

# Health behaviors and mental health among adolescents: A comparison based on BMI using the 2021 Korea Youth Risk Behavior Survey

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## Abstract

**Background:** Obesity and underweight can have adverse effects on adolescents. However, previous obesity management program conducted in Korea for adolescents with obesity showed low effectiveness, and there are few studies on underweight Korean adolescents.

**Objective:** This study aims to analyze differences in the health behaviors and mental health of adolescents based on their body mass index (BMI).

**Methods:** Data from the 2021 Korea Youth Risk Behavior Survey were examined. The health behaviors and mental health of 53,445 adolescents were analyzed according to BMI using SAS version 9.4 with the Rao-Scott  $\chi^2$  test and logistic regression analysis.

**Results:** Regarding the difference in health behaviors according to BMI, a higher proportion of participants who are drinking alcohol and are exposed to secondhand smoke were in the underweight group than in the obesity group. The rate of obesity among those engaged in physical activity was higher than that among those involved in non-physical activity. In addition, the obesity group used smartphones more than the underweight group, while the quality of sleep was better among the underweight group than the obesity group.

**Conclusion:** While the health behaviors and mental health of adolescents according to BMI are similar to those of previous studies, there are also distinct aspects. Consequently, further exploration of health behaviors and mental health based on BMI is crucial for developing and implementing targeted nursing intervention programs for adolescents with different weights.

## Keywords

Korea; adolescents; BMI; underweight; obesity; logistic regression

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## Background

As a pivotal transitional period between childhood and adulthood, adolescence plays a crucial role in shaping lifelong health. Problematic behaviors during this phase pose a potential threat to overall well-being (Edelman & Mandel, 2010). Adolescents' health behaviors, including drinking alcohol, smoking, and physical activity, affect their physical health and contribute to emotional problems such as anxiety and depression (Cho et al., 2012). The presence of emotional problems during adolescence is a risk factor for developing psychiatric disorders in adulthood (Bae et al., 2014); thus, the management of adolescents' health behaviors and mental health is essential for ensuring long-term health outcomes.

The prevalence of obesity, which is linked to health behaviors, is escalating globally. In 1975, the global obesity rates for males and females were 0.9% and 0.7%, respectively; however, over a span of approximately 40 years, these figures had surged eightfold to 7.8% and 5.6% by 2016 (NCD Risk Factor Collaboration (NCD-RisC), 2017). This trend is also evident among adolescents: The prevalence of obesity among Korean adolescents was 13.5% in 2021, a 2.4-fold

(5.6%) increase compared to 10 years prior (Korea Disease Control and Prevention Agency, 2021).

Obesity is closely related to cancer, cerebrovascular disease, and cardiovascular disease, which are the leading causes of death in Korean. It also exacerbates chronic diseases such as diabetes and hypertension and increases health-related costs (Kim, 2013). During adolescence, obesity can have a negative impact on self-esteem and peer relationships (Lim, 2020), emotional problems (Kang et al., 2016), school adjustment, and academic achievement (Bae & Yoo, 2015).

Compared with obese adolescents, underweight adolescents have received less attention. Lee et al. (2008) targeted 11 to 17 years in Korea and defined a body mass index (BMI) of less than 15 as underweight. As a result, they found that 38.3% of male and 14.6% of female elementary school students, 29.4% of male and 10.9% of female middle school students, and 14.7% of male and 16.0% of female high school students were underweight. Being underweight during adolescence has several negative consequences, such as delaying secondary sexual characteristics and hindering learning ability and school life. Being underweight during this

life stage can, thus, negatively impact not only adulthood but also the next generation (Shim, 2011).

Various institutions have conducted life-stage-specific programs, and many researchers have identified factors related to obesity. Studies on BMI among Korean adolescents have focused on the prevention and treatment of obesity (Im et al., 2017). In obesity management programs targeting children and adolescents, various interventions such as exercise therapy (Kim et al., 2007; Kim, 2021), counseling (Yoo & Lee, 2018), and behavior modification measures (Kim et al., 2013) have been developed, and their effects have been verified. However, these obesity management programs conducted a small effect size, making it difficult to ascertain their effectiveness (Sung et al., 2013). Programs conducted for Korean adolescents who are obese have significant limitations in their use as a solution. Furthermore, most Korean adolescents are dissatisfied with their weight and physical appearance (Korea Disease Control and Prevention Agency, 2021); many make efforts to lose weight, even if they have a normal weight or are underweight (Oh et al., 2013). Strategies to help adolescents maintain a healthy weight should, consequently, be re-examined.

This study examined data from a sample of Korean middle and high school students, aiming to understand the health behaviors and mental health of Korean adolescents. The study also analyzed the differences between health behaviors and mental health according to their BMI. Through this study, we aimed to provide basic data for the development of a healthy weight management program for Korean adolescents.

## Methods

### Study Design

This descriptive research study aimed to identify differences in health behaviors and mental health among Korean adolescents according to their BMI using data from the 2021 Korea Youth Risk Behavior Survey (KYRBS).

