5)	12 467	2478 (19.4)	781 (5.7)	987 (7.5)
p-value			<0.001	<0.001	<0.001		<0.001	<0.001	<0.001
Total		115 890	29 036 (25.2)	11 285 (9.4)	11 736 (9.7)	106 772	27 428 (25.6)	7270 (6.4)	10 160 (9.3)

BMI, body mass index; KRW, Korean won; BW, body weight.

Values are presented as the number of individuals (percent of the total).

[1] Underweight defined as one's BMI <5th percentile of same age group's distribution; Overweight as 85th percentile ≤ BMI <95th percentile of same age group's distribution; Obesity defined as BMI ≥ 95th percentile of same age group's distribution.

[2] Including stepfather and stepmother.

of their parents did not live with them, and those that felt a lot of stress in daily living (Table 1).

The odds ratios for skipping each meal five times or more per week in each subgroup were calculated for all independent variables after adjusting for the effect of other variables. In the case of lunch and dinner in both sexes, the overall risk of meal skipping increased substantially in 2010 and 2012 compared with 2008 ($p=0.004$ for trend in dinner skipping among females; $p<0.001$ for all other trend comparisons). The group of students whose household SES was low, those who did not live with both parents, and those whose average spending money per week was high presented the highest risk of meal skipping. These results were statistically significant and were true of every meal for both sexes.

In the case of breakfast, students of both sexes showed the lowest risk of frequent meal skipping when they had a lean body image, but this was only statistically significant in males. For lunch and dinner, in contrast, students who perceived themselves as fat recorded the lowest risk of frequent meal skipping, and almost all cases were statistically significant. The group with the highest risk for meal skipping was students who replied they had an average body type in both sexes, for every meal. On the other hand, when we focused on actual BMI, the low bodyweight group showed a tendency toward having the highest risk of meal skipping in both sexes, but these differences were not significant except for breakfast skipping in male students. Also, the risk for meal skipping showed a certain correlation with efforts to change bodyweight for boys, meaning that, for every meal, there was the highest risk for frequent meal skipping in those who were trying to lose weight and the lowest risk for frequent meal skipping in those who were trying to gain weight. However, among the girls, for every meal, the students who did not make any effort to change their weight demonstrated the lowest risk for meal skipping. Whereas the girls who were trying to lose weight recorded the highest breakfast-skipping risk and this risk showed an in turn showed a correlation with an attempt to change bodyweight, girls showed a contradictory tendency for lunch and dinner, meaning that the highest meal-skipping risk was recorded in those who were trying to gain weight, and it was statistically significant. Those with a stress levels that were slightly above the average did not have a significantly different risk of frequent lunch or dinner skipping in both sexes (Table 2).

Among these variables, we focused on the effect of house-

hold SES on meal-skipping rates, specifically the variation in meal skipping associated with SES. For this purpose, we conducted a time-series comparison of skipping rates of each meal within high, middle, and lower family affluence scale classes. The results from simply measuring the meal-skipping rate of five or more times per week according to family affluence scale each year showed that the low SES class had a significantly higher meal-skipping rate compared to the middle and high SES classes, for every meal and both sexes. The overall rates of skipping lunch and dinner were on the rise in both sexes, but between 2010 and 2012, particularly in the low family affluence scale class, the incremental slope showed definite slowing aspects and the rates themselves decreased. In the case of breakfast, on the other hand, the meal-skipping rates in all family affluence scale classes and both sexes were lower in 2012 compared to 2010 (Table 3). Although low-SES households had the highest meal-skipping rates under most conditions, such a reduction in the meal-skipping rate itself or a relatively large reduction in the incremental width in a group of low-SES household students can be interpreted as a positive sign of an improving gap in eating behavior by household income level.

