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Multilevel Analysis of the Risk Factors in High-Risk Health Behavior among Korean Adolescents

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ABSTRACT

Objectives: To examine health behaviors among Korean adolescents with a focus on both individual and school-based factors, specifically in relation to predictors of high-risk groups.
Methods: Secondary data analysis was conducted with data from the 8th Korea Youth Risk Behavior Web-Based Survey, using descriptive statistics, t tests, χ^2 test, and multilevel logistic regression analysis. Health Practice Index was calculated and a range of 0 to 2 was classified as a high-risk group.
Results: The results revealed that the individual-level variables of sex, age, stress, depression, subjective health status, school performance, health education, father's level of education, and living situation were significant predictors of high-risk behaviors. The risk was greater in girls, greater with higher age and higher stress scores, greater in adolescents with depression, greater with lower paternal educational level, and greater in adolescents who did not live with both parents, as were the school-level variables of school grade and school affluence score. The possibility of being in the high-risk group in health behavior was greater if a student attended a school where the Family Affluence Score (FAS) was lower.
Conclusion: School health education should be expanded to manage students' high-risk health behaviors, especially in schools that have many students from families with a low affluence status.

Introduction

Unhealthy behaviors that begin during adolescence can cause physical and psychological health problems later in life. For example, individuals that start smoking have worse health effects anwill and are more likely to become addicted to nicotine [1]. Furthermore, when adolescents begin smoking and drinking before 15 years of age, they at least double the risk of becoming addicted to drugs and being involved in crime than if they started these behaviors later in life [2]. Thus, we should emphasize the prevention and cessation of adolescent smoking and drinking when promoting healthy lifestyle choices.

Although the Korean government has been attempting to implement health-promotion programs to prevent smoking and drinking in adolescent populations, the age at which individuals first began smoking reduced from 15.1 years in 1998 to 13.0 years in 2008. In addition, the obesity rate increased from 8.8% in 2005 to 9.6% in 2008, with male students exhibiting an obesity rate of 12.8%, which is twice as high as the 6.0% rate among female students [3].

To develop a strategy for improving adolescent health behaviors, an advanced surveillance system should be implemented. In Korea, the Korean National Health and Nutrition Examination Survey has been conducted since 1998 to examine certain contextual factors affecting adolescent health behaviors. Since 2005, the Korean CDC has also documented 16 adolescent health behaviors—smoking, alcohol use, drug use, eating behaviors, obesity control, injury prevention, oral health, mental health, sexual behavior, exercise, hygiene, health equity, atopic asthma, internet addiction, violence, and subjective health status through an annual online school-based survey, called the Korea Youth Risk Behavior Web-Based Survey (KYRBWS).

Studies have been conducted to determine the factors related to adolescent health behaviors at both the individual and

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environmental level. However, these have been limited by small sample size and a lack of connection between individual and environmental factors [4-6]. In addition, although students tend to take up more than one health-risk behavior [7], there has been a lack of domestic studies in Korea to determine the factors associated with multiple-risk health behaviors in adolescents. A number of studies have demonstrated clustering of risk behaviors, such as smoking, substance abuse, antisocial behavior, and sexual risk behavior during adolescence [8,9]. Moreover, simultaneous engagement in such behaviors during adolescence is associated with increased morbidity and premature mortality [10].

From an ecological perspective, a number of studies about adolescences have been conducted to determine the individual and environmental factors that influence health behaviors [11]. The ecological model recognizes the importance of social structure in human behavior and health outcome [12]. and the change in behaviors depends on multiple factors including individual, organizational, or environmental relationships. The ecological model emphasizes the importance of considering all these factors on individual behavior and development. The occurrences and attributes of one factor, such as family structure and relationship quality or school environment may affect other contributing factors, which in turn, affect an adolescent's decisions and behaviors [13]. The ecological model was mostly applied when considering obesity [14], physical activities [17] and non-smoking behaviors [15]. Among these studies, assessment non-smoking behaviors was performedwere assessed on a multilevel boths individually, and organizationally, and moreover, were examined by a multilevel interventioncombining . Intervention at the individual level was effective for individuals but not so effective when considering the effects on for groups. The organizational level interventions focused on anti-smoking programs in schools, and were effective in developing non-smoking behavior.

Although students spend more time at school than at home, there have been a lack of domestic studies in Korea attempting to analyze the effect of school on student health behaviors. In addition, the current literature reveals gaps in the knowledge base on the association between the school environment and adolescent health behaviors, including a lack of studies on school socioeconomic status (SES), and few studies use multilevel modeling analyses. In this study, an ecological model was applied to determine the factors affecting high-risk health behaviors and school affluence score was used to determine school SES.