### Samples/Participants

The data used in this study were derived from the 2021 KYRBS. Initiated in 2005, the KYRBS is administered online by the Korean Disease Control and Prevention Agency (KDCA). It employs a stratified, clustered, and multistage probability sampling methodology to gain insights into the prevailing health behaviors among middle and high school students in Korea. The 2021 KYRBS was conducted from 30 August to 11 November of that year. For this study, data from 54,848 adolescents aged 13 to 18 years who completed the online health examination survey were included. A total of 1,403 questionnaires were excluded from the analysis due to missing data on height and weight.

### Instruments

The 2021 KYRBS comprised 109 questions in 16 areas, including drinking alcohol, smoking, safety awareness, and sexual behavior. This study used items related to adolescent characteristics, health behaviors, mental health, and BMI.

*Characteristics.* Data on characteristics included their sex, school grade, economic status, academic performance, and living situation. Sex was categorized as male or female, and school grades were classified into middle and high school: 1<sup>st</sup>,

2<sup>nd</sup>, and 3<sup>rd</sup> grades. Economic status and academic performance were classified as “High,” “Medium,” and “Low.” Living situation was categorized as “with family” if they lived with family or relatives or in a childcare facility, and “alone” if they lived alone or in a dormitory.

*Health Behaviors.* Health behaviors included drinking alcohol, smoking, exposure to secondhand smoke, physical activity, and using smartphone. For drinking alcohol, the question “How many days did you have at least one drink in the last 30 days?” were used. Response of “None” was classified as “No”; all other responses were classified as “Yes.” For smoking, the questions “How many days in the last 30 days did you smoke at least one regular cigarette?” and “How many days in the last 30 days did you smoke at least one electronic cigarette (e-cigarette) that contained nicotine?” were used. Responses of “None” were classified as “No”; all other responses were classified as “Yes.” For exposure to secondhand smoke, the questions “In the past seven days, how many days did you inhale smoke from cigarettes smoked by other people in your household?”, “In the past 7 days, how many days did you inhale smoke from cigarettes smoked by other people at school or indoors (classroom, bathroom, hallway)?”, and “In the past 7 days, how many days did you inhale smoke from other people’s cigarettes at other places?” were used. For all three questions, responses of “None” were classified as “No”; all other responses were classified as “Yes.” For physical activity, answers to the questions “In the last seven days, how many days did you have a faster-than-usual heart rate and engage in physical activity for 60 minutes or more to the point of shortness of breath?” and “During the last 7 days, how many days did you do 20 minutes or more of high-intensity physical activity that made you breathless or sweaty?” were used. For both questions, responses of “None” were classified as “No”; all other responses were classified as “Yes.” For using smartphone, the question “How long did you use your smartphone on average per day for the last 7 days?” were used. Participants’ total smartphone usage time for a week was calculated by adding all the usage hours; they were then classified into groups of less than 28 hours of use and more than 28 hours of use (Alobaid et al., 2018).

*Mental Health.* Mental health variables included subjective health status, body image perception, stress, sleep quality, depression, and loneliness. For subjective health status, the question “How do you usually feel about your health?” was used. Responses of “Very healthy” and “Healthy” were classified as “Healthy,” responses of “Average” were classified as “Average,” and responses of “Unhealthy” and “Very unhealthy” were classified as “Unhealthy.” For body image perception, the question “What do you think about your body shape?” was used. Responses of “Very skinny” and “Skinny” were classified as “Skinny,” responses of “Average” were classified as “Average,” and responses of “Fat” and “Very fat” were classified as “Fat.” For stress, the question “How much stress do you normally feel?” was used. Responses of “Very much” and “A lot” were classified as “High,” and responses of “Average,” “Not very much,” and “Not at all” were classified as “Low.” For sleep quality, the question “Do you think the amount of time you were asleep for the last 7 days was enough to recover from fatigue?” was used. Responses of “Never enough” and “Not enough” were classified as “Bad,” and responses of “So-so,” “Sufficient,” and “Very sufficient” were

classified as “Good.” For depression, the question “In the past 12 months, have you ever felt so sad or hopeless that you stopped your daily life for 2 weeks?” was used. Responses “Yes” were classified as “Yes,” and “No” were classified as “No”. For loneliness, the question “In the past 12 months, how often have you felt lonely?” was used. Responses of “I always feel lonely,” “I feel lonely often,” and “I feel lonely occasionally” were classified as “Yes,” while responses of “I rarely feel lonely” and “I don’t feel lonely at all” were classified as “No.”

**BMI.** BMI was calculated based on participants’ height and weight. A BMI of less than 18.5 was classified as underweight, 18.5 to less than 25.0 was classified as healthy weight, and 25.0 or more was classified as obese (Hyun & Lee, 2013).

### Data Collection

To obtain data for this study, the researcher entered a request including the purpose of use, plan for use, and required data into the KDCA homepage (<https://www.kdca.go.kr/yhs/home.jsp>). The request was approved, and the raw data were downloaded from the KDCA homepage and used for the analysis.

