

ORIGINAL RESEARCH

Perceptions of health status, physical fitness, and participation in physical activity among adolescents before and after COVID-19: analysis of 2019-2021 data from the Republic of Korea national sports survey

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Abstract

Research has examined the detrimental effects of the coronavirus disease (COVID-19) pandemic on health and physical fitness in adolescents; however, studies comparing these parameters before and after the COVID-19 outbreak have been scarce. Therefore, this study investigated differences in perceived health status, perceived physical fitness, and participation in physical activity among adolescents in the Republic of Korea before and after the COVID-19 outbreak. We chose a sample of data from 2102 adolescents aged 14–19, collected as part of a national survey by the Republic of Korea Ministry of Culture, Sports, and Tourism from 2019 to 2021. We focused on five items from the survey related to health awareness and physical activity. Although perceived health status was lower in 2021 than in 2019 or 2020, there were no differences in perceived physical fitness during the three years of the study. Regular participation in physical activity was less common in 2020 than in 2019 or 2021. The proportion of adolescents reporting sufficient rest and sleep was lower in 2021 than in 2020. In addition, fewer adolescents reported eating regular meals and engaging in nutritional supplementation in 2021 than in 2019 and 2020. Rates of abstinence from alcohol and smoking cessation were higher in 2021 than in 2019 or 2020. For all three years, adolescents reported the following as the primary reasons for engaging in regular physical activity (in order): “maintenance of mental health”, “maintenance of physical health”, “help in daily life”, and “reduction of medical expenses”. In preparation for the post-COVID-19 era, these results highlight the need to prepare measures and countermeasures to promote health and physical activity among adolescents in the Republic of Korea.

Keywords

Adolescents; COVID-19; Perceived health status; Physical activity; Physical fitness

1. Introduction

Owing to the rapid, worldwide spread of the novel coronavirus disease (COVID-19), the World Health Organization (WHO) declared it a “public health emergency of international concern” on 30 January 2020, following which it reached pandemic status—the highest level of risk for infectious diseases—on 11 March 2020 [1]. COVID-19, which is the first pandemic in modern times, has resulted in unexpected global changes that necessitate the implementation of various policies and lifestyle-related modifications to mitigate widespread devastation in the future. The COVID-19 pandemic substantially impacted daily life, with preventive measures ranging from mask mandates in all public areas, minimization of social contact, and the implementation of work-from-home policies on a global scale. In addition, educational institutions were required to shift their curricula

to include both online and in-person classes. These pandemic-related phenomena have prompted an increased interest in health and hygiene [1].

As the middle- and high-school years represent a critical period for learning and development, providing suitable health education is arguably more effective during adolescence than in other periods [2]. Lee *et al.* [3] emphasized the importance of health education during adolescence, and noting that healthy lifestyle habits are formed between the ages of 14 and 19. Given that securing healthy habits during adolescence is the foundation of lifelong health, this study focused on perceived health status and physical activity (PA) levels among adolescents in the context of the COVID-19 pandemic.

Perceived health status represents a component of health awareness, which is highly relevant when considering the likelihood of engaging in healthy behaviors. Perceptions of one's health status are subjective assessments based on the

processing of external health-related stimuli [3], meaning that they may differ depending on how the individual views and interprets facts [4]. In previous studies [2, 5–7], health awareness was compared based on subcategories such as mental health management, disease management, PA management, sleep management, dietary management, hygiene, and general health management. Many of them emphasized the importance of PA in maintaining and improving various aspects of health. PA refers to “all movements of the body that occur due to the contraction of skeletal muscles”, encompassing all activities such as basic movements, exercises, and sports-related endeavors [8, 9]. Although the term PA is usually used interchangeably with exercise, it is more comprehensive in that it incorporates both exercise and sports activities [10]. Bull *et al.* [11] reported that adolescents can benefit from moderate-to-vigorous intensity aerobic PA for an average of 60 minutes a week. The WHO also recommended that adolescents should exercise an average of 60 minutes or more a day to gain more health benefits and incorporate moderate or intense muscle exercises that train all major muscles at least twice a week. PA reduces depression and anxiety, curbs heart disease, diabetes, and cancer, and improves memory and brain health [12].