The aim of this study was to examine multilevel health risk behaviors among Korean adolescents using KYRBWS data, considering ecological factors at both the individual and school level. The results from this study may shape individual and organizational aspects of national health policy and influence the health behaviors of Korean adolescents.

Materials and Methods

1. Design, Sample, and Procedure

Data from the 8th KYRBWS was used in this data analysis study [16]. The raw data were requested from the homepage after internal review and approval, and were obtained with all private information remaining anonymous. There were 800 schools and 76,980 students invited, with a total of 757 schools and 74,186 students (96.4%) participating in the study. The study calculated participants' Health Practice Index using 6 health behaviors that were the most common among Korean adolescents and were included in a 9-year mortality analysis of Alameda County data [17]: smoking, drinking, obesity, exercise, breakfast, and sleeping. On the basis of the Health Practice Index, 28,990 high-risk and low-risk health behavior students were selected in the 7^{th}–12^{th} grades.

There was no clear guidance on the sample size to ensure adequate statistical power for multilevel logistic regression analysis. In the multilevel model, a larger number of groups is more important than a larger number of individuals per group [18].

2. Ethical considerations

The raw data were requested from the homepage, and were obtained with all private information remaining anonymous.

3. Measures

The dependent variable was binary: high-risk or low-risk health behaviors groups. The 6 health behaviors were identified by either 0 or 1, as shown in Table 1, with the total Health Practice Index ranging from 0 to 6. The high-risk behavior group scored ≤2, and the low-risk behavior scored ≥5. We excluded students whose scores were between these ranges. Lower scores indicated worse health behaviors and higher scores indicated better health behaviors.

The individual-level variables of sex, age, stress level, depression, subjective health status, school performance, father's level of education, mother's level of education, living situation, and health education experience were assessed [4-6]. Stress level was measured on a 5-point Likert-type scale (1 = none, 5 = very high). Depression was measured by the question "During the past year, did you feel very sad or hopeless?" Subjective health status and school performance were measured on a 5-point Likert-type scale (1 = very poor, 5 = very good). Parental levels of education were categorized as "high school graduate or higher" and "middle school graduate or less." Living situations were categorized as "living with both parents" and "living with a single parent or not living with either parent."

The school-level variables of geographic area, school level (middle school, high school, vocational school), school type (boys' school, girls' school, coeducation school), and school

Table 1. Description and Distribution of the Six Health Behaviors.

Health behavior	Definition		Prevalence of risk behavior
	1	0	
Smoking	No smoking in the last 30 days	Smoking in the last 30 days	11.27%
Drinking	No drinking in the last 30 days	More than 1 day of drinking in the last 30 days	19.31%
Obesity	Body mass index < 25	Body mass index ≥ 25	9.60%
Exercise	Vigorous exercise more than three times or moderate exercise more than five times per week	Vigorous exercise fewer than three times or moderate exercise fewer than five times per week	64.61%
Breakfast	Has breakfast 6–7 days/week	Has breakfast fewer than 6 days/week	48.17%
Sleeping	Sleeps 7–8 hours per night	Sleeps less than 7 hours or more than 8 hours per night	63.96%

N = 74,186.

affluence score were assessed [11]. The school affluence score was calculated using 4 variables (number of cars at home, having one's own room, number of family trips per year, and number of computers at home), with scores ranging from 0 to 7; higher scores indicated a more affluent school. Raudenbush et al [19] asserts that aggregating individual-level data can be more useful at times when capturing perceptions about the social environment, and that this matters more than the reality itself. The school affluence score was calculated using the average of the students who belonged to the school. In this study, the school SES was used to determine student affluence.

4. Data Analysis

Multilevel analysis is explained using within-group analysis of individual variable relations which can be completely different from between-group variables such as school relations. The focus of this study was the relationship between school factors and adolescent health behaviors.

Data were analyzed using SPSS version 22.0 for descriptive statistics, t tests, and chi-square ($\chi 2$) tests, and multilevel factors were analyzed using SAS Version 9.2. Our data had a multilevel structure that comprised individuals at the lower level, nested within schools at the higher level. A 2-level data structure that consisted of individual- and school-level variables was fitted using multilevel logistic regression analysis, via PROC GLIMMIX. The results are presented as odds ratios with a 95% confidence interval and a 5% significance level.

