BMC Public Health

RESEARCH

Open Access

Comparative study on health behaviors among adolescents with chronic allergic disease before and during COVID-19 using data from the Korean Youth Health Panel Surveys

Sunyeob Choi[1], Hyewon Shin[2*] and Dian Susmarini[2]

Abstract

Background This study aimed to investigate the changes in the health behaviors and subjective health perception of adolescents with chronic allergic disease, including atopic dermatitis, asthma, and allergic rhinitis, amidst the coronavirus disease 2019 (COVID-19) pandemic in South Korea.

Methods This study used the 15th (2019) and 17th (2021) raw data obtained from the Korea Youth Risk Behavior Web-based Survey (KYRBWS), conducted by the Ministry of Health and Welfare of South Korea. Data were analyzed using multiple logistic regression with complex sampling using weighted values. Odds ratios with 95% confidence intervals for six health behaviors and subjective health perception were used as the major variables.

Results Six health behaviors (dietary habits, weight gain, smoking, alcohol consumption, sleep time, and physical activity) changed substantially during COVID-19. There was an increase in the duration of sedentary activities, a slight increase in BMI, and improvements in mental health. Concurrently, there was a decrease in alcohol consumption, sleep duration, and the consumption of sweetened beverages. Despite these improvements in big six health behaviors, adolescents with chronic illnesses continue to perceive themselves as unhealthy.

Conclusions These findings suggest that the follow-up and monitoring of health behaviors and subjective health perception in adolescents with chronic allergic diseases during the COVID-19 pandemic are necessary. Understanding the mechanisms underlying sustained behavioral change can inform the development of interventions to promote healthy behavior after the pandemic has passed.

Keywords COVID-19 pandemic, Health behavior, Health risk behaviors, Adolescent

*Correspondence:
Hyewon Shin
hyeshin@ewha.ac.kr
[1]College of Nursing, Dongguk University-WISE, 123 Dongdae-ro, Gyeongju Gyeongbuk, South Korea
[2]College of Nursing, Ewha Womans Universtiy, 52, Ewhayeodae-gil, Seodaemun-gu, South Korea

© The Author(s) 2024. **Open Access** This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article or parts of it. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit http://creativecommons.org/licenses/by-nc-nd/4.0/.

Introduction

In December 2019, the Coronavirus disease 2019 (COVID-19) outbreak began in China and was announced as a pandemic by the World Health Organization (WHO) in March 2020. It is an acute respiratory disease caused by the SARS-CoV-2 coronavirus and has become a global pandemic [1]. It has affected more than 200 countries globally, with the total number of COVID-19 patients being more than seven million and the number of deaths reported to be 6,921,614 as of May 3, 2023 [2]. In South Korea, the first confirmed case of COVID-19 was registered in January 2020; 250,000 people have been diagnosed with the virus and 25,000 people have died from it [3]. Currently, the global death toll from COVID-19 has exceeded 8.54 million [4]. The incidence of chronic allergic diseases, including asthma, atopic dermatitis, and allergic rhinitis, has gradually increased owing to recent environmental changes [5]. Allergic disease prevalence and morbidity rates have been steadily increasing worldwide, particularly among children and young adults over the past decade [6]. Allergic diseases, traditionally associated with Western lifestyles, are now seeing higher morbidity rates in Asian and Indian immigrants to Western countries, with a noticeable increase over the past 20 years [7]. According to a meta-analysis that clarified the relationship between chronic allergic diseases and COVID-19, those with chronic allergic diseases have a higher risk of developing COVID-19.

The big six health risk factors which consist of alcohol consumption, smoking, insufficient sleep, inadequate physical activity, inappropriate dietary habits, and excessive weight [8, 9], provide a comprehensive approach to understanding the intricate nature of chronic diseases. These behaviors do not act independently, rather, they simultaneously contribute to the development of chronic diseases [10]. This research stands out from other studies that investigate health behavior risk factors for chronic allergic diseases, by employing the big six approach. Unlike previous studies that primarily concentrated on specific aspects of health risk factors, this study endeavors to comprehensively assess the six health risk factors in the context of COVID-19. Previous research has focused on the importance of the big six risk lifestyle behaviors and it have been identified for the short-term and long-term health of adolescents and known predictors of chronic disease including cancer, cardiovascular disease, and mental disorders [9]. Adolescence is a stage in the life cycle during which physical activity, nutrition, diet, smoking, drinking habits, and health perceptions are formed [9, 11]. Adolescence is also a period when individuals are exposed to health risk factors and make decisions regarding their health status [12]. Among adolescents, those with chronic allergic disease may be particularly affected by six major health response factors. Adolescents with chronic allergic diseases may experience food allergies due to immune responses to certain foods, requiring dietary management [13, 14], overall weight maintenance, and consistent physical activity to improve the immune system [15]. A recent study investigating children's sleep patterns during the COVID-19 pandemic discovered that children with limited outdoor activities exhibited a substantial decrease in overall physical activity and a slight decline in sleep quality as a result of increased screen time [16]. Adequate sleep is important for strengthening the immune system and alleviating symptoms in children with chronic allergic diseases; however, adolescents with allergic diseases experience poor sleep quality owing to their symptoms [17, 18]. Smoking in adolescents with chronic allergic diseases can exacerbate respiratory symptoms, whereas alcohol consumption reduces adolescents' immune system [19, 20]. The mental well-being of adolescents has been significantly impacted by the presence of COVID-19, particularly among those with substantial exposure to the virus. Research indicates that heightened apprehension about COVID-19 within this demographic can lead to detrimental mental health outcomes, including increased levels of anxiety and depression [21].

Maintaining a healthy lifestyle is particularly important for teenagers who suffer from chronic allergic diseases. Research has revealed inconsistent outcomes regarding alcohol and tobacco consumption among the youth population during the pandemic, with some studies showing reductions, others indicating increases, and still others reporting no changes [22]. The social, economic, and psychological consequences of COVID-19 may lead to increased alcohol consumption as a coping mechanism for anxiety, depression, and stress, a pattern similar to that observed during past crises [23]. Consuming alcohol has been shown to negatively affect the immune system and raise the chances of developing respiratory infections [24]. We hypothesized that the alcohol and tobacco consumptions might be decreased during the pandemic. The WHO [25] has stated that smokers are more likely to be infected with COVID-19; however, research has reported that smoking is not directly related to COVID-19, and other health problems in smokers may increase the risk of infection, indicating the need for further research [26]. In a research project exploring the association between alcohol intake and COVID-19, findings revealed that stressors, including anxiety and COVID-19 lockdowns, led to an increase in alcohol consumption. During the COVID-19 pandemic, students continuing their studies were significantly affected by worldwide school closures and lockdowns, with 87% of all students experiencing educational disruptions [27]. Likewise, middle and high schools provide online lectures or blended learning, which is mixed with online and offline classes for

students in South Korea [28]. Consequently, this led to significant changes in learning methods [29]. The transition to remote learning during COVID-19 have led to reduced daily activities among adolescents, resulting in changes in sleep patterns [30]. A study found that adolescents experienced changes in their sleeping patterns during the pandemic. Specifically, they went to bed and woke up later than before, and their nap times decreased compared to the pre-pandemic period [31]. Insufficient sleep can negatively affect mental health and academic performance [32, 33]. Moreover, physical activity among adolescents has decreased due to social distancing related to COVID-19, which can exacerbate not only physical health but also mental health problems such as depression and anxiety [34]. In addition, as schools and sports facilities were closed during the COVID-19 pandemic, adolescents spent less time on physical activity and more on smartphones, computers, and televisions [35, 36]. A study investigating the relationship between dietary habits and COVID-19 [37] found that, as the outdoor activities of adolescents decreased due to COVID-19, the consumption of snacks, sugary drinks, and sweet beverages also increased [35, 37]. Furthermore, many people experience decreased appetite due to reduced physical activity as a result of COVID-19, whereas others overeat due to stress [38]. The results regarding the relationship between dietary habits and COVID-19 are inconsistent, and further studies are warranted. Previous research has shown that obese adolescents and young adults are approximately 2.6 times more likely to be exposed to COVID-19 than non-obese individuals and are more likely to develop respiratory diseases [39]. Additionally, while some results indicate that lockdowns and activity restrictions during the COVID-19 pandemic have led to weight gain in children and adolescents, research on this issue is lacking [40], which highlights the need for further studies.

Furthermore, according to the 2020 Comprehensive Survey of Adolescents, the average weekly physical activity time decreased by 1.7 h compared to 2017, down to 2.1 h, with **60.9%** of adolescents reporting no outdoor physical activity at all. The usual weekday sleep duration increased to approximately 8 h and 20 min. This trend is attributed to the impact of COVID-19, such as social distancing measures and remote learning [41]. Various factors contribute to increasing the likelihood of unhealthy behaviors in youth, while others act as protective factors, mitigating risks even amidst significant challenges [42].

