State-of-the-Art Reviews

Exploring factors related to alcohol and substance use during the COVID-19 pandemic: a post-hoc analysis from the Korea youth risk behavior web-based survey

Hyunju Yon[1#], Sangil Park[2#], Ai Koyanagi[3,4], Louis Jacob[3,5], Lee Smith[6], Jinseok Lee[7], Guillaume Fond[8,9], Laurent Boyer[8,9], Namwoo Kim[10], Ho Geol Woo[2*]

[1]Department of Medicine, Kyung Hee University College of Medicine, Seoul, South Korea

[2]Department of Neurology, Kyung Hee University Medical Center, Seoul, South Korea

[3]Research and Development Unit, Parc Sanitari Sant Joan de Deu, CIBERSAM, ISCIII, Barcelona, Spain

[4]Catalan Institution for Research and Advanced Studies (ICREA), Pg. Lluis Companys, Barcelona, Spain

[5]Faculty of Medicine, University of Versailles Saint-Quentin-en-Yvelines, Montigny-le-Bretonneux, France

[6]Centre for Health, Performance and Wellbeing, Anglia Ruskin University, Cambridge, UK

[7]Department of Biomedical Engineering, Kyung Hee University, Yongin, South Korea

[8]Assistance Publique-Hôpitaux de Marseille (AP-HM), Aix-Marseille University, CEReSS - Health Service Research and Quality of Life Center, Marseille, France.

[9]FondaMental Foundation, Creteil, France.

[10]Department of Psychiatry, Seoul St. Mary's Hospital, The Catholic University of Korea, College of Medicine, Seoul, South Korea

Abstract

Despite the significance of the COVID-19 pandemic's effect on life, only a few previous studies have been conducted on youth substance use during the era of the COVID-19 pandemic. Thus, we aimed to determine the change in alcohol and substance use by the familial-, social-, and individual-associated risk factors among Korean adolescents, comparing the pre- and during COVID-19 pandemic period. Data on 1,109,776 Korean adolescents aged 13 to 18 years from 2005 to 2021 were obtained in a nationwide, large-scale, and serial study. This study was conducted to compare the risk factors of alcohol and substance use for overall years and the transitional effect of the COVID-19 pandemic. Among one million adolescents during the pandemic (2019 versus 2021), lower school grades (ratio of odds ratio [ROR], 1.172; 95% CI, 1.075-1.279), male (ROR, 1.098; 95% CI, 1.008-1.197), lower educational levels of parents (ROR, 1.116; 95% CI, 1.002-1.215), and lower economic levels (ROR, 1.341; 95% CI, 1.026-1.754) were more pronounced and significant among alcohol users compared to the pre-pandemic period (2019 versus 2021). During the pandemic, higher school grades (ROR, 1.561; 95% CI, 1.166-2.090) and former smoking (ROR, 1.969; 95% CI, 1.290-3.003) were more pronounced and significant among substance users than in the pre-pandemic period. Over a million adolescents' national data were used in this study to investigate changes in alcohol and drug use according to risk factors. Moreover, we compared how they were affected by the COVID-19 pandemic by comparing the change in risk factors in the pre-pandemic (2019) and pandemic periods (2021). The outcomes of this study suggest a complex interaction between a multitude of factors that influence adolescent alcohol and substance use.

Keywords: COVID-19, Alcohol, Substance use, Risk factor, Adolescent, South Korea, Nationwide representative study

1. Introduction

Alcohol and substance use in adolescents is harmful, and excessive use is a global concern.[1] The Global Burden of Disease (GBD) study found that one-third of adolescents have used alcohol in their lifetime, and approximately 14% of the total health burden can be attributed to drug abuse.[2, 3] Furthermore, alcohol and substance use in adolescents is a major

*Correspondence:
Ho Geol Woo
E-mail: nr85plasma@naver.com

ORCID
Ho Geol Woo
https://orcid.org/0000-0001-6489-0100

contributor to global increases in morbidity and mortality.[4] Thus, preventing substance use in youth is an important public health priority.[5] Rapid changes in socioeconomic factors, public policy, technology, and mental health have influenced alcohol and substance use patterns over time.[6-8] We have previously conducted an analysis on this matter and, through further in-depth analysis, have proceeded with additional research.

2. In-depth analysis

A total of 1,109,776 adolescents were included in the KYRBS-related current alcohol use analysis from 2005 to 2021 (Fig. 1 and 2).[9]

Among one million adolescents during the pandemic (2019 versus 2021), lower school grades (ratio of odds ratio [ROR], 1.172; 95% CI, 1.075-1.279), male (ROR, 1.098; 95% CI, 1.008-1.197), lower educational levels of parents (ROR, 1.116; 95% CI, 1.002-1.215), and lower economic levels (ROR, 1.341; 95% CI, 1.026-1.754) were more pronounced and significant among alcohol users compared to the pre-pandemic period (Table 1 and 2). In addition, similar patterns were observed in-depth analysis (2005-2019 versus 2020-2021; Fig. 3).