### Data Analysis

SAS version 9.4 (SAS Institute, Cary, NC, USA) was used for data analysis. For the characteristics, health behaviors, and mental health, frequencies and weighted percentages were calculated. The characteristics, health behaviors, and mental health according to BMI were analyzed using the Rao-Scott  $\chi^2$  test. Differences in characteristics, health behaviors, and mental health by weight group were evaluated using logistic regression.

### Ethical Consideration

In the KYRBS, participants’ data are given a unique number that cannot be identified; therefore, no personal information on the participants is visible, and anonymity and confidentiality are guaranteed during the survey. Informed consent is obtained from all participants prior to their participation in the survey. The survey’s findings are made accessible to the public for academic purposes. This study was conducted after being exempted from deliberation by the Institutional Bioethics Committee of K University (No.1041459-202304-HR-004-01).

## Results

### Characteristics according to BMI

**Table 1** shows the BMI data in relation to participants’ characteristics. Among the total participants, 51.8% were male. Across the different groups, 16.6% of the male participants were in the underweight group, 58.1% were in the healthy weight group, and 25.3% were in the obese group. Regarding school grades, 51.2% were middle school students. In the obesity group, the highest proportion (23.3%) were high school third-year students; in the underweight group, the highest proportion (31.7%) were middle school first-year students. Economic status was categorized as high (40.3%), medium (49.1%), or low (10.6%). For all three categories, the highest proportion of participants was in the healthy weight

group. Comparing the obesity and underweight groups, more participants with a high (22.6%) or medium (21.4%) economic status were in the underweight group, while more participants with a low (21.6%) economic status were in the obesity group. Academic performance was classified as high (37.3%), medium (31.1%), or low (31.6%). In the comparison between the obesity and underweight groups, participants with high (23.4%) and medium (21.3%) academic performance had a higher ratio in the underweight group, whereas those with low (21.1%) academic performance had a higher ratio in the obesity group. A total of 96.8% of participants reported having family support. When comparing the family contexts of the obesity and underweight groups, 21.8% of those living with family members and 14.2% of those living alone were in the underweight group.

### Health Behaviors and Mental Health according to BMI

**Table 1** shows the participants’ health behaviors and mental health according to BMI. The healthy weight group accounted for a large proportion of all health behaviors. Focusing on the comparison between the underweight and obesity groups, the following health behaviors were examined: drinking alcohol ( $\chi^2 = 159.76$ ,  $p < 0.001$ ), smoking ( $\chi^2 = 151.68$ ,  $p < 0.001$ ), exposure to secondhand smoke ( $\chi^2 = 19.59$ ,  $p < 0.001$ ), physical activity ( $\chi^2 = 109.19$ ,  $p < 0.001$ ), and using smartphone ( $\chi^2 = 19.03$ ,  $p < 0.001$ ). The results showed that the underweight group had a higher prevalence of drinking alcohol (22.7%) compared to the obesity group (17.3%). A higher prevalence of smoking was found in the obesity group, with 24.3% of those who smoked cigarettes and 22.2% of those who smoked electronic cigarettes. This was in comparison to the 13.4% who smoked cigarettes and 15.3% who smoked electronic cigarettes in the underweight group. Those who used both cigarettes and electronic cigarettes and were in the underweight group were 22.4%, which was higher than the 17.6% in the obesity group.

Furthermore, the underweight group reported higher rates of secondhand smoke exposure at 22.2%, compared to 17.5% in the obesity group. A total of 20.3% of participants who undertook physical activity were in the underweight group, which was higher than those in the obesity group (19.1%). As for using smartphone, 22.9% of the participants who used smartphones for more than 28 hours per week were in the obesity group, compared to only 20.1% in the underweight group.

Mental health according to BMI showed significant differences in the variables of subjective health status ( $\chi^2 = 403.43$ ,  $p < 0.001$ ), body image perception ( $\chi^2 = 16425.58$ ,  $p < 0.001$ ), quality of sleep ( $\chi^2 = 38.26$ ,  $p < 0.001$ ) depression ( $\chi^2 = 17.37$ ,  $p < 0.001$ ), and loneliness ( $\chi^2 = 12.46$ ,  $p = 0.002$ ). Among the participants, 20.7% of those who reported feeling “Healthy,” 23.4% of those who felt “Average,” and 23.1% of those who felt “Unhealthy” were in the underweight group. And, 16.1% of those who felt “Healthy,” 20.2% of those who felt “Average,” and 26.3% of those who felt “Unhealthy” were in the obesity group. Thus, the obesity group was more likely to rate their health unhealthy than the underweight group.