Subjective health perception is an individual's evaluation of their health and serves as a reliable predictor of future health status and healthcare utilization [43]. Subjective health perception is related to lifestyle factors such as dietary habits, smoking, alcohol consumption, physical activity, sleep deprivation, and recovery time after sleep [44]. Subjective health perception has been found to be a more accurate predictor of an individual's well-being than doctors' objective diagnoses [45] and is used as a reliable tool for assessing personal health status. Subjective health perception encompasses an individual's physical, mental, and social factors and promotes the maintenance of healthy habits and the utilization of medical services [46, 47]. Adolescents are predisposed to engaging in health-risk behaviors, including experiencing stress, sleep deprivation, insufficient physical activity, and adopting unhealthy eating habits [48]. During the pandemic, this population was particularly vulnerable to COVID-19 transmission. Factors such as experiences with COVID-19 testing, knowledge and attitudes towards COVID-19, and the level of social support contributed to shaping health prevention behaviors among adolescents [46–49]. Given that subjective health perception is influenced by individuals' self-rated of their risk behaviors, the adoption of preventive measures against COVID-19 may positively influence their subjective health perceptions. Therefore, this study attempted to examine the changes in six major health risk factors before and during COVID-19 pandemic among adolescents with chronic allergic diseases and to identify factors influencing subjective health perception using data from a representative Korea Youth Risk Behavior Web-based Survey.

Methods

Study design

This descriptive survey aimed to examine the changes in health risk factors among adolescents with chronic allergic diseases before and during COVID-19 pandemic and identify factors that influence their subjective health perception. This was a secondary data analysis study using raw data from the 15th (2019) and 17th (2021) Korea Youth Risk Behavior Web-based Survey. This was not a longitudinal research design; therefore, the subject was not the same person in the 2019 and 2021 surveys.

Research data

The Korea Youth Risk Behavior Web-based Survey (KYRBWS) is a biennial survey initiated in 2005 by the Ministry of Health and Welfare of South Korea. It aims to comprehend the health-related behaviors, perceptions, attitudes, and knowledge of middle (1st to 3rd grade) and high school students (1st to 3rd grade) in metropolitan and provincial areas of South Korea across the country [50]. The survey utilizes an anonymous, self-administered online format and employs random sampling of students from both metropolitan and provincial areas. The survey data encompassed students nationwide and employed population stratification, sample distribution, and sampling techniques. Specifically, the survey involved 39 regional groups and 117 strata during population

stratification, distributed samples to 400 middle schools and 400 high schools, and utilized a stratified cluster sampling method. The 2015 survey involved 60,100 students from 17 cities and provinces and included questions on various health aspects. In the 2021 survey, considering the COVID-19 situation, mental health (loneliness, generalized anxiety disorder) questions were added as in 2020, and other questions were included on smoking, drinking, physical activity, diet, sleep health, injury and safety awareness, and sexual behavior. A total of 113 questions were investigated [36].

Table 1 General characteristics of adolescents before and during COVID-19

Variables	Categories	2019 (*N* = 57,302) *n* (%)/M ± SE	2021 (*N* = 54,846) *n* (%)/M ± SE	*p*
Gender	Male	29,841(52.0)	28,401(51.7)	0.869
	Female	27,461(48.0)	26,445(48.3)	
Age		15.16 ± 0.04	14.99 ± 0.04	0.006
Education level	Middle school	29,384(48.0)	30,015(51.2)	0.006
	High school	27,467(52.0)	24,548(48.8)	
Height		165.74 ± 0.17	166.35 ± 0.15	0.006
Weight		59.06 ± 0.19	60.23 ± 0.19	< 0.001
Fathers' education level	Middle school graduation or below	615(1.9)	558(1.5)	< 0.001
	High school graduation	8734(28.7)	8665(25.7)	
	College graduation or above	19,979(69.4)	22,956(72.8)	
Mothers' education level	Middle school graduation or below	519(1.6)	453(1.2)	< 0.001
	High school graduation	10,174(33.3)	10,147(29.5)	
	College graduation or above	19,348(65.0)	22,720(69.3)	
Perceived household income	High	22,505(39.7)	21,567(40.1)	< 0.001
	Middle	27,456(47.8)	27,076(49.0)	
	Low	7341(12.5)	6203(10.9)	
Subjective academic performance	High	21,943(38.1)	20,527(37.1)	0.041
	Middle	17,234(30.1)	16,902(31.0)	
	Low	18,125(31.8)	17,417(31.9)	
Cohabitation with family	Living with family	54,266(95.4)	52,424(96.2)	0.086
	Not living together	3036(4.6)	2422(3.8)	

Study population

The participants in this study were adolescents who participated in the Adolescent Health Behavior Survey. The target population included those who answered "yes" to the question of whether they had been diagnosed with atopic dermatitis, asthma, or allergic rhinitis. From the 15th data (2019), a total of 60,100 students participated in the survey, the final analysis focusing on students with 57,302 experiencing chronic allergic diseases (atopic dermatitis, asthma, allergic rhinitis) and the 17th data (2021) collected data from 59,426 students, and the final analysis focusing on students experiencing chronic allergic diseases (atopic dermatitis, asthma, allergic rhinitis) with 54,846.

Measurements

The study participants' general characteristics included gender, age, educational level, height, weight, economic status, parents' educational level, academic performance, and family cohabitation. Health risk behaviors, including health habits, were measured as follows: dietary habits (consumption of fast food in the past 7 days, consumption of carbonated beverages in the past 7 days, consumption of sweetened beverages in the past 7 days, consumption of water in the past 7 days, nutrition and diet education within the last month); smoking (lifetime smoking experience, age of first smoking, smoking days in the past 30 days, starting age of daily smoking, amount of smoking in the past 30 days, experience with e-cigarettes, number of days using e-cigarettes in the past 30 days, experience with heat-hot-burn tobacco products in the past 30 days, experience of school anti-smoking education in the past 12 months); alcohol consumption (lifetime alcohol experience, age of first alcohol consumption, frequency of alcohol consumption in past 30 days, amount of alcohol consumed in past 30 days, experience of binge drinking in past 30 days, experience of school-based alcohol education in past 12 months); physical activity characteristics (frequency of physical activity for 60 min or more/week, frequency of high-intensity physical activity in past 7 days, frequency of strength training activity in past 7 days, sedentary time for study purposes on weekdays/weekends, sedentary time for non-study purposes on weekdays/weekends); body image-related characteristics (effects to control weight efforts/month, subjective health perception, subjective body perception) were included (see Tables 1 and 2 for details). Subjective health perception was measured on a 5-point using the question "How would you rate your health?" [45, 46].

Data analysis

Data analysis was conducted using a complex sample design method, considering stratification variables (strata), clustering variables (cluster), and weights (w)

Table 2 Dietary habits of adolescents before and during COVID-19

Variables	Categories	2019 *n*(%)	2021 *n*(%)	*p*
Consumption of fast food (past 7 days)	Never	10,517(18.0)	9319(16.8)	< 0.001
	Once or twice a week	32,393(56.4)	31,282(57.0)	
	Three to four times a week	11,253(20.0)	11,294(20.7)	
	Five to six times a week	2012(3.5)	1975(3.7)	
	Seven or more times a week	1127(2.0)	976(1.8)	
Consumption of carbonated beverages (past 7 days)	Never	11,361(20.0)	13,169(24.3)	< 0.001
	Once or twice a week	24,785(43.1)	22,594(41.3)	
	Three to four times a week	13,444(23.5)	11,973(21.7)	
	Five to six times a week	3979(6.9)	3440(6.3)	
	Seven or more times a week	3733(6.5)	3670(6.4)	
Consumption of Sweetened beverages (past 7 days)	Never	6970(12.2)	8476(15.6)	< 0.001
	Once or twice a week	21,604(37.4)	19,947(36.1)	
	Three to four times a week	16,734(29.3)	14,782(27.0)	
	Five to six times a week	6325(11.2)	5671(10.4)	
	Seven or more times a week	5669(10.0)	5970(10.9)	
Nutrition/diet education (past 30 days)	No	29,228(52.0)	31,517(58.5)	< 0.001
	Yes	28,074(48.0)	23,329(41.5)	
Sweetened beverages consumption (past 7 days)	Less than 1 cup a day	2335(4.1)	1963(3.6)	< 0.001
	1–2 cups a day	11,193(19.6)	9764(17.8)	
	3 cups a day	13,238(23.1)	12,221(22.3)	
	4 cups a day	10,136(17.8)	9830(18.1)	
	5 or more cups a day	20,399(35.4)	21,068(38.2)	

according to the guidelines for using KYRBWS raw data. To compare adolescents' lifestyle habits and subjective health perceptions, Rao-Scott $\chi 2$ test and complex sample general linear regression analysis were performed. To determine the elements that impact an individual's perception of their health, a complex sample logistic regression analysis, specifically a binary logistic regression analysis, was conducted. In this analysis, p-values of less than .05 were deemed to be statistically significant. Based on a prior study [51, 52], responses of 'very heathy' and 'healthy' were categorized as positive health awareness, while responses of 'unhealthy' and 'very unhealthy' were categorized as negative health awareness when analyzing a panel logit analysis.