Results

The results of 9,604 (12.95%) high-risk and 19,386 (26.13%) low-risk health behavior students were analyzed with respect to Health Practice Index. Participants' individual- and school-level characteristics were described, and a comparison of those that

Table 2. Between-Group Comparison of Demographic Characteristics.

Factor		High-risk group (*n*=9,604) N (%) or M ± SD	Low-risk group (*n*=19,386) N (%) or M ± SD	Total (*n*=28,990) N (%) or M ± SD	χ^2 or t	*p*
Individual level characteristics						
Sex	Male	5,515 (31.5)	12,020 (68.5)	17,535 (100)	56.354	<.001
	Female	4,371 (38.2)	5,528 (61.8)	11,455 (100)		
Age (y)		15.86 ± 1.48	14.00 ± 1.56	14.61 ± 1.76	98.07	<.001
Stress		3.61 ± 0.97	3.10 ± 0.93	2.28 ± 0.97	42.903	<.001
Depression	No	5,355 (35.7)	14,922 (64.3)	14,989 (100)	1375.009	<.001
	Yes	4,249 (48.8)	4,464 (51.2)	8,731 (100)		
Subjective health status		3.60 ± 0.91	4.00 ± 0.78	3.87 ± 0.85	-38.729	<.001
School performance		2.45 ± 1.18	3.19 ± 1.18	2.94 ± 1.23	-50.532	<.001
Health education experience	No	7,372 (36.5)	12,838 (63.5)	20,210 (100)	337.1	<.001
	Yes	2,232 (25.4)	6,548 (74.5)	8,780 (100)		
Father's level of education	High school graduate or higher	3,225 (25.9)	9,220 (74.1)	12,445 (100)	387.631	<.001
	Middle school graduate or less	5,623 (37.0)	9,566 (63.0)	15,189 (100)		
Mother's level of education	High school graduate or higher	2,371 (35.4)	7,590 (64.6)	6,702 (100)	501.097	<.001
	Middle school graduated or less	6,886 (29.3)	11,184 (63.1)	17,724 (100)		
Living situation	Living with both parents	1,517 (46.9)	1,714 (53.1)	23,495 (100)	410.169	.0012
	Living with a single parent	1,193 (57.0)	901 (43.0)	3,231 (100)		
School level characteristics						
Geographic area	Rural area	1,229 (34.6)	2,254 (65.4)	3,553 (100)	32.642	<.001
	City	4,117 (31.7)	8,876 (68.3)	12,993 (100)		
	Large city	4,188 (33.7)	8,256 (66.3)	12,444 (100)		
School grade	Middle school	2,357 (13.9)	14,623 (86.1)	16,980 (100)	7077.074	<.001
	High school	4,768 (56.2)	13,715 (43.8)	8,483 (100)		
	Vocational school	2,479 (70.3)	1,048 (29.7)	3,527 (100)		
School type	Boys' school	1,663 (32.0)	3,528 (68.0)	5,191 (100)	33.196	<.001
	Girls' school	1,304 (37.4)	2,184 (62.6)	3,488 (100)		
	Coed school	6,637 (32.7)	13,674 (67.3)	20,311 (100)		
School affluence score		4.46 ± 1.95	4.99 ± 1.89	4.82 ± 1.93	-22.07	<.001

N = 28,990 (two-tailed) exclude no response.

differed between the high- and low-risk health behavior groups was conducted (Table 2).

The study population contained 11,455(39.5%) females. Females were significantly more likely to be in the high-risk, vs. low-risk, group ($p < 0.001$). The average age was 14.6 years, and students in the high-risk, vs. low-risk, group were significantly older (15.9 years vs. 14.0 years; $p < 0.001$). The average school grade in the high-risk, vs. low-risk, group was significantly lower ($p < 0.001$). The level of health education was significantly less in the high-risk, vs. low-risk, group ($p < 0.001$). The higher parental educational level was less common in the high-risk, vs. low-risk, group ($p < 0.001$). Only 12.1% of the students did not live with both parents, although significantly more students in the high-risk, vs. low-risk, group did not live with both parents ($p < 0.001$).

All school-level factors were significantly related to adolescent risk behavior. Regarding geographic status, students in rural areas were significantly more likely to be in the high-risk, vs. low-risk, group. Subjects attending a vocational school were more likely to be in the high-risk, vs. low-risk, group ($p < 0.001$). Regarding school type, a girls' school was associated with significantly more risk behaviors compared with a boys' school or a coed school ($p < 0.001$). The higher the average school affluence score, the lower the possibility of being in the high-risk health behavior group ($p < 0.001$).