Studies have reported a decrease in general PA due to the COVID-19 pandemic [13–16]. Woods *et al.* [16] appropriately emphasized that such decreases in PA due to social distancing can lower resistance to viral infection and increase the risk of damage to the immune, respiratory, cardiovascular, musculoskeletal, and nervous systems. The literature has also examined the effects of COVID-19 on health and health-related behaviors among adolescents. Shepherd *et al.* [15] reported that COVID-19 restrictions led to decreased levels of PA, increased smartphone use, and poor mental health among adolescents. In an in-depth interview with Australian physical education teachers, Cruickshank *et al.* [13] observed that COVID-19 restrictions resulted in feelings of alienation from one’s peers among physical education students, thus contributing to decreased PA. Füzéki *et al.* [14] highlighted the importance of regular PA to counteract the harmful effects of COVID-19-related social distancing and isolation on mental and physical health. Chaabane *et al.* [17] agreed that school closures due to COVID-19 exerted detrimental effects on adolescent health. Pagoto and Conroy [18] also proposed various measures to revitalize health behaviors among adolescents following the pandemic.

Lee *et al.* [2] conducted an importance–execution analysis of Korean adolescents during the COVID-19 pandemic. By verifying the structural relationships among sports participation, self-elasticity, and health-promoting behavior in Korea during the pandemic, another study by Lee *et al.* [19] demonstrated the importance of sports participation in improving adolescent health and promoting healthy behaviors. Several other pandemic-era studies have also demonstrated the critical role of PA in adolescent health [12, 20, 21]. However, in these investigations, the results were derived mainly by examining the effects of social distancing on health awareness and PA using a cross-sectional design. Such designs are limited when attempting to compare findings before and after the COVID-19 outbreak. Therefore, to provide meaningful data that can be used to develop preventive measures should another pandemic

arise, this study investigated changes in perceived health status, perceived physical fitness, and regular PA among Korean adolescents before and after the outbreak of COVID-19 (2019–2021).

2. Materials and methods

2.1 Participants

This study used data collected by the Korea Ministry of Culture, Sports, and Tourism via an annual Korea National Sports Survey that targets Korean citizens each year; the results are disclosed through the national statistics portal (<http://kosis.kr>). The Korea National Sports Survey is part of the annual survey. To understand Korea’s adolescent population, we reviewed the national public statistical data from the National Statistical Office. Next, we used stratified multi-stage cluster sampling to randomly select potential participants from the 2019–2021 data compiled from the Korea National Sports Survey, which was nationally approved by the Korea Ministry of Culture, Sports, and Tourism (approval number: 113003). The Korea National Sports Survey ensured that all survey respondents expressed an intention to voluntarily participate in the survey and parental consent was obtained on behalf of all participants, who were adolescents. Given that the data sets provided by the Korea National Sports Survey do not include private identifying information, such as home addresses, telephone numbers, or social security numbers, ethical approval was not required for this study.

After excluding 673 responses with missing values, data from 2102 students were used for the final analysis (Table 1). Only adolescents who had responded to the survey for all three years of the study period were included as participants.

2.2 Measurement tools

The questionnaire used in this study was developed by the National Sports Promotion Foundation in 1991, and its reliability and validity have been verified previously. Responses to five items were used to examine changes in perceived health status, perceived physical fitness, and regular participation in PA: (1) “How do you think your health status is now?” (2) “How do you think your physical fitness is now?” (3) “How well are you doing with the following factors (regular PA, adequate rest and sleep, regular meals and nutritional supplementation, abstinence from alcohol, and smoking cessation) to keep yourself in good health and maintain stamina?” (4) “How much have you been participating in regular PA in the past year?” and (5) “How effective do you think PA is in relation to the following items (maintenance of mental health, maintenance of physical health, help in daily life, reduction of medical expenses)?” Responses to each question were rated along a 5-point Likert rating scale, and each score was calculated independently. Responses to the survey were as follows: five points = “very much so”, four points = “yes”, three points = “normal”, two points = “no”, and one point = “not at all”.

