



Original Article

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Association between Skipping Breakfast and Overweight in Korean Adolescents: Analysis of the 13th Korea Youth Risk Behavior Web-based Survey

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In Korea, skipping breakfast is of concern as an unhealthy dietary habit. While the relationship between skipping breakfast and overweight and obesity has been established in children and adolescents in Europe, studies on this topic in Korean adolescents are scarce. Therefore, we investigated the relationship between body mass index (BMI) and skipping breakfast in Korean adolescents. Data from the 13th Korea Youth Risk Behavior Web-based Survey (2017) were analyzed. This anonymous, self-administered online questionnaire examined health behaviors including smoking, drinking, obesity, eating habits, sleep duration, and physical activity in Korean youth. Questions included those on general characteristics, such as economic status, parental education level, etc. This study included data from 56,933 adolescents aged 12-18 years. Skipping breakfast was defined as consuming breakfast fewer than five times per week. BMI, health behaviors, and general characteristics were compared between the breakfast-skipping and control groups. The skipping-breakfast and control groups comprised 25,836 (45.4%) and 31,097 (54.6%) subjects, respectively. BMI was significantly higher in the breakfast-skipping group than that in the control group (21.6 ± 3.24 kg/m² vs. 21.4 ± 3.26 kg/m², $p < 0.001$). Among the normal-weight and overweight groups, 44.9% and 47.3% skipped breakfast, respectively ($p < 0.001$). After adjusting for health behaviors and general characteristics, the risk of overweight was higher in those who skipped breakfast than that in the control group (odds ratio; 1.125, 95% confidence interval; 1.077-1.176). Skipping breakfast was related to overweight in Korean adolescents. Therefore, longitudinal research is needed to determine whether skipping breakfast is associated with overweight.

Keywords: Adolescent, Body mass index, Overweight, Skipping breakfast

Introduction

Breakfast, as a meal that balances all other meals in a day, affects whether an individual has lunch and how they distribute snacks and meals during the day [1-3]. Individuals who eat breakfast show better health overall than those who skip breakfast as they consume more essential nutrients and dietary fiber; moreover, they also have better academic achievement as breakfast improves their memory [2]. In addition, skipping breakfast is correlated with obesity and abnormal menstruation and increases the risk of anemia caused by iron deficiency, diabetes, metabolic syndrome, and mortality [3-6].

As adolescence is the period during which individuals grow physically and mentally at a rapid pace, breakfast is critical in terms of providing nutrients. In particular, skipping breakfast during adolescence may contribute to the development of eating habits associated with chronic disease in adulthood. According to the Korea National Health and Nutrition Examination Survey conducted by the

Korea Centers for Disease Control & Prevention (KCDC), the percentage of adolescents aged 12-18 years who skip breakfast increased from 23.8% in 2005 to 29.0% in 2010 and 32.6% in 2015 [7]. In particular, the percentage of adolescents skipping breakfast reached 34.6% in 2016, which is much higher than the 26.3% of adults who do so; thus, skipping breakfast is becoming increasingly common among adolescents.

According to a study on the correlation between breakfast and adolescent health, obese adolescents are more likely to skip breakfast, and breakfasts tend to be low in calories, whereas dinners tend to be high in calories [8]. Project Eating Among Teens (EAT), which followed-up 2,216 male and female adolescents for five years, revealed that the frequency of breakfast consumption was inversely associated with weight gain and body mass index (BMI) [9]. A study in Australia reported that breakfast consumption was associated with a lower BMI [10], whereas a study in Canada reported that adolescents who did not eat breakfast every day were almost twice as likely to become overweight [3,10].

Likewise, while skipping breakfast was reported to increase the risk of overweight, few studies in Korea have examined the correlation between skipping breakfast and BMI and overweight in growing adolescents. Hence, the present study aimed to examine the status of skipping breakfast among Korean middle and high-school students based on The Korea Youth Risk Behavior Web-based Survey 2017 and to identify the correlation between skipping breakfast, BMI, and overweight.

