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Control & Prevention
Republic of Korea

**ORIGINAL ARTICLE**

# Does Skipping Breakfast and Being Overweight Influence Academic Achievement Among Korean Adolescents?

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## Abstract

**Objectives:** Health status and health behaviors are associated with academic achievement in children and adolescents. The purpose of this study was to investigate whether skipping breakfast and being overweight are related to academic achievement of Korean adolescents.

**Methods:** Cross-sectional data on a sample of 1,652 high-school seniors (942 males and 710 females) drawn from the 2004 Korea Education Employment Panel were analyzed.

**Results:** A higher proportion of males (15.3%) than females (6.1%) was overweight ($p < 0.001$); 37% of males and 41% of females reported skipping breakfast. Overall test scores were significantly higher for females than males ($p < 0.05$), and in language and foreign language subjects. However, both males and females who reported skipping breakfast had significantly lower scores in language, mathematics, and foreign language than those who did not report skipping breakfast. Overweight males had a lower probability than normal-weight males of having the highest language scores (OR = 0.52, $p < 0.05$), but there was no difference among females. Females who skipped breakfast had a lower probability of having the highest scores in language (OR = 0.41, $p < 0.05$), mathematics (OR = 0.24, $p < 0.01$), or foreign language (OR = 0.18, $p < 0.01$), while males had a lower probability of having the highest scores in language only (OR = 0.46, $p < 0.05$).

**Conclusion:** Skipping breakfast and being overweight are associated with poor academic achievement in Korean adolescents. Eating breakfast and weight control is being discussed as the overlooked factors that may influence better academic achievement.

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# 1. Introduction

Academic achievement of students in Korea is an issue of great interest for both students and parents, in part because academic achievement is directly related to university entrance and future employment opportunities. Recently, the relationship of being overweight and health-related behaviors to academic achievement has drawn much attention. Previous studies [1−6] have reported that health-related behaviors of adolescents—including diet, physical activity, smoking, and drinking alcohol—are related to academic achievement of school-age children and adolescents.

Being overweight or obese also appears to be related to academic achievement [7−11]. For instance, one study in Thailand found that being overweight was associated with poor school performance in adolescence (grades 7−9) but not in mid-childhood (grades 3−6) [7]. Two studies [12,13] from Finland have confirmed these findings. Obesity may influence academic achievement because it associated with increased absenteeism and a higher likelihood of being held back in school. Because of health problems associated with overweight or obesity, students may increase sick days, leading to missed classes or tardiness, and subsequently affect school performance [14,15].

Additionally, one study has reported that children who were overweight had significantly lower math and reading test scores compared with normal-weight children in 3rd grade; however, after adjusting for socioeconomic variables (i.e., maternal education and ethnicity), overweight and math and reading test scores became insignificant [16].

In addition to the relationship between weight status and academic performance, interest in health behaviors, such as dietary behaviors, and academic performance of adolescents has been studied [17]. One particular behavior—eating or skipping breakfast—has received considerable interest. Children and adolescents who skip breakfast have been shown to have a higher body mass index (BMI) and lower academic achievement than those who do not forgo breakfast [4−6]. The Adolescent Health Behaviors Survey in Korea has reported that the rate of skipping breakfast more than twice a week among adolescents aged 13−18 years was 26.7% [18]. Thus, skipping breakfast may be a risk factor for weight gain because among those who skip breakfast, increased snacking, skipping lunch, living a sedentary lifestyle, and obesity are more common than among those who do eat breakfast [19].

Eating breakfast is thought to be essential for balanced nutrient intake and healthful nutritional status, both of which can influence weight status and cognitive ability related to memory and academic performance [20−22]. However, the role that being overweight and skipping breakfast plays in school academic performance

is unclear. The extent to which weight status and eating breakfast, and their relationship to academic achievement is confounded by other factors, is equally unclear. Thus, the aim of this study was to investigate the relationship of weight status and skipping breakfast and the academic achievement of Korean high school students.