**Table 1** Differences in characteristics, health behaviors, and mental health according to BMI† (N = 53,445)

Variables	Category	n	(Weighted frequency)	%	Underweight		Healthy weight		Obesity		Rao-Scott $\chi^2$	p				
					n	(Weighted frequency)	%	n	(Weighted frequency)	%			n	(Weighted frequency)	%	
Characteristics	Sex	Male	27,773	(1,330,045)	51.8	4,651	(220,188)	16.6	16,061	(772,986)	58.1	7,061	(336,871)	25.3	2388.804	<0.001
		Female	25,672	(1,236,297)	48.2	6,912	(334,019)	27.0	16,054	(774,557)	62.7	2,706	(127,721)	10.3		
	School grade	Middle 1st	9,802	(437,860)	17.1	3,039	(138,682)	31.7	5,390	(240,728)	55.0	1,373	(58,450)	13.3	1023.019	<0.001
		Middle 2nd	10,009	(459,306)	17.9	2,631	(122,056)	26.6	5,753	(265,136)	57.7	1,625	(72,114)	15.7		
		Middle 3rd	9,508	(415,021)	16.2	2,180	(98,092)	23.6	5,679	(246,953)	59.5	1,649	(69,976)	16.9		
		High 1st	8,266	(401,569)	15.6	1,506	(75,305)	18.8	5,149	(249,719)	62.2	1,611	(76,545)	19.1		
		High 2nd	8,398	(424,461)	16.5	1,281	(66,381)	15.6	5,340	(270,264)	63.7	1,777	(87,816)	20.7		
	Economic status	High 3rd	7,462	(428,124)	16.7	926	(53,692)	12.5	4,804	(274,742)	64.2	1,732	(99,690)	23.3	65.114	<0.001
		High	21,095	(1,033,830)	40.3	4,760	(233,613)	22.6	12,640	(621,053)	60.1	3,695	(179,164)	17.3		
		Medium	26,438	(1,259,333)	49.1	5,664	(269,175)	21.4	15,981	(763,858)	60.7	4,793	(226,300)	18.0		
	Academic performance	Low	5,912	(273,179)	10.6	1,139	(51,418)	18.8	3,494	(162,632)	59.5	1,279	(59,128)	21.6	163.608	<0.001
		High	20,110	(957,602)	37.3	4,689	(224,380)	23.4	12,214	(583,026)	60.9	3,207	(150,196)	15.7		
		Medium	16,530	(798,608)	31.1	3,529	(169,776)	21.3	10,006	(485,452)	60.8	2,995	(143,380)	18.0		
	Living situation	Low	16,805	(810,132)	31.6	3,345	(160,051)	19.8	9,895	(479,065)	59.1	3,565	(171,016)	21.1	47.823	<0.001
With family		51,417	(2,484,657)	96.8	11,257	(542,581)	21.8	30,813	(1,495,315)	60.2	9,347	(446,761)	18.0			
Health Behaviors	Drinking alcohol	Alone	2,028	(81,685)	3.2	306	(11,627)	14.2	1,302	(52,227)	63.9	420	(17,831)	21.8	159.76	<0.001
		No	11,827	(568,692)	22.2	2,101	(99,764)	17.5	7,258	(350,231)	61.6	2,468	(118,696)	20.9		
	Yes	41,618	(1,997,650)	77.8	9,462	(454,443)	22.7	24,857	(1,197,312)	60.0	7,299	(345,896)	17.3	151.68	<0.001	
	Smoking	No	3,065	(150,281)	5.9	477	(22,534)	15.0	1,928	(94,857)	63.1	660	(32,890)			21.9
		Cigarette	547	(27,035)	1.1	74	(3,617)	13.4	343	(16,857)	62.5	130	(6,560)	24.3		
		E-cigarette†	2,053	(99,447)	3.9	306	(15,253)	15.3	1,277	(62,160)	62.5	470	(22,034)	22.2		
	Exposure to secondhand smoke	Both	47,780	(2,289,578)	89.2	10,706	(512,802)	22.4	28,567	(1,373,668)	60.0	8,507	(403,108)	17.6	19.59	<0.001
		No	25,180	(1,206,293)	47.0	5,296	(252,471)	20.9	15,073	(726,781)	60.3	4,811	(227,041)	18.8		
	Yes	28,265	(1,360,049)	53.0	6,267	(301,736)	22.2	17,042	(820,762)	60.3	4,956	(237,551)	17.5	109.19	<0.001	
	Physical activity	No	17,768	(872,953)	34.0	4,287	(210,169)	24.1	10,592	(521,178)	59.7	2,889	(141,606)			16.2
		Yes	35,677	(1,693,389)	66.0	7,276	(344,039)	20.3	21,523	(1,026,365)	60.6	6,878	(322,986)	19.1	19.03	<0.001
	Using smartphone (week)	<28hr	52,050	(2,503,004)	97.5	11,290	(541,490)	21.6	31,315	(1,511,444)	60.4	9,445	(450,069)	18.0		
		≥28hr	1,395	(63,338)	2.5	273	(12,717)	20.1	800	(36,098)	57.0	322	(14,523)	22.9	403.43	<0.001
	Mental Health	Subjective health status	Healthy	34,896	(1,671,726)	65.1	7,260	(345,484)	20.7	21,947	(1,056,666)	63.2	5,689	(269,576)		
Average			13,837	(665,086)	25.9	3,209	(155,687)	23.4	7,784	(374,865)	56.4	2,844	(134,535)	20.2		
Unhealthy		4,712	(229,530)	8.9	1,094	(53,036)	23.1	2,384	(116,013)	50.6	1,234	(60,481)	26.3			
Body image perception	Skinny	13,687	(662,440)	25.8	8,523	(409,014)	61.7	5,134	(251,966)	38.2	30	(1,459)	0.2	16425.58	<0.001	
	Average	19,363	(932,081)	36.3	2,835	(135,450)	14.5	15,997	(771,275)	82.8	531	(25,356)	2.7			
Fat	20,395	(971,820)	37.9	205	(9,743)	1.0	10,984	(524,301)	54.0	9,206	(437,777)	45.0	3.86	0.145		
Stress	High	10,173	(481,749)	18.8	2,153	(100,303)	20.8	6,115	(292,572)	60.8	1,905	(88,874)			18.4	
	Low	43,272	(2,084,593)	81.2	9,410	(453,904)	21.8	26,000	(1,254,971)	60.2	7,862	(375,718)	18.0	38.26	<0.001	
Sleep quality	Good	29,953	(1,420,234)	55.3	6,473	(304,346)	21.4	17,679	(844,327)	59.5	5,801	(271,561)	19.1			
	Bad	23,492	(1,146,108)	44.7	5,090	(249,862)	21.8	14,436	(703,216)	61.4	3,966	(193,031)	16.8	17.37	<0.001	
Depression	Yes	39,219	(1,883,817)	73.4	8,452	(405,334)	21.5	23,447	(1,129,302)	60.0	7,320	(349,180)	18.5			
	No	14,226	(682,525)	26.6	3,111	(148,873)	21.8	8,668	(418,241)	61.3	2,447	(115,411)	16.9	12.46	0.002	
Loneliness	Yes	25,736	(1,228,468)	47.9	5,549	(265,566)	21.6	15,260	(732,399)	59.6	4,927	(230,503)	18.8			
	No	27,709	(1,337,873)	52.1	6,014	(288,641)	21.6	16,855	(815,144)	60.9	4,840	(234,089)	17.5			