Materials and Methods

1. Data and study subjects

The present study used data from the 13th Korea Youth Risk Behavior Web-based Survey conducted in 2017. The survey was an anonymous self-administered online survey conducted on first graders in middle school to third graders in high schools nationwide to identify health behaviors such as smoking, drinking, obesity, eating habits, and physical activity among Korean adolescents.

The survey included 3,027,488 adolescents from 5,632 middle and high schools across the country as of April 2017. The sample included 400 middle schools and 400 high schools, with five middle and high schools each allocated to 17 cities and provinces. Proportional allocation was used to allocate the number of sampled schools so that the population ratio in each of the strata was identical to the sample ratio. The participants in the survey included 62,276 of 64,991 participants from 799 schools (95.8%).

The participants in the present study included 60,392 middle and high school students who provided complete responses to questionnaire items about height, weight, and breakfast frequency. The present study evaluated their BMI and conducted a secondary analysis of the participants except for those with low weight (Fig. 1).

2. Variables

1) Body measurements and obesity

The body measurements in the present study included the respondents' self-reported heights and weights up to the first decimal place. The BMI was calculated by dividing the weight (kg) by the square of the height (m). Using the 2017 Korean National Growth Charts for Children and Adolescents published by the KCDC in 2017, the present study classified the participants into percentiles by sex, age, and BMI [11]. The present study's selection criteria for overweight and obesity followed those of the Korean Pediatric Society in which overweight was defined as the 85th-94th BMI percentiles, obesity as the 95th BMI percentile or higher, and severe obesity as 120-139% of the 95th BMI percentile. In addition, the fifth BMI percentile or lower was defined as low weight and the 5th-84th BMI percentiles as normal weight.

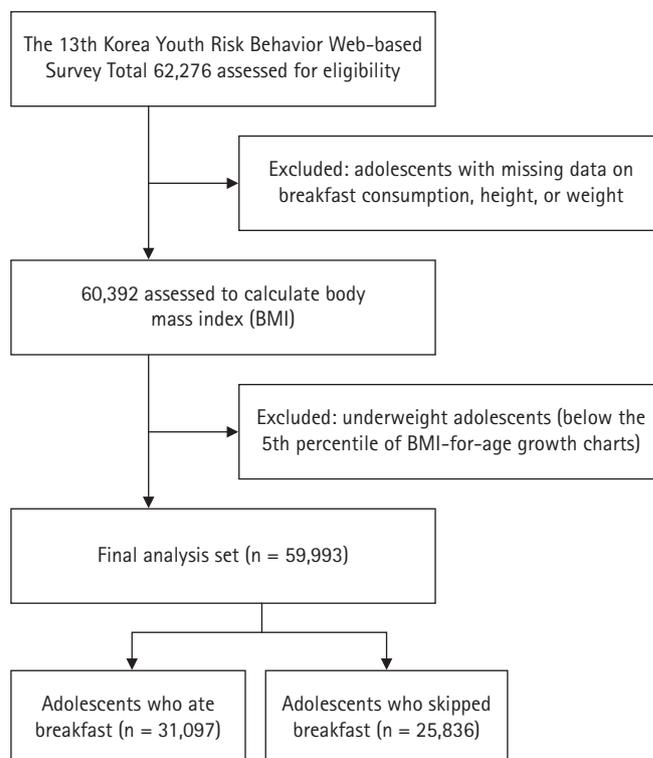


Fig. 1. Flow diagram of participant selection.

2) Factors related to eating habits and overweight

To identify participants' general characteristics, the present study included sex, age, type of housing, economic status, parent education level, drinking, and smoking. The subjective economic status responses of high, middle-high, middle, middle-low, and low in the 13th Korea Youth Risk Behavior Web-based Survey were categorized in the present study into three groups: high (high and middle-high), middle, and low (middle-low and low). Regarding parent education level, except for those who responded that they did not know, participants were divided into two groups: those with parents with college or higher and high school or lower levels of education.