During the pandemic (2019 versus 2021), higher school grades (ROR, 1.561; 95% CI, 1.166-2.090) and former smoking (ROR, 1.969; 95% CI, 1.290-3.003) were more pronounced
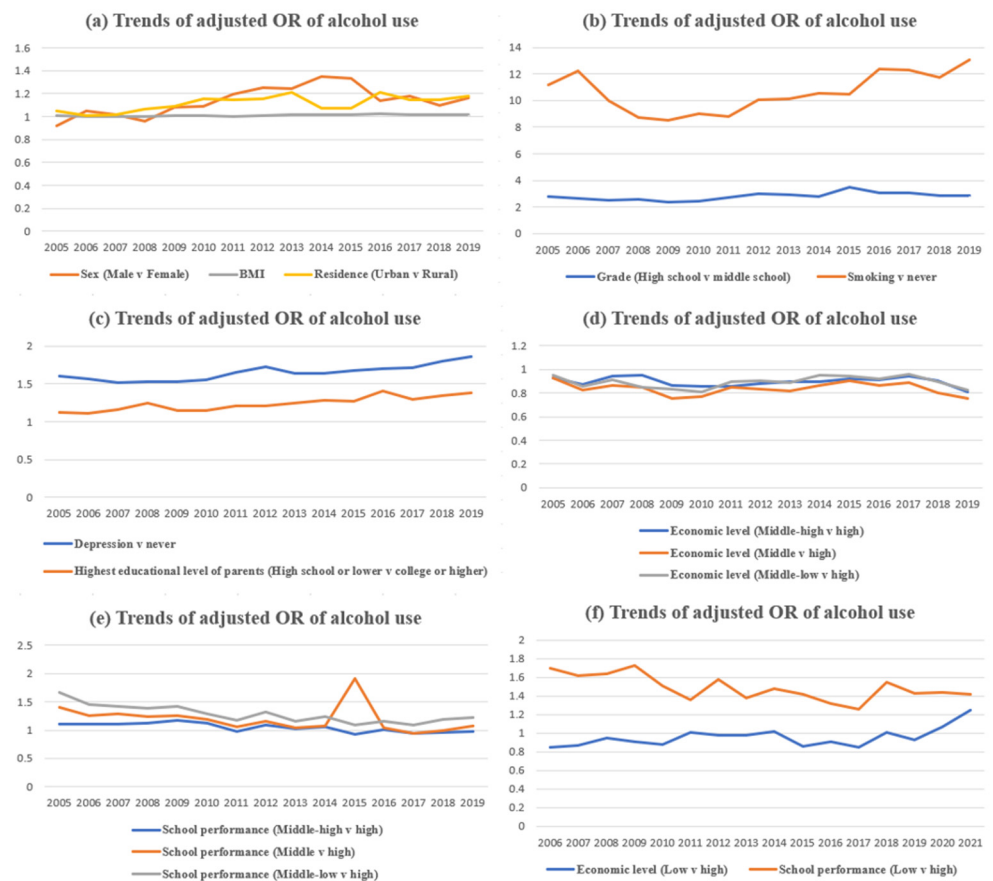

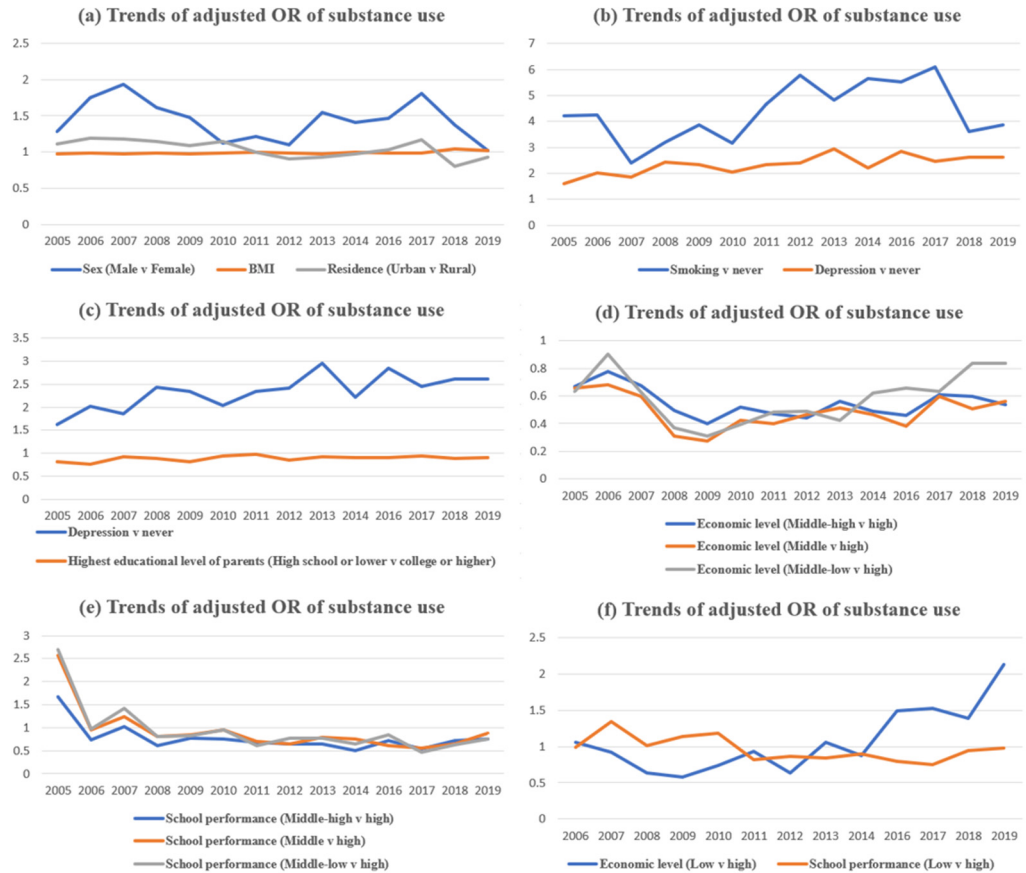**Fig. 1. Trends of adjusted OR of alcohol use between 2005 to 2019.**

Fig. 2. Trends of adjusted OR of substance use between 2005 to 2019.