When considering and adjusting other independent variables that may have an influence on meal skipping (i.e., grade level, BMI, average spending money per week, family members, perceived body image, effort towards changing bodyweight during the past month, and stress awareness), the odds ratios for skipping a meal five or more times per week showed a decrease in many cases over the study period. In some cases that showed increased odds ratios for meal skipping, the incremental change was much smaller in the low-SES class than in the high-SES class. The risk of breakfast skipping uniquely showed a gradual decrease in female students, regardless of SES status. In contrast, a relatively obvious increase in the risks of dinner skipping in male students of all SES classes, which reached doubling or even more, was observed. However, the increase in dinner skipping was less remarkable in female students. For the students in the low-SES class, only the boys revealed a discernable increasing risk of meal skipping for lunch (Table 4).

DISCUSSION

In this study, we measured the overall meal-skipping rates of Korean adolescents and differences between them associ-

Table 2. Odds ratios for skipping each meal 5 or more times per week

		Male			Female		
		Breakfast	**Lunch**	**Dinner**	**Breakfast**	**Lunch**	**Dinner**
Grade							
Middle school	1st year	1.00	1.00	1.00	1.00	1.00	1.00
	2nd year	1.05 (0.98, 1.12)	0.79 (0.73, 0.86)	0.83 (0.77, 0.90)	1.07 (1.00, 1.16)	0.76 (0.68, 0.86)	0.91 (0.82, 1.01)
	3rd year	1.13 (1.06, 1.20)	0.67 (0.61, 0.73)	0.72 (0.66, 0.79)	1.04 (0.97, 1.12)	0.62 (0.55, 0.70)	0.86 (0.78, 0.94)
High school	1st year	0.99 (0.91, 1.07)	0.49 (0.44, 0.54)	0.50 (0.46, 0.56)	1.01 (0.93, 1.09)	0.53 (0.47, 0.61)	0.73 (0.66, 0.82)
	2nd year	1.07 (0.99, 1.16)	0.45 (0.41, 0.50)	0.48 (0.44, 0.53)	1.02 (0.94, 1.10)	0.51 (0.45, 0.59)	0.79 (0.71, 0.88)
	3rd year	1.15 (1.07, 1.25)	0.45 (0.40, 0.49)	0.47 (0.42, 0.52)	0.98 (0.90, 1.06)	0.51 (0.44, 0.59)	0.72 (0.64, 0.81)
p for trend		<0.001	<0.001	<0.001	0.27	<0.001	<0.001
Year							
2008		1.00	1.00	1.00	1.00	1.00	1.00
2010		1.10 (1.03, 1.19)	1.91 (1.72, 2.14)	1.77 (1.59, 1.97)	0.95 (0.89, 1.03)	1.73 (1.51, 1.99)	1.13 (1.02, 1.25)
2012		1.09 (1.02, 1.17)	2.73 (2.47, 3.03)	2.33 (2.11, 2.57)	0.92 (0.86, 0.99)	2.50 (2.21, 2.84)	1.17 (1.07, 1.28)
p for trend		0.02	<0.001	<0.001	0.06	<0.001	0.004
BMI[1]							
Underweight		1.23 (1.11, 1.37)	1.08 (0.93, 1.25)	1.01 (0.87, 1.17)	1.11 (0.99, 1.24)	1.06 (0.88, 1.27)	1.11 (0.95, 1.31)
Normal		1.05 (0.99, 1.12)	1.00 (0.91, 1.10)	0.93 (0.85, 1.02)	0.96 (0.90, 1.02)	0.94 (0.85, 1.05)	1.06 (0.97, 1.17)
Overweight or obesity		1.00	1.00	1.00	1.00	1.00	1.00
p for trend		0.001	0.42	0.11	0.001	0.14	0.36
Family affluence scale							
High		1.00	1.00	1.00	1.00	1.00	1.00
Middle		1.25 (1.20, 1.31)	1.15 (1.09, 1.23)	1.17 (1.10, 1.24)	1.19 (1.14, 1.24)	1.06 (0.98, 1.14)	1.13 (1.06, 1.20)