Among lifestyle habits, the present study analyzed the participants' current alcohol consumption, smoking, sleep duration, and eating habits. For alcohol consumption, the participants were divided based on frequency into non-drinking (alcohol consumption less than once per month) or drinking (alcohol consumption once or more a month) groups. Similarly, the participants were divided into non-smoking (smoked for less than one day per month) and smoking (smoked for one day or more per month) groups. For eating habits, the participants were divided into those who skipped breakfast (consumed breakfast less than five days a week) and those who ate breakfast (consumed breakfast at least five days per week). The participants were also categorized according to the frequency of their consumption of soda, fast food, ramen, and cracker as three times or more less than three times per week. Finally, the participants were categorized as consuming milk and fruit intake (consumption at least once per day) or not (consumption less than once per day) based on the Dietary Reference Intakes for Koreans [12].

The characteristics of physical activity related to overweight were divided based on how many days per week the participants performed physical activity lasting for 60 minutes or longer, resulting in slightly rapid breathing (less than five or five times or more per week). They were also categorized based on how many times per week they performed vigorous physical activity and muscle-strengthening exercises lasting 20 minutes or longer (less than twice or two times or more per week).

The participants' psychological characteristics included their self-perceptions of health, body image, happiness, and stress as well as a question about whether they had seriously thought of committing suicide in the last 12 months. The participants' self-perceptions of health, body image, and happiness were each categorized into three groups: healthy, moderate, and unhealthy; skinny, moderate, and fat; and happy, av-

erage, and unhappy, respectively. The participants' self-perceptions of stress were categorized into the stressed group, who reported feeling 'stressed out a lot' or higher, and the non-stress group, who reported feeling 'stressed out a little' or lower.

3. Data analysis method

All statistical analyses were conducted using IBM SPSS Statistics for Windows version 21.0 (IBM Corp., Armonk, NY, USA). Using descriptive statistics, the present study examined the mean \pm standard deviation of continuous variables and frequencies and percentage of categorical variables. Since the Youth Risk Behavior Web-based Survey was conducted by systematic sampling and included weighted values, the present study applied these weighted values for statistical analysis. Variables known to be correlated with skipping breakfast and percentage differences between the normal-weight and overweight or higher groups were analyzed by chi-square and t-tests. Logistic regression analysis was used to calculate the adjusted odds ratios of skipping breakfast and overweight prevalence. $p < 0.05$ in two-sided tests was considered to indicate statistical significance.

Results

1. Participant general characteristics

Table 1 shows the general characteristics of adolescents aged 12-18 years included in the present study. The analysis of 56,933 adolescents who responded to the breakfast questionnaire showed that 45.4% of participants skipped breakfast, while 54.6% ate breakfast. The normal-weight and overweight or obesity groups comprised 78.7% and 21.3% of the study population, respectively. The average BMI was 21.5 ± 3.25 kg/m².

Male and female adolescents accounted for 50.6% and 49.4% of the participants, respectively. College graduation or higher accounted for 65.1% of fathers' and 58.9% of mothers' educational levels. Regarding subjective economic status, the middle group accounted for the highest portion, at 46.3%. Among eating habits, participants who drank soda three times or more per week comprised 33.0% of the population, while those eating fast food three times or more a week comprised 19.6%, those eating ramen three times or more a week comprised 25.7%, and those eating crackers three times comprised 39.3%. Participants who ate fruits or drank milk at least once per day accounted for 22.1% and 25.8% of the participants, respectively.

Table 1. Baseline characteristics (n = 56,933)