# 2. Material and methods

## 2.1. Participants

The participants consisted of high school students identified and selected from the Korea Education Employment Panel (KEEP), a database that comprises 4,000 high school seniors. The KEEP is a representative sample of 3rd-year (or senior) high school students who were enrolled in high school in 2004. A stratified random sample, 4,175 schools was drawn from 1,926 Korean high schools, excluding schools with small enrollment and/or those that were located in remote areas. Of the 4,000 students enrolled in these schools, 1,695 were excluded from the study because they did not give consent to make available their academic test scores from the Korean National Scholastic Achievement Examination (KNSAE). From the remaining 2,305 students who did consent to make available their test scores and were not excluded because of missing or incorrect data on height, weight, socioeconomic variables such as family income and level of parental education, a total of 1,652 students (942 males and 710 females) were selected for analysis.

### 2.1.1. Instruments

The KNSAE and KEEP databases were the principal sources of data for this study. The KEEP questionnaire consists of 18 items on health, social relationship, and experiences in school. For purposes of this study, the main variables were weight status and skipping breakfast, and academic achievement, and questions related to these and other variables were used.

### 2.1.2. Weight status

Weight status was established by using BMI ($kg/m^2$), which was calculated from self-reported body weight and height. BMI percentiles were obtained from the data based on the U.S. Centers for Disease Control and Prevention [23]. From the sex- and age-specific (to the month) percentile for BMI, adolescents in the 85th to 95th percentiles were classified as at-risk of being overweight and those above the 95th percentile as overweight. The participants who exceeded the 85th percentile of BMI were considered overweight for the purposes of this study.

### 2.1.3. Skipping breakfast

Frequency of eating breakfast was defined as "How many times a week do you eat breakfast?" The

categories of responses were as follows: never, sometimes, or every day. Skipping breakfast was defined as those eating breakfast "never" and "sometimes" versus those eating breakfast every day.

### 2.1.4. Academic achievement

Level of academic achievement was quantified by the KNSAE scores. In this study, we used the test scores on three obligatory subjects (language, mathematics, and foreign Language parts), and the average test score for these subjects because all students took these subjects. The level of academic achievement was classified into high, medium, and low groups.

### 2.1.5. Parental education

Education levels of both parents were obtained by interviewing the parents, and the responses included the following: finished elementary school or less ($\leq$ 6 years), junior high school ($\leq$ 9 years), senior high school (10−12 years), or college (> 12 years).

### 2.1.6. Family income

Monthly family income was obtained through parent interviews (Korean 1,000 won $\approx$ US \$1). Participants were classified into three income groups: low (income < 2,400 US\$), middle (2,400−3,500 US\$), and high (income > 3,500 US\$).

### 2.1.7. Health status

General health status was classified as good, moderate, or bad. Body shape awareness was categorized as not aware, normal, or serious.

### 2.1.8. Sleeping

The number of hours of sleep per day was determined through the following response options: more than 7 h/d or less than 7 h/d.

### 2.1.9. Television watching

Time spent on watching TV was determined through the following response options: more than 60, 30−60, or less than 30 min/d.

### 2.1.10. Computer usage

Computer use was determined through the following response options: more than 60, 30−60, or less than 30 min/d.

### 2.1.11. Other health behaviors

Smoking, drinking, and physical activity were determined through the following response options: yes or no.

### 2.1.12. Tardiness and absenteeism

The frequency with which participants skipped classes or were tardy was determined through the following response options: almost never, 1−2 times per year, or more than 3 times per year.

### 2.2. Procedure

All data in KEEP were collected via personal digital assistants (PDAs) that each participant was given. Once a participant has entered the data into his or her PDA, the data were immediately transmitted to a central server where the information was stored and accessible for analysis by the investigators. The benefits of using a PDA for such data collection include increased reliability by minimizing measurement error, verifying inconsistent responses, reducing costs for recording and punching data into a transfer medium, and saving time in data processing.

### 2.3. Data analysis

We first calculated the differences in explanatory variables by sex using Pearson's coefficients, chi-square test, and Student $t$ test. Using our measure of academic achievement as the dependent variable, we then used multivariate logistic regression models to estimate the contribution of weight status and skipping breakfast to test scores. In addition, we also analyzed the data for interaction between eating breakfast, weight status, and other independent variables. All analyses were conducted using the SPSS/PC statistical program (version 20.0 for Window; SPSS, Inc., Chicago, IL, USA).