Low		1.78 (1.68, 1.89)	1.75 (1.61, 1.90)	1.73 (1.59, 1.89)	1.64 (1.53, 1.74)	1.41 (1.26, 1.59)	1.43 (1.30, 1.58)
p for trend		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Average spending money per week (KRW)							
0-10 000		1.00	1.00	1.00	1.00	1.00	1.00
10 000-20 000		1.22 (1.16, 1.28)	1.09 (1.02, 1.18)	1.16 (1.09, 1.25)	1.22 (1.17, 1.28)	1.13 (1.04, 1.23)	1.11 (1.03, 1.19)
20 000-30 000		1.35 (1.28, 1.44)	1.25 (1.14, 1.37)	1.27 (1.16, 1.40)	1.33 (1.25, 1.41)	1.19 (1.07, 1.32)	1.27 (1.17, 1.39)
30 000-40 000		1.31 (1.22, 1.40)	1.30 (1.17, 1.44)	1.35 (1.22, 1.48)	1.48 (1.39, 1.58)	1.23 (1.09, 1.37)	1.30 (1.18, 1.43)
40 000-60 000		1.34 (1.24, 1.44)	1.24 (1.12, 1.37)	1.34 (1.21, 1.48)	1.51 (1.42, 1.61)	1.36 (1.20, 1.53)	1.38 (1.25, 1.53)
60 000 or more		1.78 (1.65, 1.91)	1.82 (1.64, 2.02)	1.93 (1.74, 2.14)	2.00 (1.85, 2.16)	1.76 (1.55, 1.99)	1.80 (1.60, 2.02)
p for trend		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Family members							
Living with both parents[2]		1.00	1.00	1.00	1.00	1.00	1.00
Do not live with at least one pareut		1.56 (1.48, 1.65)	1.16 (1.07, 1.26)	1.24 (1.15, 1.35)	1.57 (1.49, 1.65)	1.23 (1.12, 1.34)	1.33 (1.23, 1.43)
p for trend		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Perceived body image							
A little or very lean		0.93 (0.89, 0.98)	0.90 (0.84, 0.97)	0.90 (0.83, 0.96)	0.95 (0.89, 1.01)	0.90 (0.81, 0.99)	0.92 (0.84, 1.00)
A little or very fat		0.98 (0.93, 1.03)	0.83 (0.77, 0.89)	0.79 (0.73, 0.86)	0.97 (0.92, 1.01)	0.89 (0.82, 0.96)	0.92 (0.86, 0.99)
Fair		1.00	1.00	1.00	1.00	1.00	1.00
p for trend		0.03	<0.001	<0.001	<0.001	<0.001	<0.001
Effort for changing BW during the last 1 mo							
Effort for gaining weight		0.92 (0.87, 0.98)	0.99 (0.90, 1.09)	0.98 (0.89, 1.08)	1.01 (0.86, 1.19)	1.61 (1.29, 2.01)	1.57 (1.27, 1.94)
Effort for losing weight		1.13 (1.08, 1.18)	1.25 (1.17, 1.34)	1.40 (1.31, 1.50)	1.10 (1.06, 1.14)	1.17 (1.10, 1.26)	1.54 (1.44, 1.65)
No effort		1.00	1.00	1.00	1.00	1.00	1.00
p for trend		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Stress awareness							
A lot of stress		1.29 (1.22, 1.36)	1.11 (1.04, 1.20)	1.17 (1.09, 1.26)	1.62 (1.52, 1.73)	1.32 (1.18, 1.46)	1.42 (1.30, 1.56)
A little bit of stress		1.03 (0.98, 1.08)	0.95 (0.89, 1.02)	0.96 (0.90, 1.03)	1.19 (1.11, 1.28)	1.10 (0.99, 1.24)	1.10 (1.00, 1.21)
Almost no stress		1.00	1.00	1.00	1.00	1.00	1.00
p for trend		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Values are presented as odds ratio (95% confidence interval).
BMI, body mass index; KRW, Korean won; BW, body weight.
[1]Underweight defined as one's BMI <5th percentile of same age group's distribution; Overweight as 85th percentile ≤ BMI <95th percentile of same age group's distribution; Obesity defined as BMI ≥95th percentile of same age group's distribution.
[2]Including stepfather and stepmother.