Variables		Categories	N (%)
General characteristics	Sex	Male/Female	50.6/49.4
	Age (years)	12	4,685 (8.2)
		13	9,532 (16.7)
		14	9,482 (16.7)
		15	9,517 (16.7)
		16	9,805 (17.2)
		17	9,908 (17.4)
		18	4,004 (7.0)
	Body mass index (M ± SD)		21.5 ± 3.25
	Overweight	Normal	44,796 (78.7)
		Overweight	12,137 (21.3)
	Father's education	≥ College	29,116 (65.1)
	Mother's education	≥ College	26,810 (58.9)
Family economic status	High	22,704 (39.9)	
	Middle	26,334 (46.3)	
	Low	7,895 (13.9)	
Eating habits	Experience of smoking	Yes	592 (18.2)
	Experience of alcohol drinking	Yes	13,667 (61.3)
	Breakfast consumption (≥ 5 days/week)	Yes	31,097 (54.6)
	Soda consumption (≥ 3 times/week)	Yes	18,810 (33.0)
	Fast food consumption (≥ 3 times/week)	Yes	11,159 (19.6)
	Ramen consumption (≥ 3 times/week)	Yes	14,606 (25.7)
	Cracker consumption (≥ 3 times/week)	Yes	22,349 (39.3)
	Fruit consumption (≥ 1 time/day)	Yes	12,595 (22.1)
	Milk consumption (≥ 1 time/day)	Yes	14,701 (25.8)
	Physical activity	More than 60 mins/day	Yes
Vigorous physical activity		Yes	32,773 (57.6)
Muscle strengthening		Yes	19,769 (34.7)
Psychological characteristics	Self-perception of health	Healthy	41,638 (73.1)
		Moderate	11,950 (21.0)
		Unhealthy	3,345 (5.9)
	Self-perception of body image	Skinny	12,269 (21.5)
		Moderate	21,615 (38.0)
		Fat	23,049 (40.5)
	Self-perception of happiness	Happy	38,652 (67.9)
		Average	13,983 (24.6)
		Unhappy	4,298 (7.5)
	Self-perception of stress	Yes	21,054 (37.0)
Suicidal ideation	Yes	6,704 (11.8)	
Sleep hours (M ± SD)		6.23 ± 1.47	

Values are presented as means (± standard deviation) or numbers (%).

2. Correlation between skipping breakfast and obesity

Skipping breakfast significantly affected BMI; the group that skipped breakfast had a BMI of 21.6 ± 3.24 kg/m², compared to 21.4 ± 3.26 kg/m² among those who ate breakfast (Table 2). The analysis of obesity differences depending according to breakfast habits revealed a significantly higher level of obesity

in those skipping breakfast than that in those who ate breakfast (*p* < 0.001).

Among the factors related to skipping breakfast shown in Table 2, female adolescents were more likely to skip breakfast than their male counterparts (*p* < 0.001), and a higher percentage of those skipping breakfast had parents with a less

Table 2. Obesity according to breakfast skipping and affecting factors

Variables		Skip Breakfast, n (%) (N[sum] = 25,836)	Eat Breakfast, n (%) (N[sum] = 31,097)	p-Value
Body mass index (kg/m ²)		21.6 ± 3.24	21.4 ± 3.26	< 0.001
Diagnostic criteria of obesity	Normal	20,101 (77.8)	24,695 (79.4)	< 0.001
	Overweight	2,772 (10.7)	2,974 (9.6)	
	Obese	2,767 (10.7)	3,207 (10.3)	
	Severely obese	196 (0.8)	221 (0.7)	
Sex	Male	12,370 (47.9)	16,440 (52.9)	< 0.001
	Female	13,466 (52.1)	14,657 (47.1)	
Father's education	≥ College	11,693 (60.2)	17,423 (68.8)	< 0.001
Mother's education	≥ College	10,644 (53.6)	16,166 (62.9)	< 0.001
Family economic status	High	9,389 (36.3)	13,315 (42.8)	< 0.001
	Middle	12,306 (47.6)	14,028 (45.1)	
	Low	4,141 (16.0)	3,754 (12.1)	
Soda consumption (≥ 3 times/week)	Yes	9,808 (38.0)	9,002 (28.9)	< 0.001
Fast food consumption (≥ 3 times/week)	Yes	5,669 (21.9)	5,490 (17.7)	< 0.001
Ramen consumption (≥ 3 times/week)	Yes	7,449 (28.8)	7,157 (23.0)	< 0.001
Cracker consumption (≥ 3 times/week)	Yes	9,984 (38.6)	12,365 (39.8)	< 0.05
Fruit consumption (≥ 1 time/day)	Yes	4,312 (16.7)	8,283 (26.6)	< 0.001
Milk consumption (≥ 1 time/day)	Yes	5,574 (21.6)	9,127 (29.4)	< 0.001

Values are presented as number (%).

than a college level of education ($p < 0.001$). A higher percentage of those who skipped breakfast had a low subjective economic status ($p < 0.001$).