## 3. Results

In the Adolescent Health Behaviors Survey of Korea, prevalence of skipping breakfast (i.e., eating breakfast less than 5 times per week) and being overweight were 26.7% and 16.0%, respectively [18]. In our sample, skipping breakfast was higher (39.0%) and being overweight was lower (11.0%).

Table 1 shows that 37% of males and 41% of females reported eating breakfast irregularly, indicating virtually no difference in the prevalence of skipping breakfast between sexes. The prevalence of being overweight was higher for males (15.3%) than for females (6.1%; $p < 0.001$). There were no significant differences in age of parents, education level, and family income by sex.

Table 1 also shows the distribution of academic achievement and sex of participants. There were significant differences in their test scores in language, mathematics, and foreign language by sex ($p < 0.05$), with females posting significantly higher scores than males ($p < 0.05$) in language, foreign language, and average scores in these subjects. Our data show that females skipped breakfast more often than males did, but that overall academic achievement was higher for females than males.

Table 2 shows descriptive statistics for males and females separately. Both males and females who skipped breakfast had significantly lower scores in language, mathematics, and foreign language, as well as significantly lower average scores in these subjects than those who ate breakfast regularly. For males: language, 89.7

**Table 1.** Distribution of sociodemographic characteristic of participants by sex.

| Variable | Category | Males (n = 942) n (%) | Females (n = 710) n (%) | Total (n = 1,652) n (%) | p |
|---|---|---|---|---|---|
| Sociodemographic characteristics | | | | | |
| Father's age (y) | 46 under | 368 (39.1) | 278 (39.2) | 646 (39.1) | NS |
| | 47−49 | 342 (36.3) | 263 (37.0) | 605 (36.6) | |
| | 50 and older | 232 (24.6) | 169 (23.8) | 401 (24.3) | |
| | Mean $\pm$ SD* | 47.8 $\pm$ 3.8 | 47.5 $\pm$ 3.7 | 47.7 $\pm$ 3.7 | NS |
| Father's education | $\leq$ Elementary | 62 (6.6) | 42 (5.9) | 104 (6.3) | NS |
| | Junior high school | 116 (12.3) | 88 (12.4) | 204 (12.3) | |
| | High school | 453 (48.1) | 386 (54.4) | 839 (50.8) | |
| | College or higher | 311 (33.0) | 194 (27.3) | 505 (30.6) | |
| Mother's age | Under 43 | 362 (38.4) | 276 (38.9) | 638 (38.6) | NS |
| | 44−45 | 272 (28.9) | 208 (29.3) | 480 (29.1) | |
| | 45 and older | 308 (32.7) | 226 (31.8) | 534 (32.3) | |
| | Mean $\pm$ SD* | 44.7 $\pm$ 3.7 | 44.4 $\pm$ 3.4 | 44.5 $\pm$ 3.5 | NS |
| Mother's education | $\leq$ Elementary | 81 (8.6) | 52 (7.3) | 133 (8.1) | NS |
| | Junior high school | 169 (17.9) | 137 (19.3) | 306 (18.5) | |
| | High school | 555 (58.9) | 433 (61.0) | 988 (59.8) | |
| | College or higher | 137 (14.5) | 88 (12.4) | 225 (13.6) | |
| Family monthly income, Korean (US$) | $\leq$ 240 | 298 (31.6) | 256 (36.1) | 554 (33.5) | NS |
| | 241−350 | 346 (36.7) | 242 (34.1) | 588 (35.6) | |
| | 350$\leq$ | 298 (31.6) | 212 (29.9) | 510 (30.9) | |
| | Mean $\pm$ SD* | 331.2 $\pm$ 192.8 | 324.3 $\pm$ 200.5 | 328.2 $\pm$ 196.1 | NS |
| Frequency of having breakfast | Every day | 598 (63.5) | 418 (58.9) | 1,016 (61.5) | |
| | Sometimes/Never | 344 (36.6) | 292 (41.1) | 636 (38.5) | NS |
| BMI[†] | Normal | 798 (84.7) | 667 (93.9) | 1,465 (88.7) | 0.001 |
| | Overweight | 144 (15.3) | 43 (6.1) | 187 (11.3) | |
| | Mean $\pm$ SD* | 22.3 $\pm$ 3.6 | 21.0 $\pm$ 2.8 | 21.8 $\pm$ 3.3 | 0.001 |
| Subjects | Score level | | | | |
| Language | T1 | 282 (29.9) | 248 (34.9) | 530 (32.1) | 0.027 |
| | T2 | 322 (34.2) | 248 (34.9) | 570 (34.5) | |
| | T3 | 338 (35.9) | 214 (30.1) | 552 (33.4) | |
| | Mean $\pm$ SD* | 94.0 $\pm$ 20.8 | 97.5 $\pm$ 19.1 | 95.5 $\pm$ 20.2 | 0.000 |
| Mathematics | T1 | 321 (34.1) | 228 (32.1) | 549 (33.2) | 0.011 |
| | T2 | 277 (29.4) | 257 (36.2) | 534 (32.3) | |
| | T3 | 344 (36.5) | 225 (31.7) | 569 (34.4) | |
| | Mean $\pm$ SD* | 94.7 $\pm$ 18.5 | 95.1 $\pm$ 17.1 | 94.9 $\pm$ 17.9 | NS |
| Foreign Language | T1 | 288 (30.6) | 247 (34.8) | 535 (32.4) | 0.01 |
| | T2 | 300 (31.8) | 247 (34.8) | 547 (33.1) | |
| | T3 | 354 (37.6) | 216 (30.4) | 570 (34.5) | |
| | Mean $\pm$ SD* | 93.9 $\pm$ 20.4 | 96.6 $\pm$ 18.8 | 95.1 $\pm$ 19.7 | 0.006 |
| Mean score of 3 individuals | T1 | 302 (32.1) | 249 (35.1) | 551 (33.4) | NS |
| | T2 | 310 (32.9) | 247 (34.8) | 557 (33.7) | |
| | T3 | 330 (35.0) | 214 (30.1) | 544 (32.9) | |
| | Mean $\pm$ SD* | 94.2 $\pm$ 17.8 | 96.4 $\pm$ 16.1 | 95.1 $\pm$ 17.1 | 0.009 |