Table 1. Crude OR difference in pandemic-related factors associated with alcohol use among Korean youth in KYRBS, 2019 versus 2021

Variables	Pre-COVID-19 pandemic (n=55,748)		COVID-19 pandemic (n=53,445)		Ratio of OR[†] (95% CI)	p-value
	Crude OR (95% CI)	p-value	Crude OR (95% CI)	p-value		
Grade						
7th–9th grade (middle school)	1.000 (reference)		1.000 (reference)			
10th¬12th grade (high school)	**3.455 (3.277 to 3.642)**	**<0.001**	**3.104 (2.924 to 3.295)**	**<0.001**	**0.898 (0.830 to 0.973)**	**0.008**
Sex						
Male	**1.308 (1.247 to 1.372)**	**<0.001**	**1.402 (1.325 to 1.483)**	**<0.001**	1.072 (0.996 to 1.154)	0.066
Female	1.000 (reference)		1.000 (reference)			
BMI[*], kg/m^2	**1.057 (1.051 to 1.064)**	**<0.001**	**1.049 (1.041 to 1.056)**	**<0.001**	0.992 (0.983 to 1.002)	0.114
Residence						
Rural	1.000 (reference)		1.000 (reference)			

Table 1. Coutinued

Variables	Pre-COVID-19 pandemic (n=55,748)		COVID-19 pandemic (n=53,445)		Ratio of OR[†] (95% CI)	*p*-value
	Crude OR (95% CI)	*p*-value	Crude OR (95% CI)	*p*-value		
Urban	**1.181 (1.125 to 1.239)**	**<0.001**	**1.228 (1.160 to 1.299)**	**<0.001**	1.040 (0.965 to 1.120)	0.304
Current smoking	**18.010 (16.681 to 19.446)**		**20.470 (18.682 to 22.429)**	**<0.001**	**1.137 (1.009 to 1.281)**	**0.035**
Depression	**2.062 (1.963 to 2.165)**	**<0.001**	**2.042 (1.928 to 2.162)**	**<0.001**	0.993 (0.918 to 1.068)	0.800
Highest educational level of parents						
College or higher	1.000 (reference)		1.000 (reference)			
High school or lower	**1.690 (1.586 to 1.801)**	**<0.001**	**1.876 (1.748 to 2.013)**	**<0.001**	**1.110 (1.009 to 1.221)**	**0.031**
Unknown	**1.233 (1.166 to 1.304)**	**<0.001**	**1.406 (1.317 to 1.501)**	**<0.001**	**1.140 (1.046 to 1.243)**	**0.003**
Economic level						
High	1.000 (reference)		1.000 (reference)			
Middle-high	**0.864 (0.794 to 0.941)**	**0.001**	0.977 (0.881 to 1.084)	0.666	1.131 (0.954 to 1.340)	0.157
Middle	0.924 (0.854 to 1.001)	0.051	1.074 (0.975 to 1.183)	0.151	**1.162 (1.026 to 1.317)**	**0.018**
Middle low	**1.332 (1.209 to 1.467)**	**<0.001**	**1.644 (1.460 to 1.851)**	**<0.001**	**1.234 (1.059 to 1.438)**	**0.007**
Low	**1.927 (1.659 to 2.239)**	**<0.001**	**2.422 (2.031 to 2.889)**	**<0.001**	1.257 (0.997 to 1.584)	0.053
School performance						
High	1.000 (reference)		1.000 (reference)			
Middle-high	1.013 (0.926 to 1.108)	0.784	**1.155 (1.035 to 1.290)**	**0.010**	1.140 (0.989 to 1.314)	0.070
Middle	**1.232 (1.131 to 1.342)**	**<0.001**	**1.372 (1.236 to 1.524)**	**<0.001**	1.114 (0.973 to 1.275)	0.119
Middle-low	**1.668 (1.529 to 1.819)**	**<0.001**	**1.857 (1.670 to 2.066)**	**<0.001**	1.113 (0.970 to 1.277)	0.126
Low	**2.588 (2.351 to 2.850)**	**<0.001**	**2.828 (2.518 to 3.175)**	**<0.001**	1.093 (0.940 to 1.270)	0.249

BMI, body mass index; CI, confidence interval; OR, odds ratios

[*]Body mass index was calculated as weight in kilograms divided by height in meters squared.

[†]Ratio of odds ratios was calculated as $OR_{during\text{-}pandemic}$ divided by $OR_{pre\text{-}pandemic}$.

[‖]The ratio of odds ratios was calculated for one unit increase in body mass index (1 kg/㎡).

Numbers in bold indicate a significant difference ($p < 0.05$).

Table 2. Adjusted OR of difference in pandemic-related factors associated with alcohol use among Korean youth in KYRBS, 2019 versus 2021

Variables	Pre-COVID-19 pandemic (n=55,748)		COVID-19 pandemic (n=53,445)		Ratio of OR[†] (95% CI)	p-value
	Adjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value		
Grade						
7th–9th grade (middle school)	1.000 (reference)		1.000 (reference)			
10th–12th grade (high school)	**2.837 (2.678 to 3.006)**	**<0.001**	**2.420 (2.269 to 2.582)**	**<0.001**	**0.853 (0.782 to 0.930)**	**<0.001**
Sex						
Male	**1.163 (1.099 to 1.230)**	**<0.001**	**1.277 (1.197 to 1.363)**	**<0.001**	**1.098 (1.008 to 1.197)**	**0.033**
Female	1.000 (reference)		1.000 (reference)			
BMI*, kg/m^2	**1.018 (1.010 to 1.025)**	**<0.001**	**1.022 (1.014 to 1.031)**	**<0.001**	1.004 (0.993 to 1.015)	0.489
Residence						
Rural	1.000 (reference)		1.000 (reference)			
Urban	**1.183 (1.121 to 1.248)**	**<0.001**	**1.179 (1.108 to 1.254)**	**<0.001**	0.997 (0.918 to 1.082)	0.935
Current smoking	**13.101 (12.084 to 14.205)**	**<0.001**	**13.984 (12.705 to 15.392)**	**<0.001**	1.067 (0.942 to 1.210)	0.308
Depression	**1.862 (1.761 to 1.970)**	**<0.001**	**1.816 (1.703 to 1.937)**	**<0.001**	0.975 (0.895 to 1.062)	0.566
Highest educational level of parents						
College or higher	1.000 (reference)		1.000 (reference)			
High school or lower	**1.382 (1.285 to 1.485)**	**<0.001**	**1.543 (1.426 to 1.670)**	**<0.001**	**1.116 (1.003 to 1.243)**	**0.044**
Unknown	1.035 (0.972 to 1.102)	0.288	**1.142 (1.062 to 1.228)**	**<0.001**	**1.103 (1.002 to 1.215)**	**0.045**
Economic level						
High	1.000 (reference)		1.000 (reference)			
Middle-high	**0.810 (0.736 to 0.893)**	**<0.001**	0.934 (0.833 to 1.048)	0.248	1.153 (0.992 to 1.340)	0.063
Middle	**0.753 (0.686 to 0.826)**	**<0.001**	0.902 (0.808 to 1.007)	0.068	**1.198 (1.037 to 1.383)**	**0.014**
Middle low	**0.822 (0.734 to 0.921)**	**0.001**	1.050 (0.917 to 1.203)	0.479	**1.277 (1.070 to 1.525)**	**0.007**
Low	0.929 (0.779 to 1.107)	0.409	**1.246 (1.017 to 1.526)**	**0.034**	**1.341 (1.026 to 1.754)**	**0.032**
School performance						
High	1.000 (reference)		1.000 (reference)			
Middle-high	0.982 (0.889 to 1.084)	0.717	1.105 (0.981 to 1.245)	0.099	1.125 (0.964 to 1.314)	0.136