Analysis of the correlation between skipping breakfast and adolescents' eating habits showed that those who skipped breakfast were more likely to consume soda and fast food three times or more per week ($p < 0.001$, $p < 0.05$). While the percentage of those who ate ramen three times or more a week was higher in those who skipped breakfast, the percentage of those who ate crackers three times or more a week was lower in those who skipped breakfast ($p < 0.001$). Participants who skipped breakfast were less likely to eat fruits at least once per day than those who ate breakfast. Individuals who skipped breakfast also consumed milk less frequently than did those who ate breakfast ($p < 0.001$).

3. Prevalence of overweight according to breakfast habit and general characteristics

The prevalence of overweight based on participants' general characteristics revealed a higher prevalence in male adolescents ($p < 0.001$) and the lowest prevalence among those 14 years of age ($p < 0.001$). A higher level of parental education resulted in a significantly lower prevalence of overweight ($p < 0.001$), while lower economic status led to a higher prevalence of overweight ($p < 0.001$). Smoking and drinking did

not have a statistically significant effect on the prevalence of overweight ($p = 0.837$ and $p = 0.396$, respectively).

The overweight prevalence was significantly higher in the groups that skipped breakfast ($p < 0.001$). Regarding other eating habits, although the overweight prevalence was slightly higher among those who drank soda three times or more a week, the difference was not statistically significant ($p = 0.170$). Those who ate fast food, ramen, or crackers three times or more a week also tended to have a lower prevalence of overweight ($p < 0.001$). Those who ate fruits once or more per day had a lower prevalence of overweight ($p < 0.001$). In contrast, those who drank milk once or more a day had a higher prevalence of overweight ($p < 0.001$).

Regarding the correlation between physical activity and overweight, those who performed physical activity for 60 minutes or longer for at least five days per week tended to have a higher prevalence of overweight, but the difference was not statistically significant ($p = 0.904$). A higher percentage of those in the overweight group performed vigorous physical activity at least twice per week ($p < 0.001$). In comparison, the percentage of those who did muscle strengthening activities at least twice per week was lower in the overweight group ($p < 0.001$).

Among psychological characteristics, those who subjectively perceived themselves as unhealthy and fat showed a higher prev-

absence of overweight ($p < 0.001$). Those who subjectively perceived themselves as unhappy and stressed had a significantly higher prevalence of overweight ($p = 0.003$ [$p < 0.05$], $p < 0.001$). The overweight group tended to have a significantly higher level of suicidal ideation ($p = 0.005$ [$p < 0.01$]) (Table 3).

4. Correlation between skipping breakfast and overweight

To examine the correlation between skipping breakfast and

adolescent overweight, the present study calculated the odds ratios and 95% confidence intervals in univariate and multivariate models, which input significant variables from the univariate model (gender, age, fast food, ramen, milk, number of days for vigorous physical activity, number of days for muscle-strengthening, self-perception of health, self-perception of stress, and sleep duration) as control variables.