TABLE 1. General characteristics of the participants.

Variables	*Items	Before COVID-19 Outbreak		After COVID-19 Outbreak				Total	
		2019		2020		2021		n	%
		n	%	n	%	n	%		
Sex									
	Male	401	53.4	340	51.3	353	51.3	1094	52.0
	Female	350	46.6	323	48.7	335	48.7	1008	48.0
Age									
	14	117	15.6	109	16.4	117	17.0	343	16.3
	15	131	17.4	103	15.5	102	14.8	336	16.0
	16	108	14.4	98	14.8	110	16.0	316	15.0
	17	132	17.6	110	16.6	103	15.0	345	16.4
	18	127	16.9	116	17.5	125	18.2	368	17.5
	19	136	18.1	127	19.2	131	19.0	394	18.8
Total		751	100	663	100	688	100	2102	100

Data are expressed as n (%).

TABLE 2. Descriptive statistics analysis.

Variables	Mean	Standard deviation	Skewness	Kurtosis
Perceived health status	4.243	0.668	-0.723	1.159
Perceived physical fitness	4.005	0.747	-0.620	0.642
Regular physical activity	4.059	0.541	0.023	0.464
Adequate rest and sleep	4.183	0.604	-0.152	-0.225
Regular meals and nutritional supplementation	3.898	0.633	-0.036	-0.375
Abstinence from alcohol and smoking cessation	3.658	0.683	0.064	-0.193
Physical activity participation	2.999	1.107	-0.209	-0.789

TABLE 3. Differences in perceived health status over three years.

Variables	n	Average	Standard deviation	Standard error	F	p	Post-hoc (Scheffe test)
2019 (A)	751	4.264	0.667	0.021	11.080	<0.001***	A, B > C
2020 (B)	663	4.302	0.646	0.022			
2021 (C)	688	4.159	0.681	0.023			
Total	2102	4.243	0.668	0.013			

*** $p < 0.001$, one-way analysis of variance.

TABLE 4. Differences in perceived physical fitness over three years.

Variables	n	Average	Standard deviation	Standard error	F	p	Post-hoc (Scheffe test)
2019 (A)	751	4.027	0.748	0.024	2.397	0.091	-
2020 (B)	663	4.025	0.753	0.025			
2021 (C)	688	3.959	0.740	0.025			
Total	2102	4.005	0.747	0.014			

One-way analysis of variance.

2.3 Procedure and statistical analysis

Data collection for 2019 was conducted in September 2019 (*i.e.*, before the outbreak of COVID-19), whereas that for 2020 and 2021 was conducted in September 2020 and September 2021, respectively (*i.e.*, after the outbreak of COVID-19). Data were analyzed using SPSS version 18.0 (IBM Corp., Armonk, NY, USA). First, a frequency analysis was performed to examine the demographic characteristics of the study participants. Second, one-way analyses of variance were done to compare perceptions of health status/physical fitness and participation in PA before and after the COVID-19 outbreak. Third, descriptive analyses (mean and standard deviation) were performed to clarify differences in the perceived effects of regular participation in PA. Statistical significance was set at $\alpha = 0.05$.

3. Results

3.1 Descriptive statistics analysis

Table 2 presents the results of the descriptive statistics analysis (mean, standard deviation, skewness, and kurtosis) of the study's variables. The mean values for all variables range between 2.999 and 4.243 (± 0.541 – 1.107). Moreover, the absolute values of skewness and kurtosis range from 0.023–0.723 and 0.193–1.159, respectively. The univariate normality criteria of skewness ($< \pm 3.0$) and kurtosis ($< \pm 10.0$) were satisfied [22, 23].