Table 2. Continued

Variables	Pre-COVID-19 pandemic (n=55,748)		COVID-19 pandemic (n=53,445)		Ratio of OR[†] (95% CI)	p-value
	Adjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value		
Middle	1.068 (0.970 to 1.176)	0.180	1.109 (0.988 to 1.245)	0.080	1.038 (0.893 to 1.207)	0.624
Middle-low	**1.229 (1.113 to 1.357)**	**<0.001**	**1.257 (1.116 to 1.416)**	**<0.001**	1.023 (0.876 to 1.194)	0.776
Low	**1.426 (1.274 to 1.597)**	**<0.001**	**1.412 (1.236 to 1.613)**	**<0.001**	**0.990 (0.832 to 1.179)**	**0.912**

BMI, body mass index; CI, confidence interval; OR, odds ratios

[*]Body mass index was calculated as weight in kilograms divided by height in meters squared.

[†]Ratio of odds ratios was calculated as $OR_{during\text{-}pandemic}$ divided by $OR_{pre\text{-}pandemic}$.

[∥]The ratio of odds ratios was calculated for one unit increase in body mass index (1 kg/m²).

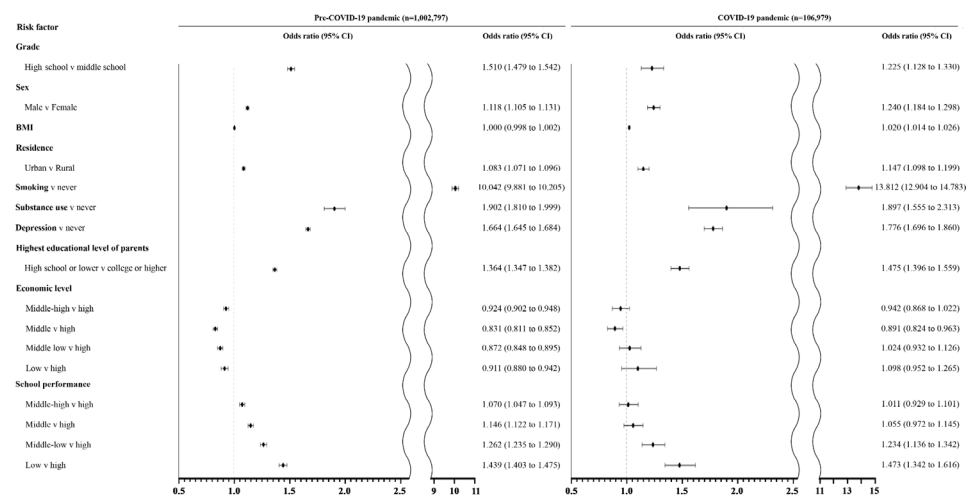Numbers in bold indicate a significant difference ($p < 0.05$).

Fig. 3. Odds ratios for association between associated factors and alcohol use by time period divided by COVID-19 pandemic happening. Odds ratio was calculated for one unit increase in BMI (1kg/m²). Horizontal lines indicate corresponding 95% confidence intervals around odds ratios. BMI, body mass index.

and significant among substance users than in the pre-pandemic period (Table 3 and 4). In addition, similar patterns were observed in-depth analysis (2005-2019 versus 2020-2021; Fig. 4).

Table 3. Crude OR difference in pandemic-related factors associated with substance use among Korean youth in KYRBS, 2019 versus 2021

Variables	Pre-COVID-19 pandemic (n=468)		COVID-19 pandemic (n=354)		Ratio of OR[†] (95% CI)	p-value
	Crude OR (95% CI)	p-value	Crude OR (95% CI)	p-value		
Grade						