Results

General characteristics of adolescents before and during COVID-19

Adolescents' general characteristics, including gender, age, education level, height, weight, parental education level, subjective economic status, subjective academic achievement, living environments, smoking experience, e-cigarette experience, alcohol consumption experience, physical activity frequency, time spent sitting for studying or other purposes, lifetime diagnosis of asthma, atopic dermatitis, allergic rhinitis, fast food consumption, and weekday/weekend sleep time, were measured and compared before and during COVID-19 (Table 1).

The analysis results showed significant differences before and during COVID-19 in age ($p=.006$), educational level ($p=.006$), height ($p=.006$), weight ($p<.001$), father's educational level ($p<.001$), mother's educational level ($p<.001$), subjective household economy ($p<.001$), subjective academic performance ($p=.041$), lifetime smoking experience ($p<.001$), experience with e-cigarette ($p<.001$), life-time alcohol consumption experience ($p<.001$), frequency of physical activity of 60 min or more ($p=.021$), sedentary time spent studying during weekdays ($p<.001$), sedentary time spent other than studying during weekdays ($p<.001$), sedentary time spent other than studying during weekends ($p<.001$), lifetime diagnosis of asthma ($p<.001$), consumption of fast food ($p<.001$), weekday sleep hour ($p=.008$), and weekend sleeping hour ($p<.001$).

Dietary habits of adolescents before and during COVID-19

Dietary habits included the frequency of consumption of fast food, carbonated beverages, sweetened beverages, and water in the past week, as well as whether the respondent had received nutrition/health education within the past 12 months. The analysis showed statistically significant differences between 2019 and 2021 in terms of the consumption of fast food in the last 7 days ($p<.001$), consumption of carbonated beverages in the past 7 days ($p<.001$), consumption of sweetened beverages in the past 7 days ($p<.001$), consumption of water in the past 7 days ($p<.001$), and nutrition/diet education within the last month ($p<.001$; Table 2).

Smoking-related factors of adolescents before and during COVID-19

As previously mentioned, smoking-related characteristics included lifetime smoking experience, age at first smoking, number of smoking days in the past month, starting age of daily smoking, amount of smoking in the past 30 days, experience with e-cigarettes, and number of days using e-cigarettes in the past 30 days. The analysis showed significant differences before and during COVID-19 in terms of lifetime smoking experience ($p<.001$), age of first smoking ($p<.001$), smoking days in the past month ($p<.001$), starting age of daily smoking ($p<.001$), amount of smoking in the past 30 days ($p<.001$), experience with e-cigarettes ($p<.001$), experience with heat-not-burn tobacco products ($p<.001$), experience with heat-not-burn tobacco products in the past 30 days ($p=.028$), frequency of heated tobacco product use within the past month ($p<.001$), and experience of school anti-smoking education in the past 12 months ($p=.007$; Table 3).

Alcohol-related factors of adolescents before and during COVID-19

Alcohol-related characteristics included lifetime alcohol consumption, age at first alcohol consumption, frequency of alcohol consumption in the past 30 days, amount of alcohol consumed in the past 30 days, experience of binge drinking in the past 30 days, and experience with school-based alcohol education in the past 12 months. The analysis showed significant differences before and during COVID-19 in lifetime alcohol consumption ($p<.001$), age at first alcohol consumption ($p<.001$), frequency of alcohol consumption in the past 30 days ($p<.001$), amount of

Table 3 Smoking-related characteristics of adolescents before and during COVID-19

Variables	Categories	2019 *n*(%)	2021 *n*(%)	*p*
Lifetime smoking experience	No	50,226(87.3)	49,517(90.1)	< 0.001
	Yes	7076(12.7)	5329(9.9)	
Age of first smoking	Before elementary school	205(2.9)	135(2.6)	< 0.001
	Elementary school	1212(16.5)	692(12.6)	
	Middle school	4398(62.7)	3676(69.6)	
	High school	1211(18.0)	763(15.2)	
Smoking days (past 30 days)	No	3383(47.4)	2925(54.7)	< 0.001
	Less than 10 days	1286(17.8)	745(13.3)	
	More than 10 days	697(10.0)	449(8.4)	
	Everyday	1710(24.8)	1210(23.6)	
Starting age of daily smoking	Before elementary school	77(4.4)	21(0.6)	< 0.001
	Elementary school	69(3.5)	151(4.4)	
	Middle school	997(57.3)	2270(67.0)	
	High school	588(34.8)	879(27.9)	
Amount of smoking (past 30 days)	No	844(21.9)	26(3.4)	< 0.001
	1–2	348(9.0)	24(3.4)	
	3–5	1052(27.3)	140(22.3)	
	6–9	730(19.7)	146(23.7)	
	10–19	526(13.9)	164(27.1)	
	20–29	317(8.2)	119(20.1)	
Experience with e-cigarettes	No	3562(49.1)	2129(39.6)	< 0.001
	Yes	3514(50.9)	3200(60.4)	
Number of days using e-cigarettes (past 30 days)	No	1969(56.0)	1855(57.5)	0.028
	Less than 10 days	959(27.0)	759(23.5)	
	More than 10 days	273(7.8)	269(8.4)	
	Everyday	313(9.1)	317(10.6)	
Experience with heat-not-burn tobacco products	No	4638(64.3)	3720(69.0)	< 0.001
	Yes	2438(35.7)	1609(31.0)	
Experience with heat-not-burn tobacco products (past 30 days)	No	1152(46.7)	957(59.4)	< 0.001
	Less than 10 days	813(33.6)	438(26.8)	
	More than 10 days	208(8.5)	107(6.9)	
	Everyday	265(11.1)	107(6.9)	
Experience of school anti-smoking education (past 12 months)	No		19,308(36.8)	
	Yes		35,540(63.2)	

Table 4 Alcohol-related characteristics of adolescents before and during COVID-19

Variables	Categories	2019 *n*(%)	2021 *n*(%)	*p*
Lifetime alcohol experience	No	35,063(60.6)	36,908(67.1)	< 0.001
	Yes	22,239(39.4)	17,938(32.9)	
Age of first alcohol consumption	Before elementary school	1179(5.0)	1039(5.5)	< 0.001
	Elementary school	4259(18.1)	3770(19.4)	
	Middle school	11,513(51.6)	9470(52.8)	
	High school	5238(25.3)	3619(22.2)	
Frequency of alcohol consumption (past 30 days)	No	13,839(61.9)	12,135(67.4)	< 0.001
	Less than 3 days	4909(22.1)	3532(19.8)	
	3–10 days	2487(11.4)	1599(9.0)	
	More than 10 days	793(3.6)	578(3.2)	
	Every day	211(1.0)	94(0.6)	
Amount of alcohol consumed (past 30 days)	1–2 glasses of soju*	3235(37.8)	2606(44.8)	< 0.001
	3–4 glasses of soju	1410(16.6)	995(16.6)	
	5–6 glasses of soju	738(9.0)	494(8.7)	
	1–2 bottles of soju	1909(22.9)	1125(19.4)	
	More than 2 bottles of soju	1108(13.7)	583(10.4)	
Experience of binge drinking (past 30 days)	No	7161(85.4)	5197(89.7)	< 0.001
	1–2 days per month	882(10.4)	432(7.0)	
	3–4 days per month	147(1.6)	65(1.2)	
	More than 5 days per month	210(2.6)	109(2.1)	
Experience of school-based alcohol education (past 12 months)	No		36,180(67.0)	
	Yes		18,668(33.0)	

*Soju is a hard liquor in South Korea; two cups of soju equal one standard drink

alcohol consumed ($p<.001$), and experience with binge drinking ($p<.001$; Table 4).

Physical activity factors of adolescents before and during COVID-19

Physical activity characteristics included 60 min or more of physical activity, high-intensity physical activity in the past 7 days (e.g., basketball, socker, climbing, and swimming), strength training exercise in the past 7 days (e.g., crunches, dumbbells, and deadlift), and sedentary time spent studying and doing something other than studying during weekdays and weekends in the past week. The analysis results showed statistically significant differences before and during COVID-19 in 60 min or more of physical activity ($p=.021$), high-intensity physical activity ($p=.02$), sedentary time spent doing something other than studying during weekdays ($p<.001$), sedentary time spent studying during weekends ($p<.001$), and sedentary time spent doing something other than studying ($p<.001$; Table 5).

Body image-related characteristics of adolescents before and during COVID-19

Body image-related characteristics included weight control efforts and subjective perception of one's body image. The results showed statistically significant differences before and during COVID-19 in subjective body perception ($p<.001$; Table 6).