The results showed that the group that skipped breakfast

Table 3. Prevalence of overweight according to various factors

Variables		Normal, n (%) (N[sum] = 44,796)	Overweight, n (%) (N[sum] = 12,137)	p-Value
Sex	Male	21,740 (48.5)	7,070 (58.3)	< 0.001
	Female	23,056 (51.4)	5,067 (41.7)	
Age (years)	12	3,689 (78.7)	996 (21.3)	< 0.001
	13	7,628 (80.0)	1,904 (20.0)	
	14	7,643 (80.6)	1,839 (19.4)	
	15	7,471 (78.5)	2,046 (21.5)	
	16	7,689 (78.4)	2,116 (21.6)	
	17	7,617 (76.9)	2,291 (23.1)	
	18	3,059 (76.4)	945 (23.6)	
Father's education	≥ College	23,597 (66.6)	5,519 (54.2)	< 0.001
Mother's education	≥ College	21,668 (60.0)	5,142 (54.4)	< 0.001
Family economic status	High	18,057 (40.3)	4,647 (38.3)	< 0.001
	Middle	20,877 (46.6)	5,457 (45.0)	
	Low	5,862 (13.1)	2,033 (16.7)	
Experience with smoking	Yes	458 (18.3)	134 (18.0)	0.837
Experience with alcohol consumption	Yes	10,555 (61.4)	3,112 (60.8)	0.396
Breakfast consumption	Yes	24,695 (55.1)	6,402 (52.7)	< 0.001
Soda consumption	Yes	14,737 (32.9)	4,073 (33.4)	0.170
Fast food consumption	Yes	8,990 (20.1)	2,169 (17.9)	< 0.001
Ramen consumption	Yes	11,913 (26.6)	2,693 (22.2)	< 0.001
Cracker consumption	Yes	18,362 (41.0)	3,987 (32.8)	< 0.001
Fruit consumption	Yes	10,255 (22.9)	2,340 (19.3)	< 0.001
Milk consumption	Yes	11,401 (25.5)	3,300 (27.2)	< 0.001
More than 60 mins/day	Yes	6,517 (14.5)	1,771 (14.6)	0.904
Vigorous physical activity	Yes	25,554 (57.0)	7,219 (59.5)	< 0.001
Muscle strengthening	Yes	15,783 (35.2)	3,986 (32.8)	< 0.001
Self-perception of health	Healthy	33,466 (74.7)	8,172 (67.3)	< 0.001
	Moderate Unhealthy	8,957 (20.0)	2,993 (24.7)	
Self-perception of body image		2,373 (5.3)	972 (8.0)	< 0.001
	Skinny	12,225 (27.3)	44 (0.4)	
	Moderate	20,869 (46.6)	746 (6.1)	
Self-perception of happiness	Fatty	11,702 (26.1)	11,347 (93.5)	0.003
	Happy	30,535 (68.2)	8,117 (66.9)	
	Average	10,958 (24.5)	3,025 (24.9)	
Self-perception of stress	Unhappy	3,303 (7.3)	995 (8.2)	< 0.001
	Yes	16,245 (36.3)	4,809 (39.6)	
Suicidal ideation	Yes	5,186 (11.6)	1,518 (12.5)	0.005

Values are presented as numbers (%).

was more overweight than the group that ate breakfast in the univariate model, which did not control for other variables (odds ratio [OR] 1.101, 95% confidence interval [CI] 1.057–1.146). In the model that controlled for sex and age, the risk ratio of overweight or higher increased 1.120-fold (OR 1.120, 95% CI 1.076–1.166) in the group that skipped breakfast compared to the group that ate breakfast. In the multivariate model that controlled for all other variables related to overweight, the risk ratio of overweight also increased significantly by 1.125-fold (OR 1.125, 95% CI 1.077–1.126) (Table 4).

Discussion

The present study analyzed raw data from the 2017 Youth Risk Behavior Web-based Survey of Korean adolescents (aged 12–18 years) to conduct a secondary analysis to compare the characteristics of the group of participants who skipped breakfast to those who did not and to identify the correlation between skipping breakfast and overweight.

The percentage of adolescents who skipped breakfast in the present study has increased sharply from 29.0% in 2010 to 45.4% in 2017 and skipping breakfast has become more prevalent nationwide. This increase may be attributable to a number of factors, including excessive study load, anxiety about college entrance exam, psychological insecurity during puberty, lack of appetite, or a lack of time to eat breakfast because of the need to go to school early [13]. However, skipping breakfast is a cause of overweight and obesity, and eating breakfast and regular eating habits reportedly help reduce

body fat; in addition, breakfast frequency and BMI are inversely correlated [14]. These findings were also confirmed in the Health Behavior in School-aged Children, which included 41 countries in a prospective study of adolescents [15].