Table 3. Continued

Variables	Pre-COVID-19 pandemic (n=468)		COVID-19 pandemic (n=354)		Ratio of OR[†] (95% CI)	p-value
	Crude OR (95% CI)	p-value	Crude OR (95% CI)	p-value		
7th–9th grade (middle school)	1.000 (reference)		1.000 (reference)			
10th¬12th grade (high school)	0.947 (0.789 to 1.137)	0.560	**0.785 (0.637 to 0.968)**	**0.023**	0.829 (0.628 to 1.094)	0.186
Sex						
Male	1.091 (0.909 to 1.309)	0.350	**1.351 (1.092 to 1.671)**	**0.006**	1.238 (0.936 to 1.639)	0.135
Female	1.000 (reference)		1.000 (reference)			
BMI*, kg/m^2	**1.029 (1.004 to 1.055)**	**0.023**	**1.041 (1.014 to 1.068)**	**0.003**	1.012 (0.976 to 1.049)	0.526
Residence						
Rural	1.000 (reference)		1.000 (reference)			
Urban	0.957 (0.797 to 1.149)	0.640	0.843 (0.681 to 1.044)	0.117	0.881 (0.665 to 1.167)	0.377
Current smoking	**4.740 (3.818 to 5.886)**	**<0.001**	**2.815 (2.013 to 3.936)**	**<0.001**	**0.594 (0.398 to 0.885)**	**0.010**
Depression	**0.332 (0.276 to 0.398)**	**<0.001**	**2.942 (2.386 to 3.627)**	**<0.001**	**8.861 (6.710 to 11.703)**	**<0.001**
Highest educational level of parents						
College or higher	1.000 (reference)		1.000 (reference)			
High school or lower	1.024 (0.789 to 1.330)	0.858	0.864 (0.648 to 1.152)	0.320	0.844 (0.572 to 1.244)	0.391
Unknown	1.187 (0.967 to 1.458)	0.101	0.994 (0.787 to 1.255)	0.958	0.837 (0.614 to 1.143)	0.263
Economic level						
High	1.000 (reference)		1.000 (reference)			
Middle-high	**0.491 (0.365 to 0.660)**	**<0.001**	**0.335 (0.202 to 0.558)**	**<0.001**	0.682 (0.379 to 1.228)	0.203
Middle	**0.509 (0.390 to 0.664)**	**<0.001**	**0.268 (0.169 to 0.424)**	**<0.001**	**0.527 (0.310 to 0.896)**	**0.018**
Middle low	0.890 (0.641 to 1.234)	0.484	**0.250 (0.160 to 0.389)**	**<0.001**	**0.281 (0.162 to 0.488)**	**<0.001**
Low	**2.877 (1.974 to 4.193)**	**<0.001**	**0.376 (0.225 to 0.628)**	**<0.001**	**0.131 (0.069 to 0.247)**	**<0.001**
School performance						
High	1.000 (reference)		1.000 (reference)			
Middle-high	**0.663 (0.486 to 0.904)**	**0.009**	0.811 (0.568 to 1.158)	0.248	1.223 (0.763 to 1.962)	0.403
Middle	0.782 (0.586 to 1.045)	0.097	0.740 (0.523 to 1.047)	0.089	0.946 (0.602 to 1.487)	0.811

Table 3. Continued

Variables	Pre-COVID-19 pandemic (n=468)		COVID-19 pandemic (n=354)		Ratio of OR[†] (95% CI)	p-value
	Crude OR (95% CI)	p-value	Crude OR (95% CI)	p-value		
Middle-low	0.803 (0.591 to 1.091)	0.161	1.110 (0.787 to 1.567)	0.551	1.382 (0.872 to 2.192)	0.169
Low	**1.557 (1.130 to 2.145)**	**0.007**	1.152 (0.765 to 1.735)	0.497	0.740 (0.440 to 1.244)	0.256

BMI, body mass index; CI, confidence interval; OR, odds ratios

[*]Body mass index was calculated as weight in kilograms divided by height in meters squared.

[†]Ratio of odds ratios was calculated as $OR_{during-pandemic}$ divided by $OR_{pre-pandemic}$.

[‖]The ratio of odds ratios was calculated for one unit increase in body mass index (1 kg/m²).

Numbers in bold indicate a significant difference ($p < 0.05$).

Table 4. Adjusted OR difference in pandemic-related factors associated with substance use among Korean youth in KYRBS, 2019 versus 2021

Variables	Pre-COVID-19 pandemic (n=468)		COVID-19 pandemic (n=354)		Ratio of OR[†] (95% CI)	p-value
	Adjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value		
Grade						
7th–9th grade (middle school)	1.000 (reference)		1.000 (reference)			
10th¬12th grade (high school)	**0.735 (0.605 to 0.892)**	**0.002**	1.147 (0.923 to 1.427)	0.216	**1.561 (1.166 to 2.090)**	**0.003**
Sex						
Male	1.017 (0.837 to 1.236)	0.864	**1.361 (1.087 to 1.705)**	**0.007**	1.338 (0.994 to 1.802)	0.055
Female	1.000 (reference)		1.000 (reference)			
BMI*, kg/m²	**1.023 (0.997 to 1.049)**	**0.090**	**1.029 (1.001 to 1.057)**	**0.040**	1.006 (0.969 to 1.044)	0.758
Residence						
Rural	1.000 (reference)		1.000 (reference)			
Urban	**0.934 (0.777 to 1.124)**	**0.471**	1.167 (0.941 to 1.447)	0.159	1.249 (0.941 to 1.659)	0.124
Current smoking	**3.876 (3.066 to 4.900)**	**<0.001**	**1.969 (1.385 to 2.798)**	**<0.001**	**0.508 (0.333 to 0.775)**	**0.002**
Depression	**2.609 (2.158 to 3.156)**	**<0.001**	**2.827 (2.281 to 3.504)**	**<0.001**	1.084 (0.813 to 1.443)	0.583
Highest educational level of parents						
College or higher	1.000 (reference)		1.000 (reference)			
High school or lower	0.911 (0.696 to 1.193)	0.500	0.757 (0.563 to 1.017)	0.065	0.831 (0.557 to 1.240)	0.364