Mental health status of adolescents before and during COVID-19

Mental health status included recovery from fatigue after sleep in the past 7 days, experience of sadness and despair in the past 12 months, experience of suicidal ideation in the past 12 months, experience of suicide planning in the past 12 months, experience of suicide attempt in the past 12 months, and average sleep time per day during weekdays and weekends. The results showed statistically significant differences before and during COVID-19 in recovery from fatigue after sleep ($p<.001$), experience of sadness and despair ($p<.001$), experience of suicide attempt in the past 12 months ($p<.001$), and average sleep time on weekdays ($p=.003$) and weekends ($p<.001$; Table 7). In particular, results regarding loneliness were found only during COVID-19 data were collected in 2021. Table 8 shows the frequency of loneliness within the past 12 months and the level of Generalized Anxiety Disorder (GAD). According to the findings, 36.3% of adolescents reported experiencing occasional feelings of loneliness, whereas 64.7% had mild levels of GAD.

Table 5 Physical activity characteristics of adolescents before and during COVID-19

Variables	Categories	2019 *n*(%)/M ± SE	2021 *n*(%)/M ± SE	*p*
60 min or more of physical activity (past 7 days)	No	19,978(35.5)	18,248(34.0)	0.021
	1 day	8705(15.3)	8481(15.7)	
	2 days	8630(15.2)	8790(16.0)	
	3 days	7330(12.7)	7170(12.9)	
	4 days	3877(6.7)	3806(6.7)	
	5 or more days	8782(14.7)	8351(14.6)	
High-intensity physical activity (past 7 days)	No	18,010(32.3)	17,779(33.7)	0.002
	1 day	10,793(18.9)	10,510(19.2)	
	2 days	9630(16.8)	9484(17.1)	
	3 days	7223(12.5)	6511(11.6)	
	4 days	3354(5.7)	3208(5.7)	
	5 or more days	8292(13.8)	7354(12.6)	
Strength training exercise (past 7 days)	No	29,678(52.4)	28,368(52.6)	0.104
	1 day	8865(15.3)	8112(14.6)	
	2 days	5999(10.4)	5771(10.3)	
	3 days	4663(8.0)	4337(7.8)	
	4 days	2273(3.8)	2282(4.1)	
	5 or more days	5824(10.0)	5976(10.6)	
Sedentary time spent studying during weekdays (on average hours/day during past 7 days)		7.79 ± 0.05	7.65 ± 0.04	0.018
Sedentary time spent doing something other than studying during weekdays hours/ past 7 days)		2.79 ± 0.01	3.49 ± 0.02	< 0.001
Sedentary time spent studying during weekends (hours/ past 7 days)		4.02 ± 0.05	3.91 ± 0.05	0.113
Sedentary time spent doing something other than studying during weekends (hours past 7 days)		4.73 ± 0.02	5.27 ± 0.03	< 0.001

Table 6 Body image-related characteristics of adolescents before and during COVID-19

Variables	Categories	2019 *n*(%)/M ± SE	2021 *n*(%)/M ± SE	*p*
Efforts to control weight (past 30 days)	No special effort	26,978(47.6)	25,434(46.9)	0.133
	Trying to lose weight	19,167(33.1)	18,590(33.6)	
	Trying to gain weight	4290(7.4)	3962(7.2)	
	Trying to maintain weight	6867(11.9)	6860(12.4)	
Subjective (self-rated) health perception	Excellent	15,471(26.8)	12,183(22.1)	< 0.001
	Very good	24,785(43.2)	23,346(42.6)	
	Moderate	12,809(22.6)	14,297(26.1)	
	Poor	3915(6.9)	4703(8.7)	
	Very poor	322(0.6)	317(0.6)	
Subjective body perception	Very underweight	2504(4.4)	2454(4.5)	0.171
	Underweight	12,046(21.1)	11,375(20.9)	
	Normal	20,728(36.1)	19,573(35.8)	
	Overweight	18,182(31.9)	17,474(31.8)	
	Obese	3842(6.5)	3970(7.0)	

Impact factors on subjective health perception before and during COVID-19

Subjective health perception was analyzed using binary logistic regression, with "excellent" and "good" coded as 0 as and "less than average" (poor, very poor) as 1. In 2019, frequent consumption of fast food (five–six times per week; odds ratio [OR] = 1.347, 95% confidence interval [CI] = 1.201–1.510) and a history of alcohol consumption (OR = 1.038, 95% CI = 1.003–1.076) were associated with a higher probability of perceiving oneself as unhealthy (Table 9). Physical activity was associated with a lower probability of perceiving oneself as unhealthy, and an increase in sitting time was associated with a higher probability of perceiving oneself as unhealthy. Adequate sleep recovery was associated with a lower OR than inadequate recovery, and a higher body mass index (BMI) was associated with a higher probability of perceiving oneself as unhealthy. In 2021, frequent consumption of fast food (three or more times per week) was associated with a higher probability of perceiving oneself as unhealthy than not eating fast food. A history of smoking was associated with a lower probability of perceiving oneself as unhealthy (OR = 0.90, 95% CI = 0.84–0.97). Physical activity was associated with a lower probability of perceiving oneself as unhealthy, and an increase in sitting time on weekdays was associated with a higher probability of perceiving oneself as unhealthy. Adequate sleep recovery was associated with a lower OR than inadequate recovery, and higher BMI was associated with a higher probability of perceiving oneself as unhealthy. Overall, the frequent consumption of fast food (three or more times per week) was associated with a higher probability of perceiving oneself as unhealthy. Having a history of alcohol consumption was associated with a higher probability of perceiving oneself as unhealthy, and having a history of smoking was associated with a lower probability of perceiving oneself as unhealthy. Physical activity was associated with a lower probability of perceiving oneself as unhealthy, whereas an increase in sitting time was associated with a higher probability of perceiving oneself as

Table 7 Mental health status before and during COVID-19

Variables	Categories	2019 *n*(%)/M ± SE	2021 *n*(%)/M ± SE	*p*
Recovery from fatigue after sleep (past 7 days)	Very sufficient	3891(6.4)	3677(6.4)	< 0.001
	Sufficient	8760(14.9)	9162(16.5)	
	Somewhat sufficient	18,580(32.2)	17,910(32.4)	
	Insufficient	16,735(29.7)	16,401(30.2)	
	Very Insufficient	9336(16.8)	7696(14.5)	
Experience of sadness and despair (past 12 months)	No	41,274(71.8)	40,154(73.2)	< 0.001
	Yes	16,028(28.2)	14,692(26.8)	
Experience of suicidal ideation (past 12 months)	No	49,804(86.9)	47,890(87.3)	0.162
	Yes	7498(13.1)	6956(12.7)	
Experience of suicidal plan (past 12 months)	No	54,996(96.0)	52,640(96.0)	0.790
	Yes	2306(4.0)	2206(4.0)	
Experience of suicide attempt (past 12 months)	No	55,571(97.0)	53,601(97.8)	< 0.001
	Yes	1731(3.0)	1245(2.2)	
Average sleep time/day during weekdays		8.45 ± 0.02	8.37 ± 0.02	0.003
Average sleep time/day during weekends		6.30 ± 0.02	6.17 ± 0.01	< 0.001

Table 8 The mental health status of participants in 2021 (*N* = 54,846)

Variables	Categories	*n* (%)
Frequency of feeling loneliness in past 12 months	Never	11,920 (21.4)
	Almost never	12,201 (26.3)
	Sometimes	19,772 (36.3)
	Often	6946 (12.7)
	Always	1809 (3.3)
GAD	Minimal	35,664 (64.7)
	Mild	13,665 (25.2)
	Moderate	3285 (6.1)
	Severe	2234 (4.1)

unhealthy. Adequate sleep recovery was associated with a lower OR than inadequate recovery, and higher BMI was associated with a higher probability of perceiving oneself as unhealthy.

Discussion

This study investigated six behaviors of chronically allergic adolescents before and during COVID-19 pandemic. As mentioned earlier, these behaviors were alcohol consumption, smoking, insufficient sleep, inadequate physical activity, inappropriate dietary habits, and excessive weight. The findings of this study revealed six generally better behaviors in adolescents with chronic allergic diseases in South Korea than before the outbreak of the pandemic. COVID-19 had a significant impact on adolescent health habits, revealing notable changes across various domains. Firstly, significant changes were observed in factors affecting lifestyle such as age, education level, parental education, subjective economic status, and academic performance.

The impact of COVID-19 on adolescent health habits revealed significant changes across various domains. Dietary habits, including consumption of fast food, carbonated beverages, sweetened beverages, and water, exhibited significant alterations during the pandemic period. Smoking-related behaviors, such as lifetime smoking experience and e-cigarette use, showed considerable differences before and during COVID-19. Similarly, alcohol-related factors, including lifetime alcohol consumption and binge drinking, displayed significant changes. Physical activity patterns, sedentary behavior, and body image perceptions also underwent noticeable shifts. Furthermore, mental health indicators, including experiences of fatigue, sadness, suicidal ideation, and loneliness, showed substantial variations during the COVID-19 period. Overall, the pandemic has had a profound on various aspects of adolescent health habits. The improvement underscores the importance of targeted interventions not only to sustain these beneficial behaviors but also to further enhance them.