Table 3. Skipping rates of each meal according to family affluence scale, varying by year

		Male				Female			
		Total	Breakfast-skip	Lunch-skip	Dinner-skip	Total	Breakfast-skip	Lunch-skip	Dinner-skip
High	2008	11507	2419 (21.2)	609 (5.1)	706 (5.7)	10017	2270 (22.7)	346 (3.1)	666 (6.2)
	2010	13313	2913 (21.6)	1240 (9.0)	1309 (9.4)	11480	2554 (22.6)	751 (6.5)	1041 (9.4)
	2012	13377	2837 (20.9)	1699 (12.3)	1635 (12.0)	12177	2576 (21.0)	1090 (9.0)	1167 (9.7)
	p-value		0.61	<0.001	<0.001		0.04	<0.001	<0.001
Middle	2008	22339	5473 (25.0)	1171 (5.2)	1344 (5.9)	20458	5453 (26.7)	869 (3.8)	1738 (8.1)
	2010	20426	5240 (25.9)	1987 (9.3)	2133 (9.9)	19074	4909 (25.5)	1263 (6.1)	1894 (9.5)
	2012	20284	5189 (25.5)	2581 (12.3)	2534 (12.1)	19392	4857 (25.2)	1673 (8.4)	1860 (9.5)
	p-value		0.52	<0.001	<0.001		0.10	<0.001	0.001
Low	2008	5432	1787 (33.9)	510 (8.9)	554 (9.7)	5485	1872 (34.7)	369 (6.3)	667 (12.2)
	2010	4652	1641 (36.1)	723 (15.5)	754 (16.1)	4293	1477 (35.3)	439 (9.8)	595 (13.7)
	2012	4560	1537 (34.2)	765 (16.7)	767 (16.6)	4396	1460 (32.8)	470 (9.9)	532 (11.4)
	p-value		0.18	<0.001	<0.001		0.22	<0.001	0.04
Total	2008	39278	9679 (25.1)	2290 (5.7)	2604 (6.4)	35960	9595 (26.7)	1584 (3.9)	3071 (8.1)
	2010	38391	9794 (25.5)	3950 (9.9)	4196 (10.4)	34847	8940 (25.6)	2453 (6.7)	3530 (9.9)
	2012	38221	9563 (24.9)	5045 (12.8)	4936 (12.6)	35965	8893 (24.6)	3233 (8.8)	3559 (9.8)

Values are presented as the number of individuals (percent of the total).

Table 4. Odds ratios for skipping each meal 5 or more times per week according to family affluence scale, varying by year[1]

		Male			Female		
		Breakfast	Lunch	Dinner	Breakfast	Lunch	Dinner
High	2008	1.00	1.00	1.00	1.00	1.00	1.00
	2010	1.11 (0.99, 1.23)	2.01 (1.70, 2.38)	1.78 (1.52, 2.09)	0.99 (0.89, 1.11)	2.12 (1.70, 2.65)	1.42 (1.21, 1.66)
	2012	1.08 (0.97, 1.20)	3.02 (2.57, 3.55)	2.50 (2.15, 2.90)	0.94 (0.84, 1.04)	3.30 (2.69, 4.06)	1.57 (1.36, 1.82)
	p for trend	0.21	<0.001	<0.001	0.28	<0.001	<0.001
Middle	2008	1.00	1.00	1.00	1.00	1.00	1.00
	2010	1.07 (0.98, 1.18)	1.78 (1.56, 2.03)	1.69 (1.48, 1.92)	0.93 (0.85, 1.01)	1.57 (1.33, 1.84)	1.01 (0.90, 1.14)
	2012	1.07 (0.98, 1.16)	2.51 (2.22, 2.84)	2.18 (1.93, 2.46)	0.92 (0.85, 1.00)	2.27 (1.95, 2.64)	1.03 (0.92, 1.15)
	p for trend	0.25	<0.001	<0.001	0.12	<0.001	0.84
Low	2008	1.00	1.00	1.00	1.00	1.00	1.00
	2010	1.14 (0.99, 1.31)	1.77 (1.43, 2.19)	1.67 (1.35, 2.06)	1.00 (0.86, 1.15)	1.62 (1.26, 2.09)	1.14 (0.94, 1.38)
	2012	1.06 (0.93, 1.21)	2.10 (1.70, 2.58)	1.87 (1.52, 2.29)	0.90 (0.79, 1.03)	1.69 (1.34, 2.12)	0.93 (0.78, 1.11)
	p for trend	0.18	<0.001	<0.001	0.19	<0.001	0.06