3.2 Differences in health status perception over three years

Table 3 presents the differences in perceived health status among Korean adolescents during the three-year study. The average ratings for 2019, 2020, and 2021 were 4.26, 4.30, and 4.16, respectively. Our analysis revealed that ratings of perceived health status were lower in 2021 than in 2019 or 2020.

3.3 Differences in perceived physical fitness over three years

Table 4 presents differences in perceived physical fitness among Korean adolescents over the 3-year study period. The average ratings for 2019, 2020, and 2021 were 4.03, 4.02, and 3.96, respectively. Our analysis revealed that there were no significant differences in perceived physical fitness in the three years.

3.4 Differences in health behaviors over three years

Table 5 presents the differences in health behaviors (regular PA, adequate rest and sleep, regular meals and nutritional supplementation, abstinence from alcohol, and smoking cessation) among Korean adolescents during the three-year study. Average ratings for regular participation in PA were 3.09 in 2019, 2.84 in 2020, and 3.05 in 2021, which revealed that adolescents reported reduced participation in regular PA in 2020 compared to 2019 and 2021. In terms of adequate rest

and sleep, the average ratings were 3.47 in 2019, 3.57 in 2020, and 3.46 in 2021, thus indicating that sufficient rest and sleep were worse in 2021 than in 2020. In terms of regular meals and nutritional supplementation, the average ratings were 3.84 in 2019, 3.83 in 2020, and 3.70 in 2021, thereby indicating that reported adherence to regular meals and nutritional supplementation was lower in 2021 than in 2019 and 2020. Finally, average ratings for abstinence from alcohol and smoking cessation were 4.47 in 2019, 4.46 in 2020, and 4.57 in 2021, which suggested that adolescents reported abstaining from alcohol and quitting smoking more in 2021 than in 2019 and 2020.

3.5 Differences in PA participation over three years

Table 6 presents the differences in regular participation in PA among Korean adolescents over the 3-year study period. The average ratings for 2019, 2020, and 2021 were 3.06, 2.84, and 2.87, respectively, thus indicating that reported regular participation in PA was lower in 2020 and 2021 than in 2019.

3.6 Ranking of the perceived effects of participating in regular PA over 3 years

Table 7 presents the change in the ranking of the perceived effects of adolescents' participation in regular PA during the three years of the study. For the entire period, the highest ratings were observed for "maintenance of physical health", followed by "maintenance of mental health", "help in daily life", and "reduction of medical expenses". Our analysis indicated no significant changes in the perceived effects of participating in PA from before to after the COVID-19 outbreak.

4. Discussion

4.1 Interpretation of the findings

Our analysis indicated that adolescents perceived their health to be poorer in 2021 than in 2019 or 2020, which may be related to the explosive increase in the number of confirmed COVID-19 cases in the Republic of Korea in early 2022 and to decreased PA due to long-term social distancing. As of June 2022, the cumulative number of cases in Korea has exceeded 18,000,000 (Korea Centers for Disease Control and Prevention), many of which involved adolescents. In fact, despite the implementation of K-communicable Diseases Control—which was praised for its success worldwide in the early stages of the pandemic—the number of confirmed cases has continued to increase since the first half of 2021, thus giving adolescents the message that they are not free from the impact of infectious diseases.

Despite these findings, there were no differences in perceived physical fitness during the three years of the study. These results suggest that adolescents are voluntarily trying to maintain and improve their physical fitness via non-face-to-face home training and running. It may also highlight the success of efforts to conduct such virtual training sessions at school sites, the PA Promoting System, and efforts to enhance physical fitness in adolescents with poor health. Dwyer *et al.*

TABLE 5. Differences in health behaviors over three years.