Table 4. Continued

Variables	Pre-COVID-19 pandemic (n=468)		COVID-19 pandemic (n=354)		Ratio of OR[†] (95% CI)	p-value
	Adjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value		
Unknown	1.112 (0.900 to 1.375)	0.325	0.890 (0.700 to 1.132)	0.343	0.800 (0.581 to 1.103)	0.173
Economic level						
High	1.000 (reference)		1.000 (reference)			
Middle-high	**0.538 (0.397 to 0.729)**	**<0.001**	0.846 (0.587 to 1.220)	0.371	1.572 (0.977 to 2.530)	0.062
Middle	**0.559 (0.422 to 0.741)**	**<0.001**	0.809 (0.568 to 1.151)	0.239	1.447 (0.921 to 2.273)	0.109
Middle low	0.837 (0.592 to 1.184)	0.314	1.042 (0.668 to 1.624)	0.857	1.245 (0.709 to 2.187)	0.446
Low	**2.128 (1.421 to 3.187)**	**<0.001**	**2.430 (1.425 to 4.143)**	**0.001**	1.142 (0.585 to 2.230)	0.698
School performance						
High	1.000 (reference)		1.000 (reference)			
Middle-high	0.756 (0.550 to 1.039)	0.084	0.852 (0.593 to 1.224)	0.386	1.127 (0.696 to 1.825)	0.627
Middle	0.873 (0.644 to 1.182)	0.378	0.753 (0.525 to 1.081)	0.124	0.863 (0.538 to 1.383)	0.539
Middle-low	0.745 (0.539 to 1.031)	0.076	1.010 (0.702 to 1.453)	0.958	1.356 (0.833 to 2.207)	0.221
Low	0.976 (0.689 to 1.382)	0.890	0.808 (0.522 to 1.250)	0.338	0.828 (0.474 to 1.447)	0.507

BMI, body mass index; CI, confidence interval; OR, odds ratios

[*]Body mass index was calculated as weight in kilograms divided by height in meters squared.

[†]Ratio of odds ratios was calculated as $OR_{during-pandemic}$ divided by $OR_{pre-pandemic}$.

[‖]The ratio of odds ratios was calculated for one unit increase in body mass index (1 kg/m²).

Numbers in bold indicate a significant difference ($p < 0.05$).

3. Comparison with previous studies

Most previous systematic reviews conducted worldwide on drug usage focused only on the mental, psychological, or social consequences of substance abuse, 23 while some focused only on risk factors for the non-medical use of prescription drugs, except for social conditions among youths.[10]

Recent systemic reviews on the risk factors of adolescents' substance or alcohol use found that the majority of the studies (13 articles) were from the United States of America (USA), three studies were from Asia, four studies were from Europe, and one study was from Latin America, Africa, and the Mediterranean.[11, 12] The number of sample participants varied widely between studies, ranging from 70 participants (minimum) to 700,178 participants (maximum),
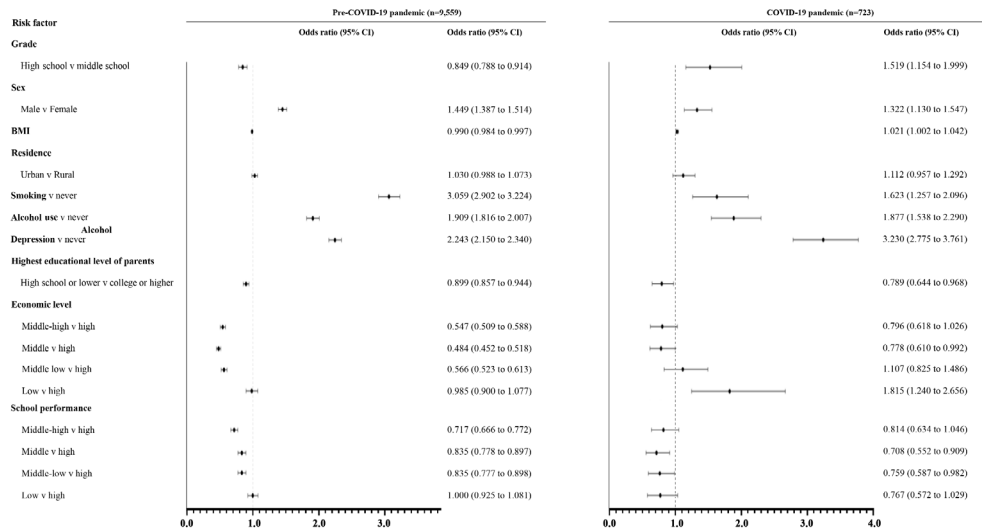
Fig. 4. Odds ratios for association between risk factors and substance use by time period divided by COVID-19 pandemic happening. Odds ratio was calculated for one unit increase in BMI (1kg/㎡). Horizontal lines indicate corresponding 95% confidence intervals around odds ratios. BMI, body mass index.

while one qualitative study utilized 100 interviewees.[11] However, their small sample size, short-term follow-up period (mostly less than six years), and inappropriate study design (non-representative or non-random selection of participants, including convenience, purposive, or volunteer sampling) have potentially contributed to low levels of evidence and inconsistent results.[11, 12] Furthermore, most studies have been conducted in America or Europe.[11, 12] These studies have only shown the risk factors for substance or alcohol use up to the pre-pandemic period.[11, 12] However, our study provides adolescents' risk factors for alcohol or substance use and the odds ratio to easily compare the change between the pre-pandemic and during pandemic periods. Furthermore, body mass index (BMI), depression, and lower economic status were strongly related to alcohol and substance use during the COVID-19 pandemic. The COVID-19 pandemic may lead to increased social isolation, depression, anxiety,[3, 13] low levels of physical activity, unhealthy diets, and subsequent weight gain, as well as increased consumption of alcohol and substances.[14, 15] Moreover, the COVID-19 pandemic has considerably impacted on household income due to premature deaths, workplace absenteeism, and reduced productivity, leading to unemployment.[16, 17] It may result in economic problems, depression, and a subsequent increase in alcohol and substance consumption.[18, 19]

4. Policy implication

Many unhealthy habits start in adolescence, and when alcohol and substance use begins at an early age, there is a high likelihood of developing substance use in future life.[20] Alcohol and substance addiction significantly impact people, families, and communities and can lead to issues and negative impacts on social, physical, and mental health.[21] As a result, it is important to identify high-risk adolescents and provide them with preventative services, daily

monitoring of youth health data, and prevention programs, for example, the PROSPER device,[22] the "4-H Health Rocks" device,[23] and the unplugged program. As the COVID-19 pandemic has changed the trend of young people's alcohol and drug use in particular,[24] it is crucial to identify various factors associated with alcohol and substance use to develop policies that will lessen young people's use of them.[20]