Values are presented as odds ratio (95% confidence interval).
[1]Adjusted for grade level, body mass index, average spending money per week, household members, perceived self-body image, effort towards changing body weight during the last month, and amount of stress.

ated with various factors in boys and girls, with a specific focus on household SES classes. Our observations included the changing patterns in meal-skipping through 2010 and 2012, compared to 2008. For some variables, the pattern of skipping breakfast demonstrated different features from that of lunch and dinner. In most cases, for both sexes, we could infer that breakfast skipping was a voluntary choice, as our results showed that the group of students who perceived themselves as thin had a lower breakfast-skipping rate than those who

perceived themselves as fat, and the groups of students trying to lose weight showed the highest meal-skipping rate. On the other hand, the pattern of skipping lunch and dinner showed the opposite characteristics, meaning that students who perceived themselves as thin or had low bodyweight recorded an even higher skipping rate, and girls trying to gain weight recorded the highest meal-skipping rate. This has two possible implications: One is that unintended lunch- or dinner-skipping itself functions as an independent variable and influences

each individual's body type or BMI, rather than being an intended action resulting from one's perceived body type or effort to change bodyweight; the other is that there could be a tendency in the low bodyweight group and the group trying to gain weight to skip lunch or dinner and substitute other snacks in place of their regular meals. Meanwhile, for boys, when classified by the effort to change bodyweight, all groups showed the tendency to skip meals in accord with their weight changing goals for every meal. This suggests that, for the male students, lunch- and dinner skipping were also intentional and voluntary like breakfast skipping.

We found that, the greater the allowance the students received, the higher the rate of meal skipping and the risk of meal skipping. Particularly in the group of students with the greatest average spending money per week, which exceeded 60 000 Korean wons (about 50 US dollars), the odds ratios for skipping meals five times or more per week markedly increased in both sexes. This could be inferred to be related to the relatively large allowance, perhaps in dual-income families, but further research would be needed to confirm this. Regarding stress awareness, girls reported gradually increasing meal-skipping rates for all three meals as their stress from daily life increased. However, for the boys, only the breakfast-skipping rate increased as their stress increased; lunch- and dinner-skipping rates were lower in boys who experienced a bit of stress than those who felt almost none.

Students who belonged to the low household SES class had higher meal-skipping rates and higher odds ratios for frequent meal skipping compared to those of the other SES classes, which was particularly clear in the male students, whose differential between the low class and other classes was about 1.8 times. This indicates an apparent gap in regular eating behavior between the low household income level group and other groups. In addition, the students who reported not living with both parents had the highest skipping rates in both sexes for every meal, and it was more remarkable in breakfast skipping than lunch- or dinner skipping. Therefore, we propose that government-led programs be implemented to support these disadvantaged groups. For example, establishment of a public free meal service center, or implementation of programs such as food stamps or the School Breakfast Program, which have been implemented in the US, as well as programs for educating and encouraging healthy eating habits for disadvantaged adolescents, would be advantageous [30,31].

Our results show that, though the overall meal-skipping

rates and odds ratios for frequent meal skipping for lunch and dinner increased over time in both sexes, the incremental rates decreased between 2010 and 2012, particularly in the low-income group, suggesting that the existing difference in basic health behaviors or eating patterns between low SES households and others, whether it is a problem of accessibility or a problem of personal inclination, had a tendency to decrease over time. This data constitutes an improvement from a public health perspective and may be partially associated with the implementation of free lunch services in schools, which was implemented and has been extended to nearly all Korean middle and high schools throughout 2011 and 2012. On the other hand, unlike the decrease in the SES gap in lunch- and dinner-skipping, there is almost no change in the differences in breakfast-skipping rates between the low SES class and others from 2008 to 2012. The meal-skipping rates and odds ratios for breakfast generally decreased a little but did not change much between 2010 and 2012 in both sexes, and all SES classes. Nevertheless, ongoing high or increasing meal-skipping rates for any of the three meals in adolescents should be considered a significant problem.