Items	Variables	n	Average	Standard deviation	Standard error	F	p	Post-hoc (Scheffe test)
Regular physical activity	2019 (A)	751	3.090	0.985	0.031	13.728	<0.001***	A, C > B
	2020 (B)	663	2.840	1.213	0.041			
	2021 (C)	688	3.054	1.112	0.037			
Adequate rest and sleep	2019 (A)	751	3.473	0.836	0.026	4.238	0.015*	B > C
	2020 (B)	663	3.570	0.929	0.031			
	2021 (C)	688	3.456	0.911	0.031			
Regular meals and nutritional supplementation	2019 (A)	751	3.845	0.700	0.022	10.999	<0.001***	A, B > C
	2020 (B)	663	3.827	0.740	0.025			
	2021 (C)	688	3.695	0.795	0.027			
Abstinence from alcohol and smoking cessation	2019 (A)	751	4.471	0.776	0.024	5.813	0.003**	A, B < C
	2020 (B)	663	4.461	0.785	0.026			
	2021 (C)	688	4.572	0.733	0.025			

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$, one-way analysis of variance.

TABLE 6. Differences in physical activity participation over three years.

Variables	N	Average	Standard deviation	Standard error	F	p	Post-hoc (Scheffe test)
2019 (A)	751	3.059	0.386	0.015	36.880	<0.001***	A > B, C
2020 (B)	663	2.836	0.572	0.025			
2021 (C)	688	2.865	0.517	0.021			
Total	2102	2.927	0.502	0.012			

*** $p < 0.001$, one-way analysis of variance.

TABLE 7. Ranking of the perceived effects of participating in regular physical activity over 3 years.

Variables	n	Maintenance of mental health	Maintenance of physical health	Help in daily life	Reduction of medical expenses
2019 (A)	751	4.02 ± 0.56	4.15 ± 0.62	3.88 ± 0.64	3.69 ± 0.66
2020 (B)	663	4.11 ± 0.57	4.23 ± 0.63	3.92 ± 0.69	3.62 ± 0.69
2021 (C)	688	4.05 ± 0.49	4.18 ± 0.55	3.90 ± 0.66	3.66 ± 0.70

Data are expressed as mean ± standard deviation.

[24] argued that the pandemic represents an opportunity to emphasize the importance of PA, especially during adolescence, when healthy habits that set the stage for lifelong health are formed.

Our analysis of health behaviors indicated that ratings for regular participation in PA were lower in 2020 than in 2019 or 2021. Ratings indicative of adequate rest and sleep were also lower in 2021 than in 2020, and fewer adolescents reported regular meals and nutritional supplementation in 2021 than in 2019 or 2020. In addition, ratings for abstinence from alcohol and smoking cessation were higher in 2021 than in 2019 or 2020. In accordance with these results, Lee *et al.* [2] noted that differences in the perceived importance and actual performance of health behaviors during the pandemic were related to the ability to manage sleep, PA, dietary habits, mental health, disease, hygiene, and general health (in that order). Lower ratings related to sleep and rest suggest that adolescents perceived that they had been getting inadequate sleep. In a

study by Lee *et al.* [25], Korean adolescents reported that their sleep and the amount of time spent engaged in PA were relatively insufficient due to the educational policy centered on university entrance exams, which supports the results of this study. These results may be related to the impact of social distancing measures on the ability to engage in activities with others and the efforts required to maintain health with minimal living space at home. Our findings suggest that adolescents' interest in and efforts to maintain health can be improved by strengthening health education centered on sleep hygiene, especially in the context of a pandemic.

Similarly, adolescents reported less frequent participation in PA in 2020 and 2021 than in 2019, thus highlighting the effects of a limited ability to participate in sports during the pandemic. Castañeda-Babarro *et al.* [26] reported that individuals experienced increases in sedentary time along with decreases in PA during the pandemic, in contrast to our findings. Several recent studies have also established that social distancing due

to COVID-19 has reduced PA levels [13, 15, 16], thus leading to various adverse effects [14, 16, 27].