†BMI = Body mass index, †E-cigarette = Electronic cigarette

Regarding body image perception, 61.7% of those who described themselves as “Skinny,” 14.5% of those who described themselves as “Average,” and 1.0% who described themselves as “Fat” were in the underweight group. In contrast, 0.2% of those who reported themselves as “Skinny,” 2.7% of those who reported themselves as “Average,” and 45.0% of those who reported themselves as “Fat” were in the obesity group, indicating that this group was more likely to recognize their body type as fat than the underweight group. Among the participants, 21.4% of those who rated their sleep quality as “Good” and 21.8% who said that their sleep quality was “Bad” were in the underweight group; 19.1% of those who rated their sleep quality as “Good” and 16.8% of those who rated it as “Bad” were in the obesity group. For those with depression, 21.5% were in the underweight group, and 18.5% were in the obesity group. Among those who have experienced loneliness, 21.6% were in the underweight group, and 18.8% were in the obesity group.

### Differences in Characteristics, Health Behaviors, and Mental Health according to BMI

**Table 2** shows the results of the regression analysis, which examined characteristics, health behaviors, and mental health based on a healthy weight to confirm their associations with BMI. Analyzing the obesity group in relation to the healthy weight group, it was found that higher school grades (odds ratio [OR] = 2.69, 95% confidence interval [CI] = 2.39~3.03), lower academic performance (OR = 1.15, 95% CI = 1.06~1.25), more physical activity (OR = 1.13, 95% CI = 1.05~1.21), using smartphones (OR = 1.32, 95% CI = 1.10~1.59), unhealthy subjective health status (OR = 1.61, 95% CI = 1.45~1.78), fat body image (OR = 272.19, 95% CI = 179.33~413.12), better quality of sleep (OR = 1.14, 95% CI = 1.07~1.21), and more depression (OR = 1.11, 95% CI = 1.03~1.20).

On the other hand, analyzing the underweight group in relation to the healthy weight group, it was found that female (OR = 4.25, 95% CI = 3.93~4.59), lower academic performance (OR = 1.21, 95% CI = 1.12~1.31), drinking alcohol (OR = 1.16, 95% CI = 1.07~1.26), more using smartphones (OR = 1.25, 95% CI = 1.02~1.53), unhealthy subjective health status (OR = 1.44, 95% CI = 1.29~1.61), low stress (OR = 1.11, 95% CI = 1.02~1.21), more loneliness (OR = 1.18, 95% CI = 1.10~1.26).

## Discussion

Obesity can have adverse effects on adolescents. In addition, being underweight adversely affects brain growth, recovery, and secondary sexual characteristics in adolescents (Shim, 2011). It is, thus, important to maintain a healthy weight in adolescence. However, there are few studies on underweight Korean adolescents. Moreover, a previous obesity management program conducted in Korea for adolescents with obesity showed low effectiveness (Sung et al., 2013), highlighting the need for a new perspective. Accordingly, this study aimed to provide basic data to inform the development of a healthy weight management program by comparing the health behaviors and mental health of Korean adolescents according to BMI.