Multiple regression analyses were used to predict factors that were significantly associated with high-risk, vs. low-risk, health behavior (Table 3). The estimated random effect was 0.2239 with a standard error of 0.0234 ($p < 0.001$). Among the individual-level variables, sex, age, stress, depression, subjective health status, school performance, health education, father's level of education, and living situation were significant predictors of high-risk health behaviors. Females (OR=1.41, 95% CI=1.29-1.54) exhibited a

Table 3. Multilevel Logistic Analysis of High-Risk Group Results.

	Estimate	Standard error	*t*	*p*	Odds ratio	95% confidence interval
Fixed effect						
Intercept	-5.8191	0.4063	-14.32	< .001		
Individual level characteristics (reference)						
Sex (Male)						
Female	0.3457	0.4476	7.72	<.001	1.41	1.29- 1. 54
Age (y)	0.4180	0.0185	22.59	<.001	1.58	1.47- 1. 58
Stress	0.3412	0.0204	16.72	<.001	1.41	1.35- 1.46
Depression (No)						
Yes	0.5102	0.0374	13.64	<.001	1.67	1.55- 1.79
Subjective health status	-0.1695	0.0205	-8.27	<.001	0.84	0.81- 0.88
School performance	-0.4530	0.0152	-30.68	<.001	0.63	0.61- 0.65
Health education experience	-0.0421	0.0178	-2.36	0.018	0.96	0.93- 0.99
Father's level of education (High school graduate or higher)						
Middle school graduate or less	0.1257	0.0427	2.94	0.003	1.13	1.04- 1.23
Mother's level of education (High school graduate or higher)						
Middle school graduate or less	0.0498	0.0465	1.07	0.285	1.05	0.96- 1.15
Living situation (Living with both parents)						
Living with a single parent	0.3944	0.0589	6.69	<.001	1.48	1.32- 1.67
School level characteristics (reference)						
Geographic area (Rural area)						
City	0.0907	0.0773	1.17	0.241	1.10	0.94- 1.27
Large city	0.1210	0.0745	1.63	0.104	1.13	0.98- 1.36
School grade (Middle school)						
High school	0.7531	0.0735	10.25	< .001	2.12	1.84- 2.45
Vocational school	1.3321	0.0995	13.39	< .001	3.79	3.12- 4.61
School type (Coed school)						
Boys' school	0.0833	0.0666	1.25	0.211	1.09	0.95- 1.24
Girls' school	-0.1707	0.0720	-2.37	0.018	0.84	0.73- 0.97
School affluence score	-0.2597	0.0657	-3.95	< .001	0.77	0.68- 0.88
Random effect	0.2239	0.0234	9.57	< .001		

N = 28,990 exclude no response.

greater tendency to be in the high-risk, vs. low risk, group, as did older students (OR=1.58, 95% CI=1.47-1.58). Students who had high stress levels (OR=1.41, 95% CI=1.35-1.46) and high levels of depression (OR=1.67, 95% CI=1.55-1.79) were also more likely to be in the high-risk, vs. low-risk, group, as were students whose fathers had only graduated from middle school (OR=1.13, 95% CI=1.04-1.23), and those who lived with a single parent (OR=1.48, 95% CI=1.32-1.67).

Among the school-level variables, school grade and school affluence score were significant predictors of group risk status. Compared with middle school students, high school (OR=2.12, 95% CI=1.84-2.45) and vocational school students (OR=3.79, 95% CI=3.12-4.61) were more likely to be in the high-risk, vs. low-risk, group, as were students who were enrolled in schools with lower school affluence scores (OR=0.77, 95% CI=0.68- 0.88).

Discussion

This study was performed by applying multilevel analysis to simultaneously consider the effect of both individual, and school factors on adolescent health behavior, specifically in relation to predictors of high-risk behaviors. Multilevel modeling techniques were used to examine within- and between-school variance, and to test the significance of predictors at both the individual and school levels on adolescent high-risk behaviors.

The results of the analyses show that, among the individual-level factors, the significant predictors of adolescent health behavior were sex, age, stress, and depression. The likelihood of being in a high-risk health behavior group was increased in girls. Shin and Kang [20] found that gender was consistently related to health behavior: girls were more likely to practice healthy behaviors (i.e., weight control, hygiene, safety, and computer use) than boys, with the exception of physical activity.

As age and level of stress increased, the risk of engaging in all 6 health behaviors studied also increased. Older age results in social and environmental limitations, where health education may be neglected in this social context, and also as a result of excessive school work under the academic-centered curriculum of Korea. This aligns with the findings of Park et al [21], who reported significant differences in health behaviors (such as smoking, controlling weight, the habit of eating breakfast, and health practice index) according to stress perception.