A decrease was observed in alcohol consumption in frequency and amount in the past 30 days and in alcohol-related behavior such as binge drinking. This result is supported by a study indicating that adolescents' alcohol consumption decreased during the pandemic [53]. Due to the lack of studies on adolescents with chronic illness, the most common comparison is with healthy adolescents. Similar to healthy adolescents, alcohol consumption during the pandemic may be related to stress and anxiety, routine lifestyle disruptions, and social isolation [54]. In the United States, alcohol screening and counselling for adolescents with chronic illness are not part of routine subspecialty care visits, and behavioral health issues are only briefly addressed [55]. The number of smoking adolescents decreased; however, those who did smoked more cigarettes compared to before the pandemic. The data show the number of cigarettes smoked (6–29 cigarettes) in the last 30 days, demonstrating a significant increase compared to before the pandemic. This trend is different from that identified previous studies [53, 56], in which healthy adolescents in Korea also showed a reduction in smoking activity during the pandemic. Another finding is an increase in experience with e-cigarettes during the pandemic. As society continues to adapt and recover from the COVID-19 pandemic, greater opportunities

Table 9 Factors on subjective health perception of adolescents before and during COVID-19

Variables	Categories	Total	2019	2021
		OR 95% CI	OR 95% CI	OR 95% CI
Consumption of fast food (past 7 days)	No			
	Once or twice a week	0.984 (0.944, 1.026)	0.971 (0.916, 1.028)	0.987 (0.928, 1.049)
	Three to four times a week	**1.106 (1.052, 1.162)**	1.066 (0.992, 1.147)	**1.129 (1.054, 1.210)**
	Five to six times a week	**1.334 (1.227, 1.450)**	**1.347 (1.201, 1.510)**	**1.309 (1.160, 1.478)**
	Seven or more times a week	**1.208 (1.081, 1.349)**	1.067 (0.905, 1.257)	**1.366 (1.172, 1.593)**
Lifetime smoking experience	No			
	Yes	**0.918 (0.873, 0.966)**	0.948 (0.887, 1.014)	**0.903 (0.837, 0.974)**
Lifetime alcohol consumption experience	No			
	Yes	**1.038 (1.003, 1.076)**	**1.090 (1.037, 1.146)**	1.028 (0.979, 1.080)
60 min or more of physical activity (past 7 days)	No			
	1 day	**0.923 (0.886, 0.962)**	**0.899 (0.846, 0.955)**	**0.939 (0.886, 0.994)**
	2 days	**0.731 (0.700, 0.764)**	**0.727 (0.682, 0.775)**	**0.726 (0.684, 0.772)**
	3 days	**0.610 (0.582, 0.640)**	**0.588 (0.549, 0.630)**	**0.625 (0.584, 0.668)**
	4 days	**0.456 (0.427, 0.488)**	**0.421 (0.382, 0.465)**	**0.482 (0.440, 0.528)**
	5 or more days	**0.354 (0.334, 0.374)**	**0.339 (0.312, 0.368)**	**0.362 (0.335, 0.390)**
Sedentary time spent doing something other than studying during weekdays		**1.009 (1.002, 1.016)**	1.006 (0.995, 1.017)	0.998 (0.989, 1.007)
Sedentary time spent doing something other than studying during weekends		**1.032 (1.027, 1.038)**	**1.035 (1.028, 1.043)**	**1.030 (1.191, 1.488)**
Recovery from fatigue after sleep (past 7 days)	Very sufficient			
	Sufficient	**0.622 (0.596, 0.650)**	**0.619 (0.583, 0.657)**	**0.614 (0.577, 0.654)**
	Somewhat sufficient	**0.432 (0.413, 0.452)**	**0.414 (0.388, 0.441)**	**0.442 (0.415, 0.471)**
	Insufficient	**0.279 (0.264, 0.294)**	**0.276 (0.254, 0.299)**	**0.274 (0.255, 0.295)**
	Very Insufficient	**0.233 (0.216, 0.252)**	**0.229 (0.204, 0.257)**	**0.233 (0.209, 0.259)**
BMI		**1.035 (1.031, 1.039)**	**1.034 (1.028, 1.040)**	**1.033 (1.028, 1.039)**

*Subjective health perception can be judged by analyzing the logistic model for unhealthy by setting "excellent" and "good" to 0 and "less than average" to 1

*Significant factors are bolded, indicating areas where factor likely to increase unhealthy behaviors or to decrease unhealthy behaviors

for social contact among adolescents can be anticipated, along with an increased likelihood of obtaining e-cigarettes from social contacts and observing e-cigarette use behaviors among peers [57]. The decline in alcohol and cigarette consumption during the pandemic may be attributed to reduced social interactions with peers, limited access to substances, and more time spent at home with parents [58]. Limited mobility appears to protect against unhealthy behavior.

Adolescents in this study slept 8 min less during weekdays and 13 min (6.17 ± 0.01) less on weekdays compared to their sleep hours before the pandemic. This finding is inconsistent with that of healthy adolescents, whose sleep duration increased during the pandemic, which may have resulted from less time spent commuting from home to school [9]. Helito's study [59] demonstrated that children with chronic illness have less sleep time compared to their healthy counterpart. Increased screen time, poor sleep quality, and that the lack of school activities may have contributed to the prevalence of insomnia and sleep problems. Despite the observed reductions in sleep duration, precisely 8 min on weekdays and 13 min on weekends, the comparative sleep times before and during the pandemic remain unchanged, with adolescents averaging 8 h per night on weekdays and only 6 h on weekends. The reduction does not significantly alter the pre-existing sleep patterns among adolescents. Notably, the weekend sleep duration continues to fall below the recommended 8 to 10 h per day for this age group [60] underscoring a persistent area of concern. Lack of sleep among adolescents with chronic allergic disease puts them at risk of disease because of their weakened immune system. Walking, moderate-intensity activities, and vigorous-intensity activities improved both subjective and objective sleep quality [61], indicating the need to enhance sleep quality among adolescents during the COVID-19 pandemic.

We observed an increase of 18 min of sedentary activity during weekdays and 27.6 min during weekends, as well as an increase of 3 days of physical activity. A study showed no difference in sedentary and screen time (such as the duration for which something is visible in smartphone applications or the Internet) between chronically ill and healthy adolescents before the pandemic, with an average sedentary time of 10.2 h per day [62]. Lower physical activity was recorded among healthy adolescents after the pandemic, ranging from 10.8 to 91 min/day [63]. Before the pandemic, chronically ill adolescents were disadvantaged by physical movement limitation and pain caused by their illness. In this study, only 34% did not exercise, and the frequency of physical activity for 1–3 days increased after the pandemic. They may have been able to adapt to the pandemic by maintaining their

physical activity levels through at-home exercises and outdoor activities that allow physical distancing. A study of children in the United States during the pandemic showed an increase in children's use of local streets and sidewalks, and parents reported that their children had gone for a walk the day before [64]. Additionally, nearly one-third of children participated in online streaming physical activities [65]. Lower socioeconomic status predicted lower physical activity during the pandemic [63], whereas in this study, families had better income after the pandemic, which provides another explanation for the higher level of physical activity among adolescents with chronic allergic diseases. General nurses need to maintain good behavior and improve it for this population to stay physically active.

In terms of dietary habits, more adolescents consumed fast food at least three times a week, and their consumption of carbonated and sweetened beverages decreased. Despite a decline in the frequency of sweetened beverage consumption, slightly more than half of the adolescents with chronic allergic disease consumed at least four cups per day. This decrease in sweetened beverages is similar to those reported in a study among healthy adolescents in Australia [9]. It could be due to mobility restrictions during the pandemic which resulted in limited peer influence and access to obtain sugary drinks. Additionally, it led to increased consumption of home-cooked meals, eating with other family members, more mindful eating, and participation in cooking [66].

The BMI of the subjects before the pandemic was 21.5; during the pandemic, it had slightly increased to 21.7. Both BMIs are considered normal weight [67]. This change can be interpreted as a shift in dietary habits due to the suspension of school meals and the decrease in physical activity and offline classes during the lockdown period caused by the COVID-19 situation [68]. However, this finding is in contrast to a study in the United States, which observed an increase in obesity prevalence and BMI-z after the pandemic, particularly among school-aged Black or Hispanic children and those who were prescribed antihypertensive medications [69]. The BMI z-score indicated the relative weight based on the child's age and gender [70]. In light of these disparate outcomes, differences in BMI between adolescents with chronic allergic disease in the United States and South Korea should be investigated.

Aside from the six behaviors previously mentioned, mental health among adolescents with chronic illness was better than before the pandemic, as shown by a decrease in sadness and despair and suicide attempts. It is believed that the mental well-being of children has improved as a result of a decrease in negative emotions they encounter, as many parents now work from home and spend more time with their children [71].