The study's results are discussed below, focusing on the

obesity and underweight groups rather than the healthy weight group, which accounted for the highest proportion of the sample. The difference in characteristics according to BMI showed a high ratio of males in the obesity group, and that obesity increased as the school grade increased. In contrast, the ratio of female adolescents was high in the underweight group, although this ratio decreased as school grades increased. These results may be related to the fact that females tend to have better eating habits than males, try to eat a variety of foods, including vegetables or milk, and are more interested in weight management; therefore, they tend to control their diet more than males (Park et al., 2000). As Korean adolescents enter middle school, their stress levels increase since their education becomes more focused on passing entrance exams. Since this stress can cause binge eating or overeating, it is thought that this may explain why obesity increased and underweight decreased as school grades increased (Yun, 2020).

In this study, better economic status was related to a higher rate of underweight and a lower rate of obesity. If economic status is poor, low-cost, high-calorie, and low-nutrition food may frequently be provided rather than fresh and healthy food. Further, since both parents may have to work, care may be limited, and children's snack intake can increase (Park & Song, 2019; Wang & Lim, 2012). Consequently, the proportion of obese adolescents in lower income was high. In contrast, Im et al. (2017) found that eating fast food and ramen three or more times a week was more common among underweight adolescents and less common among adolescents with obesity than among those with a normal weight. Similarly, as underweight adolescents have poor eating habits, such as frequent consumption of ramen and snacks (Kim et al., 2021; Park & Song, 2019), adolescents' eating habits should be closely examined. Further, it is possible that individuals with gastrointestinal diseases may not become obese even if they consume high-calorie, low-nutrient foods. As such, it is essential to prioritize attention to any underlying health issues among underweight adolescents.

This study's results also showed that the rate of obesity increased as academic performance decreased. Moon and Park (2009) reported that the higher the stress related to obesity, the lower the academic achievement. In contrast, Lee and Kim (2011) found that female middle school students at risk of eating disorders experienced more academic problems than those with a normal weight. Low academic achievement negatively affects adolescents' self-concept formation, causing a sense of inferiority, psychological atrophy, and a vicious cycle of low achievement motivation due to poor learning attitudes (Jo & Kim, 2012). Participation in programs to reduce BMI, such as focusing on physical activity and improving eating habits, can help adolescents with obesity perceive themselves positively and induce psychological changes to improve their academic achievement.

Regarding the difference in health behaviors according to BMI, the rates of drinking alcohol were higher for the underweight group than the obesity group. However, Im et al. (2017) found that obesity was highly associated with drinking alcohol, offering a contradictory result. Therefore, it is necessary to confirm the relationship between drinking alcohol and BMI in adolescents through prospective studies. For adolescents, body image is a crucial factor in promoting

healthy behaviors and correcting problematic behaviors (Yoon, 2022; Yun, 2020). A negative body image can be a barrier to practicing healthy behaviors and trigger inappropriate weight loss behaviors (Yun, 2020). In Korea, a quarter of adolescents have a distorted image of their bodies (Yoon, 2022). They do not view their bodies objectively but instead dissect them into

parts and believe they need to eliminate fat or muscle to achieve an ideal figure (Ahn & Ha, 2016). To counteract unhealthy habits among adolescents, it is essential to help them develop a positive body image and an accurate perception of their bodies.