Among the school-level factors, subjects attending a vocational high school had a greater likelihood of being in the high-risk group; the risk was about 3-times higher in vocational high school participants than in students at other types of schools.The higher the level of SES in a school, the lower the possibility of being in the high-risk group. That is to say, the possibility of being in the high-risk health behavior group was greater if a student attended a school where SES was lower.

Studies have been performed to identify the relationship between SES and adolescents' health behaviors. Cubbin et al [22] reported a relationship between adolescents' sexual behavior and SES, as measured using the variables of family structure, poverty-to-income ratio, parents' highest education level, employment, assets, and housing value. Among these, the likelihood of female adolescents initiating sex was only affected by parents' highest level of education. Male adolescents were only affected by housing value, such that those with a low housing value were 6 times more likely to initiate sex relative to those with a baseline housing status. Humphreys & Ruseski [23] also reported a significant relationship between SES and steroid use in adolescents.

In this study, SES variables, such as parental educational levels and school affluence score, were identified as significant predictors of adolescent health behaviors. Adolescents with lower parental education levels tended to have riskier health behaviors, as did adolescents who did not live with both parents. In this study, SES was also measured at the school level via school affluence scores. Results showed that the lower the school-level SES, the greater the number of risk behaviors adolescents exhibited. Therefore, schools in low SES communities should focus more on promoting health among students.

Students with greater health education opportunities exhibited fewer health risk behaviors in this study, whereas older students and students in higher grades exhibited more risk behaviors, which is in line with the findings of Cubbin et al [22]. In Korea, school health education was provided across a number of different subjects until 2008. However, in 2009, the Ministry of Education introduced a separate health education subject, which was optional. Korean society tends to focus on the college entrance examination for high school students, therefore, only 6.5% of all high schools in Korea offered health education as a subject [24].

Studies have demonstrated the effectiveness of school health education, with Swartz et al [25] reporting an 80% increase in students' awareness of depression prevention after receiving this education. van Sluijs et al [26] also reported that school-based intervention was an effective strategy for increasing physical activity among students. Cho [27] found that regular health education from school nurses improved middle school students' health-related knowledge, attitudes and behaviors, and thus, recommended developing standardized manuals and educational materials for providing systematic and effective health education to manage adolescents' risk behaviors.

The strengths of this study are its large sample size and the use of multilevel analysis to consider simultaneously the effects of both individual and school factors on adolescent health behaviors. However, it has the limitations of a restricted age range and the possibility that the cultural context could reduce the applicability of the findings to other populations. Another limitation is our inability to infer causal relationships from the findings because of the cross-sectional study design. In addition, participants' health behaviors were self-reported online rather than being directly measured. Because adolescents tend to overestimate socially desirable behaviors and underestimate negative behaviors, these responses may have been subject to social desirability bias.

Wide-scale healthcare data analysis exploits the vast amounts of available data and has highly practical applications for aiding the development of future healthcare systems and policies. This study explored how the KYRBWS has become a growing force in changing school healthcare practices and policies.

Several researchers have examined covariance between risk behaviors among children using a range of variables and a variety of methods. Another study has shown that interventions among Finnish men [28] were more effective than an intervention for a single behavior in adolescence. They found significant clustering of 3 or 4 adverse behaviors related to smoking, alcohol, diet, and physical activity, with more adverse choices being associated with smoking. However, prevention efforts traditionally have taken a targeted approach, seeking to prevent a single risk behavior. A more powerful and cost-effective approach may be to employ strategies designed to address factors associated with multiple risk behaviors [29].

This study was conducted to analysze a database that could be used to create health-promotion programs for individual schools. In addition, the results of this study suggest that supportive policies be instituted in schools with low average SES levels, and that future studies could include other school-level factors that can

affect adolescent health behavior, such as school climates. Stewart [30] reported that school climates were able to regulate student's behaviors and to solve school problems effectively, and that an intervention that applied individual and environmental variables was more effective than an intervention that applied single level variables.

The following recommendations are based on the results of this study:

Firstly, the KYRBWS have been formulated on the basis of the data collected at the individual level. Adolescent health behaviors are related to individual and organizational factors, and group or organization level variables such as school climate have to be conducted in the KYRBWS. Next, regular and systematic health education must be provided to manage adolescents' risk behaviors. Lastly, the ecological model and multilevel analysis may be applied to further studies to address school policy for promoting adolescent health.

Conflicts of Interest

No potential conflict of interest relevant to this article was reported.

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