In this study, adolescents who were depressed, had low socioeconomic status and had higher BMI, were more vulnerable to alcohol and drug use during the COVID-19 pandemic. Considering these findings, it is psychiatric counseling is recommended, such as education for lowering anxiety and depression levels, promoting home-based physical activities, and aiding cognitive behavioral therapy based in school and community settings.[25] Relatively higher risk of alcohol and substance use during the pandemic in economically vulnerable adolescents might also have been affected by increased health-related stress, less peer support, and vulnerability to health-related stress in this population.[26] Special attention to decreasing these gaps between adolescents from lower-income and higher-income families is necessary for the late stages of the COVID-19 pandemic.[27]

5. Strengths and limitations

This post-hoc study examined large population-based data from a nationwide investigation of factors associated with adolescent alcohol and substance use in Korea. Long-term data from 2005 to 2021 were used, making it easier to track changes in the variables related to alcohol and other substance use.[28] The changes during the early and mid-pandemic periods were confirmed by including data from 2021.

This study had several limitations. First, data from a self-report questionnaire were used to gauge adolescent substance and alcohol use. Owing to social desirability bias, this may understate the true prevalence of adolescents' substance use. However, a previous study suggested that this questionnaire is generally reliable in determining estimates (kappas ≥0.81).[29] Second, a detailed analysis of each type was constrained by the unknown specific types of substances used. This could result in a bias in the adolescent substance use trend toward the specific substance they used. Third, the findings may not reflect the global population because our data only included South Korean adolescents.[30] International large-scale studies investigating the factors associated with substance and alcohol use in youth are warranted to clarify this issue. Fourth, to reduce the number of questions in the in-depth smoking survey, the amount of substance usage, which did not significantly affect the results, was excluded from the 2015 survey. However, since 2016, substance use has been included in an annual survey without a circular survey. Therefore, the 2015 substance usage survey data were omitted from the KYRBS, which could have skewed the conclusions of this study. Finally, because the late period of the COVID-19 pandemic was not included in this study, it must be continuously reviewed to account for additional risk factors during the late stage of the pandemic.

The study protocol was endorsed by Kyung Hee University (KHUH 2022-06-042) and the KDCA, who provided written informed consent.

6. Conclusion

Over a million adolescents' national data were used in this study to investigate changes in alcohol and drug use according to risk factors from 2005 to 2021. Moreover, we compared how they were affected by the COVID-19 pandemic by comparing the change in risk factors in the pre-pandemic (2005–2019) and pandemic periods (2020–2021). The outcomes of this study suggest a complex interaction between a multitude of factors that influence adolescent alcohol and substance use. Among these variables, school grades, male, lower educational levels of parents, and smoking status were more pronounced and significant in adolescents with alcohol and substance use. This may be due to the COVID-19 pandemic. Therefore, after the pandemic, for successful prevention of alcohol and substance use in adolescents, greater control of risk factors is needed.

Capsule Summary

This review paper aims to determine the change in alcohol and substance use by the familial-, social-, and individual-associated risk factors among Korean adolescents, comparing the pre- and during COVID-19 pandemic period.

Patient and public involvement

No patients were directly involved in designing the research question or in conducting the research. No patients were asked for advice on interpretation or writing up the results. There are no plans to involve patients or the relevant patient community in dissemination at this moment.

Transparency statement

The leading authors (Dr. HGW) are an honest, accurate, and transparent account of the study being reported.

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None

Author Contribution

All authors made substantial contributions to all of the following: (1) the conception and design of the study, or acquisition of data, and interpretation of data, (2) drafting the article or revising it critically for important intellectual content, (3) final approval of the version to be submitted.

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Conflicts of Interest

All authors state that they have no actual or potential conflict of interest including any financial, personal, or other relationships with other people or organizations.

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References

1. Bryazka D, Reitsma MB, Griswold MG, Abate KH, Abbafati C, Abbasi-Kangevari M, et al. Population-level risks of alcohol consumption by amount, geography, age, sex, and year: a systematic analysis for the Global Burden of Disease Study 2020. The Lancet. 2022;400(10347):185-235.

2. Mokdad AH, Forouzanfar MH, Daoud F, Mokdad AA, El Bcheraoui C, Moradi-Lakeh M, et al. Global burden of diseases, injuries, and risk factors for young people's health during 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013. The Lancet. 2016;387(10036):2383-401.

3. Barocas JA, Nall SK, Axelrath S, Pladsen C, Boyer A, Kral AH, et al. Population-Level Health Effects of Involuntary Displacement of People Experiencing Unsheltered Homelessness Who Inject Drugs in US Cities. Jama. 2023.

4. Yeo YH, He X, Ting P-S, Zu J, Almario CV, Spiegel BM, et al. Evaluation of trends in alcohol use disorder–related mortality in the US before and during the COVID-19 pandemic. JAMA Network Open. 2022;5(5):e2210259-e2210259.

5. Alarcó-Rosales R, Sánchez-SanSegundo M, Ferrer-Cascales R, Albaladejo-Blazquez N, Lordan O, Zaragoza-Martí A. Effects of a school-based intervention for preventing substance use among adolescents at risk of academic failure: A pilot study of the reasoning and rehabilitation V2 program. Healthcare (Basel, Switzerland). 2021;9(11).

6. Strang J, Babor T, Caulkins J, Fischer B, Foxcroft D, Humphreys K. Drug policy and the public good: evidence for effective interventions. Lancet (London, England). 2012;379(9810):71-83.

7. Henriksen L, Feighery EC, Schleicher NC, Fortmann SP. Receptivity to alcohol marketing predicts initiation of alcohol use. The Journal of Adolescent Health : Official Publication of the Society for Adolescent Medicine. 2008;42(1):28-35.