For all three years of the study, ratings regarding the effectiveness of PA on various aspects of health were highest for “maintaining mental health”. They suggest that, regardless of the pandemic, adolescents considered mental health the most important reason to engage in PA, while concerns related to medical expenses were relatively insignificant. Korean adolescents face immense stress due to the burden of entrance exams and rigorous academics. Several studies have also highlighted the significant influence of stress related to romantic relationships, friendships, and familial relationships on young people. Furthermore, this finding is in accordance with studies [28, 29] that demonstrate that older participants are more inclined to be concerned with medical expenses than younger participants, who are less likely to receive hospital treatment or have chronic illnesses. Notably, there appears to be a social consensus among adolescents regarding the importance of PA.

4.2 Practical implications of the study

As of 2022, many countries, including the Republic of Korea, have begun preparing for the “post-COVID” era, given the decreased rates of infection. Although the COVID-19 era may soon end, many anthropologists predict that nuclear war and epidemics represent the main threats to human life in the modern era, thereby emphasizing the need to be prepared should another epidemic emerge.

Our results suggest that adolescents are aware of experiencing decreases in health and PA compared to before the COVID-19 pandemic, which highlights the need to develop instructional strategies and preventive measures in preparation for another pandemic situation. Lee *et al.* [30] focused on strengthening PA as a necessary component to ensure the recovery and transformation of physical education in school settings in the post-pandemic era. As the saying goes, “It takes a village to raise a child”; schools, families, and local communities must work together to ensure the proper growth of their adolescents. In this context, a coherent and integrated approach involving both schools and families is essential. For example, if a school presents a customized health and fitness task that includes PA, eating, and sleeping habits, efforts should be made to create a home environment conducive to practicing these habits as a family. This process will require an expanded role for physical education teachers, who should be responsible for planning and directing physical activities to ensure maximum opportunities for adolescents to participate in classes, school-based activities, and extracurricular/leisure activities [31]. Accordingly, physical education teachers must take greater responsibility for issues regarding struggling with PA and play an active role in addressing them [26]. Recently, the Teacher Learning Community has been developed to improve professionalism and competency among physical education teachers. Therefore, the Korea Ministry of Education and each provincial office of education should develop an active support plan for the Teacher Learning Community. Efforts should be made to improve the health and PA of adolescents so that they can lay the foundation for a healthy life in preparation for the upcoming post-COVID era.

Finally, based on the difficulties experienced while conducting this study, we offer the following suggestions for future research. First, although we utilized a large data sample, our analysis was restricted to the Republic of Korea. Therefore, it is difficult to generalize these findings to other populations. Second, the data obtained for this study were based on the last three years (2019–2021) of the Korea National Sports Survey conducted by the Korean government. Further research is required to explore long-term changes in behavior in the post-pandemic era. Third, demographic characteristics were examined via a frequency analysis in this study. Future studies related to health awareness and PA should conduct more detailed analyses based on sex, age group, residential area, economic level, and socio-cultural background. Fourth, we were unable to provide in-depth conclusions related to sports participation in the post-pandemic era. Further research should explore physical education and school planning after the COVID-19 pandemic. Fifth, survey data are limited in their ability to provide insight into certain individual factors, thus highlighting the need for qualitative and mixed-methods studies to approach the issue of perceived health and PA in the adolescent population.

5. Conclusions

In preparation for the upcoming post-COVID-19 era, our results highlight the need to prepare measures and countermeasures to promote health and PA among adolescents in the Republic of Korea. It must be the top priority for school sports after the pandemic. Further studies are required to examine other ways in which the pandemic may have impacted health and PA among adolescents.

AVAILABILITY OF DATA AND MATERIALS

The data presented in this study are available on reasonable request from the corresponding author.

AUTHOR CONTRIBUTIONS

SML and IHS—designed the research study and methodology. SML and HIS—provided software. SHK and THK—contributed to formal analysis. SHK and THK—contributed to resources and data curation. SML and HIS—contributed to data curation. SML and HIS—wrote the manuscript. SHK and THK—revised the manuscript. SML and HIS—contributed to visualization. SML and HIS—supervised the study. SHK and THK—were in charge of project administration. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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