*Mean $\pm$ SD: $p < 0.05$ by t test; $p < 0.05$ by chi-square test; [†]Not overweight < 85 the percentile BMI, overweight $\geq$ 85th percentile. BMI = body mass index; NS = not significant; SD = standard deviation; T1 = high score group, T2 = normal score group, T3 = low score group.

versus 96.4; mathematics, 91.0 versus 96.9; foreign language 89.7 versus 96.3; average, 90.1 versus 96.5. For females: language, 92.4 versus 101.1; mathematics, 90.7 versus 98.2; foreign language, 91.2 versus 100.4; average, 91.4 versus 99.9 ($p < 0.05$).

The Pearson correlation coefficients between breakfast and watching TV, between BMI and self-reported health, and between breakfast and BMI were 0.2 ($p < 0.001$), 0.16 ($p < 0.001$), and $-0.069$ ($p < 0.001$), respectively (results not presented in the table). Among the independent variables, the correlation between watching TV and computer usage was the strongest (0.36, $p < 0.001$).

Table 3 shows that when potential confounder variables were included in the predictive logistic regression

**Table 2.** Mean differences of language, mathematics, foreign language, and mean scores by skipping breakfast and overweight by sex.

| Variables | Males | | | Females | | |
|---|---|---|---|---|---|---|
| | Eaters | Skippers | Difference | Eaters | Skippers | Difference |
| Language | 96.4 | 89.7 | 6.7* | 101.1 | 92.4 | 8.6* |
| Mathematics | 96.9 | 91.0 | 5.7* | 98.2 | 90.7 | 7.5* |
| Foreign language | 96.3 | 89.7 | 6.6* | 100.4 | 91.2 | 9.2* |
| Mean scores | 96.5 | 90.1 | 6.4* | 99.9 | 91.4 | 8.5* |
| | Normal | Overweight | Difference | Normal | Overweight | Difference |
| Language | 94.0 | 93.5 | 0.5 | 97.5 | 98.3 | 0.8 |
| Mathematics | 94.7 | 95.1 | −0.4 | 95.2 | 93.3 | 1.9 |
| Foreign language | 93.7 | 93.6 | 0.1 | 96.7 | 94.6 | 2.1 |
| Mean scores | 94.0 | 94.2 | −0.2 | 96.5 | 95.4 | 1.1 |