The present study found a parental education level of high school or lower led to significantly higher percentages of participants who skipped skipping and who were overweight than those of adolescents with parental education levels of college or higher. A higher level of parental education, which serves as a socioeconomic indicator, leads to more interest in eating habits and health and such parents are more likely to control their adolescent children's weight, provide breakfast, and encourage healthy behaviors. This finding is consistent with those of previous studies in Korea and worldwide that a lower level of parental education results in a higher level of obesity [16–18].

According to studies on the correlation between socioeconomic level and obesity prevalence published in Korea from the early 2000s until recently, the risk of obesity has increased over time in groups with a lower socioeconomic status compared to the risk in groups with a higher socioeconomic status. Another analysis of the 2007 Korean Youth Risk Behavior Web-based Survey also reported a higher prevalence of obesity in the group with a lower level of parental education and socioeconomic status; furthermore, a study on adolescents from 33 countries reported that a lower family economic status was associated with increased skipping of breakfast and that such health behaviors had an effect on overweight [19]. Given that a lower subjective economic status resulted in higher

Table 4. Summary of stratified analyses to examine the effect of various characteristics on the pooled odds ratios of overweight for those who consumed or skipped breakfast

Variables	Model 1		Model 2		Model 3	
	OR	95% CI	OR	95% CI	OR	95% CI
Skipping breakfast	1.101	1.057–1.146	1.120	1.076–1.166	1.125	1.077–1.176
Sex			0.672	0.645–0.700	0.628	0.599–0.658
Age			1.037	1.025–1.049	1.028	1.013–1.043
Fast food consumption					0.897	0.847–0.950
Ramen					0.756	0.717–0.797
Milk					1.080	1.028–1.134
Vigorous physical activity					1.081	1.032–1.132
Muscle strengthening					0.771	0.733–0.811
Self-perception of health						
Self-perception of health (moderate)					1.438	1.364–1.516
Self-perception of health (unhealthy)					1.672	1.532–1.825
Self-perception of stress					1.115	1.064–1.169
Sleep hours					1.009	0.992–1.026

Values are presented as number (%). OR, odds ratio; CI, confidence interval.

percentages of participants who skipped breakfast and were overweight in the present study, there was a high correlation between family economic status, which is indicative of the socioeconomic level, and the risk of overweight in adolescence. This result is consistent with that of other studies that observed adolescent health inequality depending on the socioeconomic level [20]. In other words, a lower socioeconomic level increases the percentage of individuals who skip breakfast, decreases access to exercise facilities and physical activity, increases the number of non-physically active leisure hours such as television watching, and ultimately leads to overweight.

Comparison of percentages of male and female adolescents in the present study who skipped breakfast and were overweight revealed a higher percentage of female adolescents who skipped breakfast than that among their male counterparts; however, more male adolescents were overweight and were more likely to become overweight with age. The finding of a higher prevalence of overweight with age in male adolescents is consistent with that of a previous study that reported a higher percentage of obesity among older male adolescents [21] and a study that reported a higher percentage of obesity with age among adolescents aged 12-18 years [22]. The cause for this phenomenon is reported in another study that found increased intake of obesity-related foods with age in Korean adolescents, in addition to an increase in their sedentary eating habits due to lifestyles focused on college entrance exams [23]. Female adolescents may skip breakfast as they get older because they become more interested in controlling their weight and looks than their male counterparts [24]. However, the finding of a lower prevalence of overweight among female adolescents than in their male counterparts although they skipped breakfast seems to be related to physical sex differences in body type, weight, interest in physical appearance, eating speed, and total food consumption [25].

Among eating habits, excess consumption of fast food and soda is a major cause of overweight, and it is generally known that the intake of such foods should be reduced to decrease weight. Adolescent's consumption of fruits instead of fast food or ramen, which contain high levels of fat, sugar, and salt, can prevent health problems such as obesity, diabetes, and cardiovascular disease. Moreover, such health behaviors are important as they lead to healthy eating habits in adulthood [26]. In addition, adolescents who ate fast food three times or more a week reported a higher sense of unhappiness than did those who did not consume fast food as often [27]. However, the present study observed a lower prevalence of overweight among breakfast-skipping participants who ate fast food, ra-