In addition to household SES, whether or not the student lived with both parents also appears to be an important factor in adolescent eating habits and meal-skipping rates. Further consideration regarding an interaction between these two factors, as well as the high meal-skipping rates of those in the low bodyweight and high-stress groups, followed by appropriate management, may be fruitful.

Some studies in Korea have investigated the various factors that are associated with adolescents' meal skipping, such as accurate knowledge of nutrition, type of residential district, parental occupation, and health behaviors like cigarette smoking, along with the variables included in the present study such as household SES [13,15,17-19,23]. Several other studies have emphasized the factors associated with social support like care from the family, rather than household statuses [14,15,32]. Those factors turned out to be an important variable in our research as well; as represented by "family members" variable, which meant 'single- or two-parent household' in our study, it could be one explanation of why students were more likely to skip breakfast than any other meal, in that breakfast is usually and mainly served at home. Moreover, the influences of all these factors taken together may explain meal-skipping rates which remain high in spite of the expansion of free school meal services.

To conclude, the reasons behind continuously high and increasing meal-skipping rates should be analyzed, considering all the above mentioned factors, followed by appropriate interventions. Special consideration should be taken for high-risk groups such as students who are attempting to lose weight or belong to the low bodyweight group, children of single-parent or low-income families, socially alienated or neglected students, and so on, who have been identified through previous research or our study. A range of interventions should be attempted, such as providing education about nutrition, managing stress, helping students to establish a healthy self-image, and managing or encouraging schools and students to engage in a school food service program that aims to ingrain healthy eating habits into adolescents [14,15,22-24]. In addition, we should consider a range of approaches for improving our current school food service and its implementation. First, we could focus on several gaps in our program. This survey was conducted when school was in session, but more students will be at risk of frequent meal skipping during holidays when regular school lunch service is not provided. The Korean government has made an effort to cope with this problem, by running a boxed lunch delivery program with various organizations and institutions during vacations. Like this, other supplementary services can be provided to fill the gaps in meal services of existing programs. Second, satisfaction with the existing services, on the basis of frequent surveys or interviews, could be improved, using a number of different policies and interventions [33,34]. Efforts to expand school meal programs and providing better meals at school while improving hygiene and service, combined with expertise and programs that incorporate the social welfare system, would result in achieving greater efficacy of school meal programs [33-36].

In this study, we used data from 2008, 2010, and 2012 to observe the change in Korean student meal-skipping rates over time. In analyses of subgroups divided by household SES, we identified the differences in meal-skipping rates by SES. However, this was a cross-sectional study, making it difficult to establish definite causality between dependent and independent variables. Furthermore, there are calculations other than those used in this study that could have been used to determine the meal-skipping rate, which could have resulted in different findings than those reported here. Among several indices for SES of household, we used the FAS score, which is known for strong associations with health outcomes that are

related to family culture and behavior, but less so for some behaviors where peer norms are a potentially powerful influence. The FAS also has its own limitations, in that it does not reflect changing patterns in family consumption and lifestyle today [26,27]. The results from using different socioeconomic indicators other than the FAS, such as father's education level or student's perceived SES, did not reveal remarkable differences from the results of this study. Additionally, with regard to policy implementation, it is worth noting that there is a difference between an interpretation based on statistical significance, which is subject to a large sample size, and the meaning of results based on effect size, which should be considered in policy-making processes.

In conclusion, in the context of increased overall meal-skipping rates, household SES continues to play an important role in Korean adolescent eating habits related to appropriate meal intake. Although we found that the gap in eating behavior between households of differing SES showed a small reduction over time, there were also many other factors that perturb healthy eating habits, such as not living in a two-parent household or excessive stress. These factors should be further investigated and appropriate government-led interventions enacted.

CONFLICT OF INTEREST

The authors have no conflicts of interest with the material presented in this paper.

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