*$p < 0.05$ by t test.

model, adolescents who were overweight had a significantly lower probability of having the highest academic test average [odds ratio (OR) = 0.46, $p < 0.01$] than those who were not overweight. Males who were overweight had a significantly lower probability of having the highest language test scores (OR = 0.52, $p < 0.05$) than those who were not overweight, but no difference was observed among the females. In addition, participants who skipped breakfast had a significantly lower probability of having the highest average score (OR = 0.4, $p < 0.01$). Females who skipped breakfast had a significantly lower probability of having the highest scores in language, mathematics, or foreign language (language, OR = 0.41, $p < 0.05$; mathematics, OR = 0.24, $p < 0.01$; foreign language, OR = 0.18, $p < 0.01$), whereas males had a significantly lower probability of notching the highest score in language only (OR = 0.46, $p < 0.05$).

Those who were in bed longer, watch TV more, use computer more, and had more absenteeism had a significantly lower probability of having the highest scores (OR = 0.14, $p < 0.001$; OR = 0.26, $p < 0.001$; OR = 0.35, $p < 0.001$; and OR = 0.41, $p < 0.05$, respectively). Also, the higher the father's education level and the family income, the higher the probabilities became (OR = 4.53, $p < 0.001$; OR = 2.23, $p < 0.001$; OR = 3.05, $p < 0.01$; OR = 2.18, $p < 0.001$; and OR = 2.06, $p < 0.001$, respectively) (results not presented in the table).

## 4. Discussion

The purpose of this study was to investigate whether skipping breakfast and being overweight were influential factors in academic achievement among Korean adolescents. Our data show that academic achievement is strongly associated with skipping breakfast and being overweight. We found that skipping breakfast was negatively associated with test scores in language,

mathematics, and foreign language among females. Females who skipped breakfast recorded scores 7.5−9.2 points lower on the KNSAE than those who ate breakfast regularly. In the present study, the results are consistent with at least one previous report showing that eating breakfast irregularly or not at all resulted in lower attendance rates and lower scores in English, mathematics, social studies, and science among nursing students [24].

In the present study, eating breakfast was associated with better NSAE test scores for Korean high school seniors [25]. Choe et al [25] noted that students who were regular breakfast eaters recorded higher scores than those who skipped breakfast [25]. Other studies have shown that eating breakfast, lunch, and dinner on a regular basis are associated with academic achievement [26]. Adolescent students who consumed a high-quality breakfast, one that contains at least one food from the cereals group or fruits, were found to have higher average test scores than those eating a poor-quality breakfast or skipping breakfast [27]. In another study, when comparing breakfast quality in a group of children (i.e., inclusion of foods from the cereal, dairy, and fruit food groups), scores were higher in younger compared with older children, and in males compared with females [28]. The results of observational studies demonstrate that students participating in a school breakfast program had significantly better grades in math and a decrease in school absenteeism or tardiness [29]. Similar effects of breakfast consumption on grades [27], academic achievement [30], and in attention and memory [31] have been demonstrated.