**Table 2** Differences in characteristics, health behaviors, and mental health according to BMI† (N = 53,445)

Variables	Category	Underweight		Obesity		
		OR (95% CI)	p	OR (95% CI)	p	
Characteristics	Sex	Male	Ref.		Ref.	
		Female	4.25(3.93~4.59)	<0.001	0.22(0.20~0.23)	<0.001
	School grade	Middle 1st	Ref.	<0.001	Ref.	<0.001
		Middle 2nd	0.63(0.57~0.69)	<0.001	1.32(1.19~1.47)	<0.001
		Middle 3rd	0.46(0.42~0.51)	<0.001	1.62(1.45~1.82)	<0.001
		High 1st	0.30(0.27~0.34)	<0.001	2.06(1.82~2.34)	<0.001
		High 2nd	0.23(0.21~0.26)	<0.001	2.23(1.98~2.52)	<0.001
		High 3rd	0.18(0.16~0.20)	<0.001	2.69(2.39~3.03)	<0.001
	Economic status	High	Ref.	0.579	Ref.	0.875
		Medium	1.01(0.94~1.07)	0.885	0.98(0.92~1.05)	0.617
		Low	0.95(0.85~1.06)	0.367	0.98(0.88~1.10)	0.731
	Academic performance	High	Ref.	<0.001	Ref.	0.001
		Medium	1.16(1.08~1.26)	<0.001	1.12(1.03~1.21)	0.007
Low		1.21(1.12~1.31)	<0.001	1.15(1.06~1.25)	0.001	
Living situation	With family	Ref.		Ref.		
	Alone	0.83(0.67~1.03)	0.090	1.09(0.92~1.30)	0.316	
Health Behaviors	Drinking alcohol	No	Ref.		Ref.	
		Yes	1.16(1.07~1.26)	<0.001	0.94(0.87~1.02)	0.112
	Smoking	No	Ref.	0.135	Ref.	0.888
		Cigarette	0.78(0.54~1.13)	0.181	1.08(0.78~1.50)	0.645
		E-cigarette†	0.91(0.71~1.16)	0.441	1.07(0.86~1.32)	0.544
		Both	1.06(0.91~1.24)	0.474	1.06(0.92~1.22)	0.447
	Exposure to secondhand smoke	No	Ref.		Ref.	
		Yes	0.99(0.94~1.05)	0.802	0.99(0.93~1.05)	0.701
	Physical activity	No	Ref.		Ref.	
		Yes	0.86(0.81~0.92)	<0.001	1.13(1.05~1.21)	0.001
	Using smartphone (week)	<28hr	Ref.		Ref.	
≥28hr		1.25(1.02~1.53)	0.034	1.32(1.10~1.59)	0.003	
Mental Health	Subjective health status	Healthy	Ref.	<0.001	Ref.	<0.001
		Average	1.37(1.27~1.47)	<0.001	1.24(1.16~1.33)	<0.001
		Unhealthy	1.44(1.29~1.61)	<0.001	1.61(1.45~1.78)	<0.001
	Body image perception	Skinny	Ref.	<0.001	Ref.	<0.001
		Average	0.06(0.05~0.06)	<0.001	8.65(5.65~13.26)	<0.001
		Fat	0.01(0.00~0.01)	<0.001	272.19(179.33~413.12)	<0.001
	Stress	High	Ref.		Ref.	
		Low	1.11(1.02~1.21)	0.019	0.96(0.88~1.04)	0.323
	Sleep quality	Bad	Ref.		Ref.	
		Good	0.99(0.93~1.06)	0.717	1.14(1.07~1.21)	<0.001
	Depression	No	Ref.		Ref.	
		Yes	1.01(0.93~1.08)	0.893	1.11(1.03~1.20)	0.004
	Loneliness	No	Ref.		Ref.	
Yes		1.18(1.10~1.26)	<0.001	1.07(1.00~1.14)	0.068	

†BMI = Body mass index; CI = Confidence interval; OR = Odds ratio; †E-cigarette = Electronic cigarette

In this study, the rate of obesity among those engaged in physical activity was higher than that among those involved in non-physical activity. This result is similar to that of Im et al. (2017) but contrasts with the result that obesity decreases as physical activity increases (Yoon, 2018). In particular, adolescents may lead a sedentary lifestyle by playing games or watching videos, and physical activity and lack of exercise can cause obesity (Im et al., 2017). Previously, low levels of physical activity were considered to result in obesity (Brown et al., 2019; Hong, 2019). However, it cannot be concluded that a person with obesity will be inactive: In this study, the ratio of physical activity to obesity was relatively high. Consequently,

there is a need to reconsider obesity from a public health perspective.

Conversely, being underweight was more common among adolescents who did not participate in physical activity than those who did. This result contrasts with that of being obese. Kim et al. (2013) found that adolescents into obese and non-obese groups only and do not consider the status of adolescents who are underweight. Effective nutrition management programs need to identify and address the characteristics associated with underweight youth separate from obesity.

If smartphones are used for an average of 28 hours or

more per week, it can be considered excessive use (Alobaid et al., 2018). In this study, the obesity group used smartphones for more hours per week than the underweight group. However, Park and Song (2019) found that while reading online news and watching games or user-created content on a smartphone increased the risk of obesity, sending messages or chatting reduced it. Thus, though adolescents' BMI may increase with a sedentary life in which they spend a lot of time using smartphones, daily activities such as chatting can decrease their BMI because they can be done while moving or exercising. As the relationship between smartphone use and BMI remains unclear, prospective studies that can confirm this relationship are needed.

Regarding the differences in BMI according to mental health, the obesity ratio increased as subjective health status and body image perception deteriorated. Obesity is a very sensitive problem in adolescence, which is when a sense of self-identity is formed. As such, obesity can lead to negative outcomes such as an inferiority complex, avoidance of interpersonal relationships, self-abasement, and depression (Im et al., 2017). Maintaining a healthy weight improves adolescents' subjective health status and body image perceptions; therefore, programs to help adolescents manage their weight are necessary.

This study found that sleep quality was better among the underweight group than the obesity group. This finding is similar to that of Kwon et al. (2010), who observed that BMI significantly decreased as sleep duration increased. In contrast, Im et al. (2017) found that the obesity rate increased as sleep quality improved. Consequently, further analysis of the relationship between sleep quality and BMI is required. In addition, if the links between sleep patterns and BMI are identified, customized sleep management can be provided through a BMI-based weight management program.