8. Merikangas KR, He JP, Burstein M, Swanson SA, Avenevoli S, Cui L, et al. Lifetime prevalence of mental disorders in U.S. adolescents: Results from the national comorbidity survey replication-adolescent supplement (NCS-A). Journal of the American Academy of Child and Adolescent Psychiatry. 2010;49(10):980-9.

9. Yon H, Park S, Shin JU, Koyanagi A, Jacob L, Smith L, et al. Differences in pandemic-related factors associated with alcohol and substance use among Korean adolescents: Nationwide representative study. Biomed Environ Sci. 2023;36(6):542-8.

10. Macleod J, Oakes R, Copello A, Crome I, Egger M, Hickman M, et al. Psychological and social sequelae of cannabis and other illicit drug use by young people: A systematic review of longitudinal, general population studies. Lancet (London, England). 2004;363(9421):1579-88.

11. Nawi AM, Ismail R, Ibrahim F, Hassan MR, Manaf MRA, Amit N, et al. Risk and protective factors of drug abuse among adolescents: A systematic review. BMC Public

Health. 2021;21(1):2088.

12. Nargiso JE, Ballard EL, Skeer MR. Erratum to: A systematic review of risk and protective factors associated with nonmedical use of prescription drugs among youth in the United States: A social ecological perspective. Journal of Studies on Alcohol and Drugs. 2015;76(2):348.

13. Gori T, Lelieveld J, Münzel T. Perspective: Cardiovascular disease and the Covid-19 pandemic. Basic Research in Cardiology. 2020;115(3):32.

14. Muscogiuri G, Barrea L, Savastano S, Colao A. Nutritional recommendations for COVID-19 quarantine. European Journal of Clinical Nutrition. 2020;74(6):850-1.

15. Lee SW, Lee J, Moon SY, Jin HY, Yang JM, Ogino S, et al. Physical activity and the risk of SARS-CoV-2 infection, severe COVID-19 illness and COVID-19 related mortality in South Korea: A nationwide cohort study. Br J Sports Med. 2022;56(16):901-12.

16. Pak A, Adegboye OA, Adekunle AI, Rahman KM, McBryde ES, Eisen DP. Economic consequences of the COVID-19 outbreak: The need for epidemic preparedness. Frontiers in Public Health. 2020;8:241.

17. Adegunsoye A, Saunders MR. Racial disparities among lung transplant survivors-shadows and substance. JAMA Network Open. 2023;6(4):e238285.

18. Smith L, Shin JI, Koyanagi A. Vaccine strategy against COVID-19 with a focus on the Omicron and stealth Omicron variants: Life Cycle committee recommendations. Life Cycle. 2022;2:e5.

19. Gilic B, Zenic N, Separovic V, Jurcev Savicevic A, Sekulic D. Evidencing the influence of pre-pandemic sports participation and substance misuse on physical activity during the COVID-19 lockdown: A prospective analysis among older adolescents. International Journal of Occupational Medicine and Environmental Health. 2021;34(2):151-63.

20. Das JK, Salam RA, Arshad A, Finkelstein Y, Bhutta ZA. Interventions for adolescent substance abuse: An overview of systematic reviews. The Journal of Adolescent Health : Official Publication of the Society for Adolescent Medicine. 2016;59(4s):S61-s75.

21. Sussman S, Skara S, Ames SL. Substance abuse among adolescents. Substance Use & Misuse. 2008;43(12-13):1802-28.

22. Spoth R, Redmond C, Shin C, Greenberg M, Feinberg M, Schainker L. PROSPER community-university partnership delivery system effects on substance misuse through 6 1/2 years past baseline from a cluster randomized controlled intervention trial. Preventive Medicine. 2013;56(3-4):190-6.

23. Miovský M, Vonkova H, Čablová L, Gabrhelík R. Cannabis use in children with individualized risk profiles: Predicting the effect of universal prevention intervention. Addictive Behaviors. 2015;50:110-6.

24. Dumas TM, Ellis W, Litt DM. What does adolescent substance use look like during the COVID-19 pandemic? Examining changes in frequency, social contexts, and pandemic-related predictors. The Journal of Adolescent Health: Official Publication of the Society for Adolescent Medicine. 2020;67(3):354-61.

25. Patel V, Araya R, Chatterjee S, Chisholm D, Cohen A, De Silva M, et al. Treatment and prevention of mental disorders in low-income and middle-income countries. Lancet (London, England). 2007;370(9591):991-1005.

26. Wang MT, Henry DA, Scanlon CL, Del Toro J, Voltin SE. Adolescent psychosocial

adjustment during COVID-19: An intensive longitudinal study. Journal of Clinical Child and Adolescent Psychology: The Official Journal for the Society of Clinical Child and Adolescent Psychology, American Psychological Association, Division 53. 2022:1-16.

27. Raffa BJ, Schilling S, Henry MK, Ritter V, Bennett CE, Huang JS, et al. Ingestion of Illicit substances by young children before and during the COVID-19 pandemic. JAMA Network Open. 2023;6(4):e239549.

28. Lee KH, Yon DK, Suh DI. Prevalence of allergic diseases among Korean adolescents during the COVID-19 pandemic: Comparison with pre-COVID-19 11-year trends. European Review for Medical and Pharmacological Sciences. 2022;26(7):2556-68.

29. Bae J, Joung H, Kim JY, Kwon KN, Kim YT, Park SW. Test-retest reliability of a questionnaire for the Korea youth risk behavior web-based survey. Journal of Preventive Medicine and Public Health = Yebang Uihakhoe chi. 2010;43(5):403-10.

30. Shin H, Park S, Yon H, Ban CY, Turner S, Cho SH, et al. Estimated prevalence and trends in smoking among adolescents in South Korea, 2005-2021: A nationwide serial study. World Journal of Pediatrics : WJP. 2023;19(4):366-77.