In addition to the link between eating breakfast and academic achievement, we found that being overweight was related to students' language test scores and average scores on various subjects. Our results support previous studies that reported that overweight adolescents had significantly lower academic achievement [32,33] and

**Table 3.** Odds ratios based on multivariate logistic regression models for higher academic achievement (language, mathematics, foreign language, mean scores).

| Correlate | Categories | Highest score (vs. lowest score) odds ratio (95% confidence intervals) | | | | | | |
| | | Males | | | Females | | | |
| | | Language (n = 620) | Mathematics (n = 665) | Foreign language (n = 642) | Language (n = 462) | Mathematics (n = 463) | Foreign language (n = 463) | Mean scores (n = 1,095) |
|---|---|---|---|---|---|---|---|---|
| BMI[a] | Normal | Reference | | | | | | Reference |
| | Overweight | 0.52 (0.29–0.94)* | 1.05 (0.60–1.82) | 0.61 (0.30–1.16) | 1.80 (0.55–5.91) | 0.68 (0.26–1.78) | 0.96 (0.35–2.65) | 0.46 (0.27–0.79)** |
| Breakfast | Every day | Reference | | | | | | Reference |
| | Sometimes | 0.70 (0.42–1.15) | 0.68 (0.42–1.10) | 0.90 (0.54–1.49) | 0.55 (0.32–0.94)* | 0.41 (0.24–0.68)*** | 0.43 (0.24–0.74)** | 0.55 (0.38–0.81)** |
| | Never | 0.46 (0.23–0.91)* | 0.67 (0.34–1.31) | 0.59 (0.29–1.21) | 0.41 (0.19–0.88)* | 0.24 (0.11–0.53)*** | 0.18 (0.08–0.44)*** | 0.40 (0.24–0.67)** |

[a]Adjusted model (significantly at 0.05): Father education, Family income (won), Self-reported health, Body shape awareness, Sleeping time, Watching TV time, Using Computer Time, Smoking status, Drinking status, Physical activity, Tardiness, Absenteeism. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. BMI = body mass index.

lower scores in language subjects, as well as significantly lower grade-point average, than their normal-weight peers [10].

Another national study found that overweight and normal children were gaining similarly on math and reading test scores in kindergartners, resulting in significantly lower test scores among overweight children at the end of 1st grade; however, after including socioeconomic and behavioral variables, this became insignificant [15]. Similarly, overweight children have been shown to have significantly lower math and reading test scores compared with normal-weight children in 3rd grade; however, after adjusting for socio-economic variables (i.e., maternal education, ethnicity), overweight and math and reading test scores became insignificant [16]. Our study showed that academic achievement was strongly associated with skipping breakfast and being overweight. After controlling for sex, socioeconomic variables, and other health-related behavior variables, both males and females who skipped breakfast and were overweight showed a significantly lower probability of having the highest scores in the mean scores.

In addition, our results showed that academic achievement was also associated with other health-related behaviors. The longer students reported staying in bed, watching TV, using the computer, not exercising, smoking, and drinking, the poorer their academic achievement. Excessive television viewing during adolescence has been shown to elevate the risk for subsequent attention and learning difficulties [34]. Similarly, the effects of smoking or drinking on school performance can also be profound to the extent that substance and alcohol abuse can lead to physical changes in the brain and neurocognitive function [10,35−37]. With more than 16.5% of Korean adolescents at risk of being overweight or overweight and 26.7% skipping breakfast (less 5 times per week), and with concerns about adolescents' health behaviors in school, such behaviors pose significant implications for the educational effects of intervention programs, for better academic achievements, and health behaviors.

Several limitations of this study are worth mentioning. First, we used cross-sectional data and thus it is not possible to assess the causal relationship of skipping breakfast and being overweight to academic achievement. Although it is possible that adolescents who are overweight tended to skip breakfast more often than those who are not, it is more unlikely that adolescents with lower grades might have a tendency to skip breakfast more often than those with higher grades. Second, there may have been even more important confounders than those we were able to study, thus further obscuring the association between being overweight, skipping breakfast, and academic achievement. Factors such as stress [38], depression [24], and school connectedness [39−41], were not included in our

analysis. For example, school connectedness—liking school and having positive relations with teachers and peers—has been shown to be associated with health outcomes [39].

In conclusion, academic achievement was strongly associated with skipping breakfast, being overweight, and several health behaviors in Korean adolescents. These results suggest that better dietary habits and nutrition education, including the importance of eating a regular breakfast, controlling weight, and other health-related behaviors, may be important factors not only for underlying good health but also the chances for good academic achievement.

## Conflicts of interest

The authors declare no conflicts of interest.

## Acknowledgments

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