In a systematic study of Korean school-age children with chronic diseases, it was found that children diagnosed with conditions such as diabetes, asthma, atopic dermatitis, and childhood cancer were concerned about their classmates' curiosity regarding their chronic diseases during school. They also reported difficulties in communicating with their peers. Administering medication for disease management at school was inconvenient, and they experienced negative emotions due to their illness, which made school life challenging. Additionally, they struggled with self-care, and their overall life satisfaction was negatively impacted by the lack of support or discrimination from teachers or peers tempted to eat inappropriate foods at school [72]. This study suggested that children with chronic allergic illnesses tend to have better mental health status due to less stressful situations related to school activities and interactions. This reduced school interaction leads to less stress because it minimizes exposure to social pressures, and academic challenges, thereby creating a more relaxed environment. A positive correlation was found between academic stress and difficulties due to COVID-19, which means that the greater the difficulties due to COVID-19, the more stress related to academics [73]. There was a positive correlation between difficulties due to COVID-19 and family relationships, and a negative correlation between academic stress and family relationships. In other words, it can be interpreted that even in a pandemic situation, if adolescents receive appropriate support from their families, it has a positive effect on academic stress [73] The impact of social support is not included in the data analysis, future research is necessary.

Although the number of smoking adolescents and alcohol consumption decreased during the pandemic, alcohol consumption was three times higher than smoking; nevertheless, alcohol-related behaviors decreased following the pandemic. The lack of health education on alcohol consumption can contribute to the high prevalence of alcohol use among adolescents. During the COVID-19 pandemic, a substantial debate addressed the impact of nicotine use, and smoking was regarded as a major risk factor for the poor progression of the disease [74]. One study suggested that enhancing smoking cessation trials amid the pandemic is a clinical priority that needs strong support, and public health initiatives should include smoking cessation with top-notch advice and unconventional methods during COVID-19 [75]. This may have resulted in a lack of alcohol education during the pandemic. Therefore, a self-administered, condition-specific psychoeducational intervention could be used to increase alcohol-related knowledge and perceived risk among adolescents with chronic illnesses [55].

Adolescents with chronic illnesses are portrayed as being less healthy despite an increasing trend in the

big six health behaviors since the pandemic began; this may be because they are more susceptible to infection and spend less time outdoors. Both before and during COVID-19 pandemic, these adolescents have shown the same pattern of habits perceived as unhealthy.

This is similar to the finding that the proportion of adolescents perceiving themselves as healthy decreased in 2021 compared to 2019, based on the same raw data [76]. In particular, those who consume fast food two to three times per week are more likely to perceive themselves as unhealthy, whereas those who smoke, have a higher BMI, have consumed alcohol, and engage in more physical activity are less likely to perceive themselves as unhealthy. Compared to healthy children, children with asthma are more inclined to view themselves as unhealthy because they perceive health as the absence of health problems and symptoms [77]. In conjunction with the pandemic, their limited view of health may be the source of their subjective view of illness in this study as individuals with a high level of subjective health perception are more likely to engage in healthy behaviors and seek professional medical care when necessary [46, 47]. The perception of being unhealthy in adolescents with these characteristics allows health professionals to encourage healthier behaviors. According to the results of this study, students who have unhealthy behaviors such as eating fast food, smoking cigarettes, or drinking alcohol are aware of unhealthy behaviors by themselves. Therefore, it is essential to continue providing health education for students with healthy or chronic illnesses and guidance on health behaviors by examining individual health beliefs and perceptions even amid such a disease. Generally, patients with well-controlled asthma and other allergic diseases do not have an increased risk of SARS-CoV-2 infection or severe COVID-19 outcomes [5]. Parents of chronically ill children in Australia feel more fearful about the risk of developing severe COVID-19 disease [78]. They are more protective by taking more precautions and using problem-focused coping in dealing with the COVID-19 pandemic [78]. A study among caregivers of chronically ill children in Germany showed lower appointment cancellations and group training, amidst higher cancellations due to fear of infection and physical distancing [79]. Adherence was also higher among Israeli patients with asthma, and when compared to their pre-pandemic symptom trajectory, 20% of patients demonstrated better-than-expected control [80]. This reflects how parents took precautions to protect their children during the pandemic. Parents have a protective and directing parenting style characterized by a high level of warmth and a high level of control through explicit management to direct children through demanding treatment [81] or situations such as a pandemic. This may explain why the children's big six behaviors were better than before the pandemic.

Implications for nursing practice and research

The findings of this study have four implications for nursing practice and research related to the six behaviors of children with chronic diseases and allergies. First, health education should be provided to maintain and increase the level of healthy behavior. Because these behaviors are interconnected, it is necessary to provide health education regarding all six. Comprehensive health education can assist children in understanding the interrelationships between various behaviors and their effects on their overall health. By delivering extensive education, nurses can empower children to make informed decisions and maintain healthy behaviors. Second, it is necessary to provide parents with informational support to encourage their children to adopt healthy behaviors. For instance, according to one study, more than one-third of parents of children with chronic disease were uncertain about their child's physical activity out of concern for the medical condition [82]. Children's healthy behaviors may be improved by addressing parents' doubts with appropriate information. Physical activity during a pandemic can be sustained with careful consideration of safety. Children with asthma can engage in indoor activities that are less asthma-inducing (such as swimming) as opposed to outdoor activities (such as walking) and lower-intensity exercises that allow ventilation to recover [83]. Moreover, as children with chronic illness view being healthy as the absence of health problems and symptoms, pediatric nurses need to assess their views of health [77]. The likelihood of having multiple illnesses later in life is clearly correlated with how healthy a person rates themselves as an adolescent [84]. Because each adolescent may view health differently, it is possible to provide them with counseling that is tailored specifically to their health needs in relation to the big six behaviors—for instance, regarding balanced nutrition, physical activity, and alcohol consumption. This will assist nurses in encouraging families and children to manage their health during the pandemic. Finally, the long-term sustainability of the big six behaviors and the factors that influence their adoption and maintenance over time need to be investigated. Understanding the mechanisms underlying sustained behavioral changes can inform the development of interventions to promote healthy behaviors after the pandemic.

Limitations

This study has limitations. Primarily, the measurements were based on self-reported data, which may introduce bias. More objective methods, such as observations or behavioral diaries, could provide a more accurate

assessment. Additionally, the cross-sectional nature of the study limits the ability to capture detailed information about behaviors over time. Furthermore, reliance on secondary data constrains the opportunity to gather more comprehensive data.

Conclusion

This study investigated the changes in the health behaviors and subjective health perception of adolescents with chronic allergic disease during the COVID-19 pandemic in South Korea using raw data from the KYRBWS. This study found that the six health behavior factors and subjective health perception substantially changed during the pandemic. These findings suggest that it is necessary to follow up and monitor the health behaviors and subjective health perception of adolescents with chronic allergic disease during the COVID-19 pandemic.

Abbreviations

OR	Odds ratio
CI	Confidence interval
BMI	Body mass index
COVID-19	Coronavirus disease 2019
WHO	World Health Organization
GAD	Generalized Anxiety Disorder
KYRBWS	Korea Youth Risk Behavior Web-based Survey

Acknowledgements

We acknowledged the support from Dr. Sang Jin Lee, who helped with the statistical analyses in this paper.

Author contributions

Study design: Choi, Susmarini, Shin. Data collection and analysis: Choi, Susmarini, Shin. Data interpretation: Choi, Susmarini, Shin. Manuscript writing and revision: Choi, Susmarini, Shin.

Funding

This work was supported by a National Research Foundation of Korea (NRF) grant funded by the Korean government (MSIT)(No.NRF2022R1G1A1010942). This work was supported by the Dongguk University Research Fund of 2024.