In this study, the underweight group had a higher probability of experiencing depression than the obese group. This result is consistent with that of (Hong & Hong, 2019) but contrasts that of Seo et al. (2019). Kim et al. (2023) examined adult females and found that depression was significantly higher in those with BMIs in the underweight and severely obese ranges and those who perceived their body shape as thin or obese. These results suggest that dissatisfaction with one's body and negative perceptions of body shape may contribute to depression. Nevertheless, studies have reported that obesity and depression can affect both directions rather than being preceded by the other (Milaneschi et al., 2019). In this study, loneliness was also more likely to be experienced by the underweight group than the obesity group.

Conversely, Hajek and König (2019) found that loneliness was higher among obese individuals. Through a systematic review, Hajek et al. (2021) acknowledged the correlation between obesity and loneliness but reported that it was difficult to generalize the results. Further research that explores the relationship between obesity, depression, and loneliness is, thus, needed.

Jung et al. (2017) found that underweight and obese individuals had a 16% and 13% higher risk of depression than those with a normal weight. Currently, in Korea, inappropriate weight-loss behaviors among adolescents that result from a culture that prefers a very thin body type are recognized as a problem. These behaviors hinder adolescents' physical and

mental growth and can cause depression, stress, and suicidal behaviors (Kim, 2021). It is necessary to help adolescents form a positive body image, perceive their bodies objectively, and improve their self-esteem. In addition, since previous studies have focused primarily on adults or multiple age groups, further research specifically conducted with adolescents is needed.

This study found that while the health behaviors and mental health of adolescents according to BMI are similar to those of previous studies, there are also distinct aspects. As a result, ongoing exploration of health behaviors and mental health based on BMI is crucial for developing and implementing targeted intervention programs for each group.

### Implications of the Study for Nursing Practice

This study has several important implications for nursing practice. First, it is necessary to establish awareness of healthy weight throughout society, including the healthcare and nursing profession. Adolescents' interest in appearance gradually increases, forming their body image by comparing their bodies with others. This subjective perception of body type is difficult to escape, given the influence of social and mass media. Due to a cultural belief that thinness is beautiful and positive, adolescents prefer being underweight, which can cause various problems, including eating disorders (Kim, 2021). Society must be adjusted to help instill awareness of healthy weight in adolescents, allow them to establish a healthy body image, and enable them to accept their bodies and perceive them positively.

### Limitations and Recommendations

The KYRBS does not include indicators of underweight. Research is needed on obesity and underweight in adolescents, their characteristics, and negative weight control behaviors. Managing an appropriate weight during the growth and development period of adolescence is of utmost importance. In particular, school health programs in Korea tend to focus on overweight or obese adolescents; thus, physical activity for underweight adolescents should also be considered.

Additionally, to understand health and problem behaviors among adolescents, it is necessary to consider their physical characteristics and perceived body image. It is believed that establishing a healthy body image for adolescents will help them recognize a healthy weight and learn balanced eating habits, suppress negative emotions, and further contribute to forming self-esteem and self-identity.

Since this study used school-level data, the results should be interpreted cautiously since data for adolescents who had not yet entered middle or high school were omitted. In addition, measurement error is possible because we did not directly measure participants' height and weight and received responses through a self-report questionnaire. In particular, females are more sensitive to height and weight than male; therefore, they may tend to overreport their height and underreport their weight. Consequently, subsequent studies should present results obtained using actual measured height and weight data. Nevertheless, this study is significant because it provides basic data for developing a future healthy weight management program for adolescents by confirming health behaviors and mental health according to BMI, using

data that represents Korean adolescents at the national level.

## Conclusion

This study aimed to identify differences in adolescents' health behaviors and mental health according to their BMI using data from the 2021 KYRBS. The findings revealed a high proportion of underweight female adolescents. As the grade level increased and economic status improved, underweight increased, and obesity decreased. The proportion of adolescents who were obese was higher among those with low academic performance, whereas underweight adolescents showed higher rates of drinking alcohol and exposure to secondhand smoke. Physical activity was found to be higher in the obesity group than in the underweight group. However, the level of physical inactivity in the obesity group could not be conclusively determined. In addition, the obesity group spent more time using smartphones than the underweight group. Subjective health status and body shape recognition were poor in the obesity group, and depression and loneliness were high in the underweight group, although quality of sleep was good. To develop an effective healthy weight management program for adolescents, we must break away from existing stereotypes. It is necessary to develop a customized program by identifying the differences between health behaviors and mental health according to BMI; this program should be applied to all areas, such as eating habits, exercise, sleep, and depression management.

## Declaration of Conflicting Interest

The authors declare no conflicts of interest.

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## Authors' Contributions

Conceptualization, Investigation, Supervision, and Project Administration: H-R. Formal Analysis, Data Curation, Writing-Review & Editing: N-G. Methodology, Validation, Resources, Writing-Original Draft Preparation, Visualization, Funding Acquisition: H-R and N-G. All authors were accountable in each step of the study and approved the final version of the article to be published.

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## Data Availability

The raw data can be downloaded from the Korea Centers for Disease Control and Prevention website (<https://www.kdca.go.kr/yhs/home.jsp>).

## Declaration of Use of AI in Scientific Writing

Nothing to declare.

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