men, and crackers three times or more a week and fruits once or more a day and higher prevalence among those in the breakfast-skipping group who drank milk at least once per day. Similar to recent study findings of a lack of correlation between the intake frequency of fast food and soda and BMI, this result suggests that intake per eating occasion, calories, and lifestyle habits rather than intake frequency may have affected the BMI [28]. In addition, multiple studies on children and adolescent have reported an inconsistent correlation between fast food intake and obesity. One report observed no statistical correlation between BMI and weekly consumption frequency of fast food [28]. Similarly, an analysis of 2,656 children and adolescents in the China Health and Nutrition Survey reported that even though the fast food intake of adolescents aged 13-17 years rose sharply from 17.9 to 26.3%, this increase did not result in increased obesity and overweight [29]. When fast food was consumed more than three times a week, adolescents' relationship with excess weight was inversely correlated with that of men, but not with women [30]. Likewise, while various studies showed a positive correlation with age, sex, and intake frequency, some studies showed no correlation or opposite findings [31]. These results can be influenced by the growth of adolescents, and the combination of personal, socioeconomic and environmental characteristics can affect the relationship between fast food intake and obesity, and also affect the individual's diet [31].

Even though physical activity is required during adolescence since it is a period where required nutrients increase and mental, psychological, and physical changes occur rapidly, not only do Korean adolescents lack physical activity but they are also under stress due to psychological burden regarding their study and exams. Therefore, as physical activity during adolescence is beneficial for health and also affects health in adulthood, it is directly related to overweight or obesity-related disease, the risk of breast cancer, and bone health in adulthood. In the present study, while a higher level of muscle strengthening twice or more per week in the group that skipped breakfast tended to reduce the overweight prevalence, vigorous physical activity twice or more per week tended to increase the overweight prevalence. This finding seems to suggest that adolescents' recent interest in body type or efforts to control weight may have affected the prevalence of overweight even though they skipped breakfast. The definitions of muscle strengthening, vigorous physical activity, and time per session were not clear and overeating after muscle strengthening or vigorous physical activity could have affected the prevalence of overweight.

With regard to the participants' psychological characteristics in the present study, the prevalence of overweight was higher when the participants subjectively perceived themselves as unhealthy and fat. In addition, a subjective perception as unhappy and stressed was significantly correlated with the prevalence of overweight. A study on Korean adults confirmed a significant correlation between overweight and depression [32] and reported that the negative effect on self-esteem was higher in obese women than in women with normal weight; it also showed a higher prevalence of depression symptoms in obese women [33]. The present study's finding that a worse self-perception of health led to a higher prevalence of overweight is attributed to the fact that perceived subjective health status is an overall indicator of physical and mental well-being and quality of life. A lower level of perceived health status has a negative effect on not only physical health but also the ability to cope with stress.

To sum up the results of the present and previous studies, skipping breakfast during adolescence increased the prevalence of overweight and socioeconomic factors and health behaviors were correlated with this increased prevalence of overweight. Since adolescent overweight transitions into adulthood obesity and is likely to cause disease in adulthood, it is important to prevent adolescent overweight to improve health in not just adolescence but also in adulthood. As the present study confirmed factors contributing to breakfast skipping and overweight in adolescents, the importance of overweight-related socioeconomic factors and mental health should not be overlooked along with efforts to increase awareness of the importance of breakfast.

Even though the present study used the Korean National Growth Charts for Children and Adolescents, which were revised in 2017 using raw data from the Youth Risk Behavior Web-based Survey to analyze the correlation between skipping breakfast and overweight among Korean adolescents, it has the limitation inherent to cross-sectional studies in that it cannot determine the causality between factors. In addition, given that only BMI was used to confirm adolescent overweight and height, weight, and socioeconomic factors were self-reported, the overweight prevalence may not have been completely accurate. Nonetheless, the present study identified the correlation between breakfast skipping and overweight among Korean adolescents.

Therefore, a carefully planned prospective study that overcomes the limitations of the present study is required to analyze related factors.

Conflict of interest

All authors declare no conflicts-of-interest related to this article.

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