Data availability

The datasets generated during and/or analyzed during the current study are available in the Korea Youth Risk Behavior Web-based Survey (KYRBWS) repository, [https://www.kdca.go.kr/yhs/home.jsp]. The Korea Youth Risk Behavior Web-based Survey (KYRBWS) is a research conducted with government approval (Approval No. 11758) to assess the health behaviors of South Korean adolescents. This survey has been carried out annually since 2005, targeting students from the 1st grade of middle school to the 3rd grade of high school nationwide. The survey is conducted using an anonymous self-administered online questionnaire, with consent obtained online, and participation takes place in computer rooms within schools. The secondary data utilized in this study were derived from the government survey that obtained informed consent from all participants, including minors, at the time of the data collection. Ethical approval for this study was being exempted. However, the original data were collected under ethical guidelines. Anyone can download the raw data from the depository address in formats such as SAS or SPSS. The contact email address is [hyeshin@ewha.ac.kr], the corresponding author of this article.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Received: 16 August 2023 / Accepted: 6 September 2024
Published online: 10 October 2024

References

1. Park SE. Epidemiology, virology, and clinical features of severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2; coronavirus Disease-19). Clin Exp Pediatr. 2020;63(4):119.
2. World Health Organization. WHO chief declares end to COVID-19 as a global health emergency. https://news.un.org/en/story/2023/05/113636730. Published 2023. Accessed May 9, 2023.
3. Park J, Min J, Song JH, et al. The COVID-19 pandemic response and its impact on Post-corona Health Emergency and Disaster Risk Management in Republic of Korea. Sustainability. 2023;15(4):3175.
4. John Hopkins University. COVID-19 Dashboard. https://coronavirus.jhu.edu/map.html. Published 2003. Accessed May 9, 2023.
5. Lee J. Factors related to allergic rhinitis in Korean adults. J Korea Acad-Ind Coop Soc. 2018;19(12):749–57.
6. Kong Y, Kim M, Jin HS, Park S. Association with genetic polymorphism of rs117033348 and allergic Disease in Korean Population. Biomed Sci. 2021;27(3):177–81.
7. Simon D. Recent advances in clinical allergy and immunology 2019. Int Arch Allergy Immunol. 2019;180(4):291–305.
8. Ding D, Rogers K, van der Ploeg H, Stamatakis E, Bauman AE. Traditional and emerging lifestyle risk behaviors and all-cause mortality in middle-aged and older adults: evidence from a large population-based Australian cohort. PLoS Med. 2015;12(12):e1001917.
9. Gardner LA, Debenham J, Newton NC, Chapman C, Wylie FE, Osman B, Champion KE. I BMJ Open. 2022;12(6):e060309.
10. Meader N, King K, Moe-Byrne T, Wright K, et al. A systematic review on the clustering and co-occurrence of multiple risk behaviours. BMC Public Health. 2016;16:1–9.
11. Park MR, Yang HJ. Influence factors on subjective health status of youth - utilized the National Health and Nutrition Examination Survey (2013–2016). Asia Pac J Multimed Serv Converg Art Humanit Sociol. 2018;8(10):745–53.
12. Park SJ. The longitudinal effects of youth social capital on self-rated health. Stud Korean Youth. 2018;29(2):241–69.
13. Loo EXL, Chew LJX, Zulkifli A, Tang HHF, van Bever H, Shek LPC. The role of diet in the prevention of atopy and the development of asthma. Expert Rev Respir Med. 2020;14(12):1253–63.
14. Paparo L, Picariello G, Bruno C, Pisapia L, Cuomo M, Mamone G. Nutritional Keys for Intestinal Barrier Modulation in atopic dermatitis. Nutrients. 2021;13(2):611.
15. Eichenberger PA, Diener SN, Kofmehl R, Spengler CM. Effects of exercise training on airway hyperreactivity in asthma: a systematic review and meta-analysis. Sports Med. 2013;43(11):1157–70.
16. Sharma GD, Thomas A, Paul J. Reviving tourism industry post-COVID-19: A resilience-based framework. Tour Manag Perspect., Koinis-Mitchell D, Craig T, Esteban CA, Klein RB. Sleep and allergic disease: A summary of the literature and future directions for research. J Allergy Clin Immunol. 2012;130(6):1275–1281.
17. Koinis-Mitchell D, Craig T, Esteban CA, Klein RB. Sleep and allergic disease: A summary of the literature and future directions for research. J Allergy Clin Immunol 2012;130(6):1275–81. https://doi.org/10.1016/j.jaci.2012.06.026.
18. Meltzer LJ, Ullrich M, Szefler SJ. Sleep duration, sleep hygiene, and insomnia in adolescents with asthma. J Allergy Clin Immunol Pract. 2015;3(6):968–75.
19. Choi K, Bernat D. E-cigarette use among Florida youth with and without asthma. Am J Prev Med. 2016;51(4):446–53.
20. Ogeil RP, Lubman DI. Alcohol and substance use by young people with a chronic illness: a brief review. Paediatr Respir Rev. 2015;16(1):14–21.
21. Octavius GS, Silviani FR, Lesmandjaja A, Angelina, Juliansen A. Impact of COVID-19 on adolescents' mental health: a systematic review. Middle East Curr Psychiatry. 2020;27:1–8.

22. Gonçalves A, Bertrand J, Ke R, Comets E, De Lamballerie X, Malvy D, Guedj J. Timing of antiviral treatment initiation is critical to reduce SARS-CoV-2 viral load. CPT Pharmacometrics Syst Pharmacol. 2020;9(9):509–14.
23. Calina D, Hartung T, Mardare I, Mitroi M, Poulas K, Tsatsakis A, Rogoveanu I, Docea AO. COVID-19 pandemic and alcohol consumption: impacts and interconnections. Toxicol Rep. 2021;8:529–35. https://doi.org/10.1016/j.toxrep.2021.03.005.
24. Mukhtar S. COVID-19 pandemic and alcohol consumption: impacts and interactions. J Subst Use. 2021;26(1):6–12.
25. World Health Organization. Smoking and COVID-19. https://www.who.int/news-room/commentaries/detail/smoking-and-covid-19. Published 2020. Accessed [Insert Date Here].
26. Patel R, Norris G. Smoking and COVID-19: a review of the evidence. Front Public Health. 2021;9:650187.
27. Aristovnik A, Keržič D, Ravšelj D, Tomaževič N, Umek L. Impacts of the Covid-19 pandemic on life of higher education students: global survey dataset from the First Wave. Data Brief. 2021;39:107659.
28. Kim BJ. The analysis of the Effect on Achievement of the COVID-19 Situation: focusing on Middle Schools in the Metropolitan Area. Korean Educational Adm Soc. 2021;39(4):107–29.
29. Kim MH, Yeon JY. Change of dietary habits and the use of home meal replacement and delivered foods due to COVID-19 among college students in Chungcheong province. Korea JHN. 2021;54(4):383–97.
30. Bartel K, Scheeren R, Pietrowsky R, Schwarte R. Sleep during COVID-19 lockdowns in adolescents: a systematic review. Sleep Med. 2021;77:177–84.
31. Santos JS, Louzada FM. Changes in adolescents' sleep during COVID-19 outbreak reveal the inadequacy of early morning school schedules. Sleep Sci. 2022;15(Spec 1):74–9. https://doi.org/10.5935/1984-0063.20200127.
32. Zhou SJ, Wang LL, Yang R, Yang XJ, Zhang LG, Guo ZC. Sleep problems among Chinese adolescents and young adults during the coronavirus-2019 pandemic. Sleep Med. 2020;74:39–47.
33. Zhang J, Shang X, Zhang L, et al. Physical activity and mental health in adolescents during the COVID-19 pandemic lockdown. Int J Environ Res Public Health. 2021;18(3):1003.
34. Pietrobelli A, Pecoraro L, Ferruzzi A, et al. Effects of COVID-19 lockdown on lifestyle behaviors in children with obesity living in Verona, Italy: a longitudinal study. Obesity. 2020;28(8):1382–5.
35. Ruiz-Roso MB, de Carvalho Padilha P, Mantilla-Escalante DC, et al. Covid-19 confinement and changes of adolescent's dietary trends in Italy, Spain, Chile, Colombia and Brazil. Nutrients. 2020;12(6):1807.
36. Rodríguez-Pérez C, Molina-Montes E, Verardo V, Artacho R, García-Villanova B, Guerra-Hernández EJ. Ruíz-López MD. Changes in dietary behaviours during the COVID-19 outbreak confinement in the Spanish COVIDiet study. Nutrients. 2020;12(6):1730.
37. Rundle AG, Park Y, Herbstman JB, Kinsey EW, Wang YC. COVID-19-related school closings and risk of weight gain among children. Obesity. 2020;28(6):1008–9.
38. Hossain MA, Hasan MT, Chowdhury S, Sultana S, Sheikh NA. Impact of COVID-19 lockdown on dietary habits among university students in Bangladesh: a cross-sectional study. Heliyon. 2021;7(3):e06716.
39. Wang H, Liu S, Shen J, Mok BW, Gao P, Li M, He J. Obesity and COVID-19 among adolescent and young adult patients in Hubei Province: A cross-sectional study. PLoS One. 2021;16(3):e0246827.
40. Vogel M, Geserick M, Gausche R, Beger C, Poulain T, Meigen C, … Pfäffle R. Age-and weight group-specific weight gain patterns in children and adolescents during the 15 years before and during the COVID-19 pandemic. Int J Obes. 2022;46(1):144–152.
41. Choi J, Park Y, Kim HE et al. (2021). Daily life changes and life satisfaction among Korean school-aged children in the COVID-19 pandemic. IJERPH. 2021;18(6):3324.
42. Richter L. The effects of the COVID-19 pandemic on the risk of youth substance use. J Adolesc Health. 2020;67(4):467–8.
43. OECD. Health at a glance 2015: OECD indicators. OECD Publishing.
44. Segovia J, Bartlett RF, Edwards AC. An empirical analysis of the dimensions of health status measures. Soc Sci Med. 1989;29(6):761–8.
45. Idler EL, Benyamini Y. Self-rated health and mortality: a review of twenty-seven community studies. J Health Soc Behav. 1997;38(1):21–37.
46. Jylhä M. What is self-rated health and why does it predict mortality? Towards a unified conceptual model. Soc Sci Med. 2009;69(3):307–16.
47. Garbarski D. Research in and prospects for the measurement of health using self-rated health. Public Opin Q. 2016;80(4):977–97.
48. Kim EH. Knowledge, attitude, and practice of hand hygiene in high school students. Crisisonomy. 2018;14:73–86.
49. Lee S, Jung GH, Song HY. Factors related to the COVID-19 Prevention behaviors of adolescents: focusing on six Middle and High Schools in Korea. Healthc (Basel Switzerland). 2023;11(20):2779.
50. Korea Disease Control and Prevention Agency. Youth health behavior online survey. https://www.kdca.go.kr/yhs/. Published [Insert Date Here]. Accessed March 11, 2023.
51. Choi KW. Factors related to self-rated health in adolescents: findings from the Korea Youth Panel Survey. Korea J Health Edu Promot. 2014;31(3):39–50.
52. Choi SY. Factors influencing positive subjective health awareness in multicultural adolescents in South Korea: data from the multicultural adolescents panel study. CHNR. 2021;27(4):328.
53. Jeong W. Comparison of alcohol consumption and tobacco use among Korean adolescents before and during the COVID-19 pandemic. PLoS ONE. 2023;18(3):e0283462.
54. Ashwin A, Cherukuri SD, Rammohan A. Negative effects of COVID-19 pandemic on adolescent health: insights, perspectives, and recommendations. J Global Health. 2022;12.
55. Weitzman ER, Wisk LE, Minegishi M, Cox R, Lunstead J, Brogna M, Levy S. Effects of a patient-centered intervention to reduce Alcohol Use among Youth with Chronic Medical conditions. J Adolesc Health. 2021;71(4):S24–33.
56. Lee SL. The convergence factors of Mental health in Korean adolescents on oral symptom experience: the 17th(2021) Korea Youth Risk Behavior Survey. J Korea Acad-Ind Cooper Soc. 2022;23(11):93–9.
57. Kreslake JM, O'Connor KM, Liu M, Vallone DM, Hair E. A resurgence of e-cigarette use among adolescents and young adults late in the COVID-19 pandemic. PLoS ONE. 2023;18(3):e0282894.
58. Helito AC, Lindoso L, Sieczkowska SM, Astley C, Queiroz LB, Rose N, … Silva CA. Poor Sleep quality and health-related quality of life impact in adolescents with and without chronic immunosuppressive conditions during COVID-19 quarantine. Clinics. 2021;76:e3501.
59. Helito CP, Helito PVP, Leão RV, Louza ICF, Bordalo-Rodrigues M, Cerri GG. Magnetic resonance imaging assessment of the normal knee anterolateral ligament in children and adolescents. Skeletal Radiol. 2018;47:1263–8.
60. Paruthi S, Brooks LJ, D'Ambrosio C, et al. Consensus Statement of the American Academy of Sleep Medicine on the recommended amount of sleep for healthy children: methodology and discussion. JCSM. 2016;12(11):1549–61.
61. Mahfouz MS, Ali SA, Bahari AY, Ajeebi RE, Sabei HJ, Somaily SY, Madkhali YA, Hrooby RH, Shook RN. Association between Sleep Quality and Physical Activity in Saudi Arabian University students. Nat Sci Sleep. 2020;12:775–82.
62. Walker RG, Obeid J, Nguyen T, Ploeger H, Proudfoot NA, Bos C, Timmons BW. Sedentary time and screen-based sedentary behaviors of children with a chronic disease. Pediatr Exerc Sci. 2015;27(2):219–225.
63. Rossi L, Behme N, Breuer C. Physical activity of children and adolescents during the COVID-19 pandemic—A scoping review. Int J Environ Res Public Health. 2021;18:21.
64. Dunton GF, Leventhal AM, Rebar AL, Gardner B, Intille SS, Rothman AJ. Towards consensus in conceptualizing and operationalizing physical activity maintenance. Psychol Sport Exerc. 2022;61:102214.
65. Dunton GF, Do B, Wang SD. Early effects of the COVID-19 pandemic on physical activity and sedentary behavior in children living in the US. BMC Public Health. 2020;20(1):1–13.
66. Mazzolani BC, Smaira FI, Astley C, Iraha AY, Pinto AJ, Marques IG, Gualano B. Changes in eating habits and sedentary behavior during the COVID-19 pandemic in adolescents with chronic conditions. Front Pediatr. 2021;9:714120.
67. World Health Organization. Computation of centiles and z-scores for height-for-age, weight-for-age and BMI-for-age. Geneva: WHO; 2007.
68. Jha S, Mehendale AM. Increased incidence of obesity in children and adolescents Post-COVID-19 pandemic: a review article. Cureus. 2022;14(9):e29348.
69. Rifas-Shiman SL, Aris IM, Bailey C, Daley MF, Heerman WJ, Janicke DM, Lin PID, Petimar J, Block JP. Changes in obesity and BMI among children and adolescents with selected chronic conditions during the COVID-19 pandemic. Obesity. 2022;30(10):1932–7.
70. Vanderwall C, Eickhoff J, Randall Clark R, Carrel AL. BMI z-score in obese children is a poor predictor of adiposity changes over time. BMC Pediatr. 2018;18(1):1–6.
71. De Figueiredo CS, Sandre PC, Portugal LCL, Mázala-de-Oliveira T, da Silva Chagas L, Raony Í, Bomfim POS. COVID-19 pandemic impact on children and adolescents' mental health: Biological, environmental, and social factors. Prog Neuropsychopharmacol Biol Psychiatry. 2021;106:110171.

72. Uhm JY, Choi MY, Uhm JY, Choi MY. Perceptions of School Health Care among School-aged children and adolescents with chronic disease: an integrative review. Child Health Nurs Res. 2020;26(2):309–22.
73. Son JH, Lee YK. COVID-19 and Human rights of youths- focusing on COVID-19 difficulties, Family relationships, and academic stress. J Hum Rights Law-related Educ. 2022;15(2):159–77.
74. Finck JM, Bohnet S, Auth K, Tangemann-Münstedt I, Drömann D, Franzen KF. Smoking Behavior and Smoking Cessation because of and during the COVID-19 pandemic: a brief online survey 12 months into the pandemic and during the Second Wave in Europe. Int J Environ Res Public Health. 2022;19(24):16540.
75. Alqahtani JS, Aldhahir AM, Oyelade T, Alghamdi SM, Almamary AS. Smoking cessation during COVID-19: the top to-do list. npj Prim Care Respir Med. 2021;31(1):1–2.
76. Korea Disease Control and Prevention Agency. Trends in perceived health status among adolescents, 2011∼2021. Published 2022. Accessed April, 2024.
77. Lima L, Silva V, Lemos MS. How chronic disease affects children's views on being ill and healthy: a comparative study. Scand J Caring Sci. 2017;31(4):922–9.
78. Ademhan Tural D, Emiralioglu N, Tural Hesapcioglu S, Karahan S, Ozsezen B, Sunman B, … Kiper N. Psychiatric and general health effects of COVID-19 pandemic on children with chronic lung disease and parents' coping styles. Pediatr Pulmonol. 2020;55(12):3579–3586.
79. Göldel JM, Kamrath C, Minden K, Wiegand S, Lanzinger S, Sengler C, Weihrauch-Blüher S, Holl RW, Tittel SR, Warschburger P. Access to Healthcare for Children and Adolescents with a Chronic Health Condition during the COVID-19 pandemic: first results from the KICK-COVID study in Germany. Children. 2023;10(1).
80. Papadopoulos NG, Custovic A, Deschildre A, et al. Impact of COVID-19 on pediatric asthma: practice adjustments and disease burden. J Allergy Clin Immunol Pract. 2020;8:2592–9.
81. Guite JW, Russell BS, Homan KJ, Tepe RM, Williams SE. Parenting in the context of children's chronic pain: balancing care and burden. Children. 2018;5(12).
82. McMullen JA, McCrindle BW, Dell SD, Feldman BM, Longmuir PE. Understanding parent perceptions of healthy physical activity for their child with a chronic medical condition: a cross-sectional study. Paediatr Child Health. 2019;24(3):e135–41.
83. West SL, Banks L, Schneiderman JE, Caterini JE, Stephens S, White G, Dogra S, Wells GD. Physical activity for children with chronic disease; a narrative review and practical applications. BMC Pediatr. 2019;19:1–18.
84. Hetlevik Ø, Meland E, Hufthammer KO, Breidablik HJ, Jahanlu D, Vie TL. Self-rated health in adolescence as a predictor of 'multi-illness' in early adulthood: a prospective registry-based Norwegian HUNT study. SSM Popul Health. 2020;11:100604.

Publisher's note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.