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ORIGINAL RESEARCH

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Relationship of the number of days of participation in school physical education classes in a week with body mass index, number of hospital treatments for school violence, and mental health status among Korean male adolescents

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Abstract

School sports activities may help address obesity, school violence and mental health issues, which can be considered the biggest issues related to adolescents. However, previous research has not examined the relationship between participation in school physical education classes and obesity, school violence and mental health among adolescents by focusing on the number of days adolescents participate in school physical education classes. Therefore, this study investigated the association of the number of days of participation in physical education classes in a week with body mass index, number of hospital treatments for school violence, and mental health status among Korean male adolescents. Data of 25,749 male Korean adolescents were collected from the 2022 Korea Youth Risk Behavior Survey. Data collected were analyzed using frequency analyses, chi-square analyses and multivariate logistic regression analyses. The results showed that the more Korean male adolescents participate in physical education classes in a week, the more likely they are to become healthy, overweight and obese. The more they participate in physical education classes in a week, the less often they are treated in hospitals for school violence. The more they participate in school physical education classes in a week, the less likely they are to experience suicidal ideation but more likely to feel lonely. Overall, increasing the number of physical education classes can help solve adolescents' health problems, but they must participate actively and voluntarily in the classes. Efforts must be made to increase their active and voluntary participation.

Keywords

Body mass index; Hospital treatments; Mental health; Physical education class; School violence

1. Introduction

Adolescence is the transitional period between childhood and adulthood when individuals experience many changes, such as physical growth and mental and social maturity. Lack of physical activity during adolescence increases one's likelihood of becoming obese, and obese adolescents are highly likely to remain obese or suffer from metabolic diseases in adulthood [1]. In contrast, physically active adolescents are at a lower risk of cardiovascular disease, and participating in physical activity in adolescence prevents obesity, increases physical strength and immunity, and reduces depression and stress. Therefore, engaging in physical activity is vital during adolescence [2]. However, many adolescents in Korea do not follow the World Health Organization's guidelines for physical activity [3]. As adolescents spend a lot of time in school, school sports play a major role in their physical activity experiences. Therefore, adolescents' physical activity should be increased through school sports activities.

Many countries have implemented policies to promote adolescents' physical activity through school sports activities [4–6]. For example, Finland has implemented the Helsinki International Artist Programme at the national level. It focuses on moving classrooms, healthy school practices, and physical education to increase adolescents' physical activity and help manage their weight and health [5]. In Texas (United States), the physical education curriculum requires adolescents to participate in moderate-intensity physical activity at least 30 minutes a day and 135 minutes per week for at least four semesters [6]. Recently, the Korean Ministry of Education announced that it would implement the Physical Activity Promotion System in the third grade of elementary school and increase the

number of physical education classes, revealing mid- to long-term plans to prevent obesity and improve adolescents' health through school sports [4].

Adolescents' health problems, particularly obesity, school violence and mental health issues, have become social issues that must be addressed at the national level. Furthermore, COVID-19 reduced adolescents' physical activity, thereby increasing the number of adolescents suffering from physical deterioration, obesity and depression. Therefore, it becomes imperative to restore adolescents' physical and mental health as soon as possible. Participating in school sports can help prevent obesity and school violence among adolescents and improve their mental health [7, 8]. Therefore, obesity, school violence and mental health issues, which can be considered the biggest issues related to adolescents, should be addressed using school sports activities.

Accordingly, this study examined the association of the number of days of participation in school physical education classes in a week with body mass index (BMI), number of hospital treatments for school violence, and mental health status among Korean male adolescents. Many studies have examined the relationship of participation in school physical education classes with obesity, school violence and mental health among adolescents [7–10]. However, this study is different from prior studies because it focused on the number of days adolescents participated in school physical education classes, which has not been examined in previous studies. This study holds significance because it explores in detail how BMI, the number of hospital treatments for school violence, and mental health issues, which are emerging social problems among adolescents, are related to the number of days an adolescent participates in physical education classes in a week in their school.

2. Materials and methods

2.1 Data collection

We collected the data of 51,850 individuals who had participated in the 2022 Korea Youth Risk Behavior Survey (KYRBS). We excluded the data of 1397 individuals whose information regarding the study topic was not available. Among the data of the remaining individuals, we extracted and used the data of 25,749 male adolescents. The KYRBS is a self-administered annual survey conducted by the Korea Disease Control and Prevention Agency. Adolescents participate in this survey using computers or mobile devices at their school.

2.2 Measures

2.2.1 Independent variables

The independent variable was the number of days of participation in school physical education classes in a week. It was measured by asking respondents, "In the last seven days, how many times did you participate in physical activity during gym class?" Respondents could rate their answer on a 4-point Likert scale ranging from 1 (none), 2 (1 day), 3 (2 days), to 4 (3 or more days).

2.2.2 Dependent variables

The dependent variables were BMI, the number of hospital treatments for school violence, depressive symptoms, suicidal ideation, stress and loneliness. Based on the height (m^2) and weight (kg) entered by the respondents, we calculated BMI as weight/height and classified respondents with BMI less than 18.5 as underweight, between 18.5 and 23 as healthy, between 23 and 25 as overweight, and more than 25 as obese. The number of hospital treatments for school violence was measured by asking respondents, "In the last 12 months, how many times did you get treated in a hospital for violence by a friend, staffs and members of school?" Respondents could rate their answer on a 7-point Likert scale ranging from 1 (none), 2 (1 time), 3 (2 times), 4 (3 times), 5 (4 times), 6 (5 times), to 7 (more than 6 times). We categorized these responses as none, 1–2 times, 3–4 times, and 5 or more times. Depressive symptoms were measured by asking respondents, "In the last 12 months, did you feel sad or hopeless to the point of stopping your daily routine for two weeks?" Respondents could rate their answers on a 2-point Likert scale ranging from 1 (no) to 2 (yes). These responses were used without any modifications. Suicidal ideation was measured by asking respondents, "In the last 12 months, did you have suicidal thoughts?" Respondents could rate their answers on a 2-point Likert scale ranging from 1 (no) to 2 (yes). These responses were used without any modifications. Stress was measured by asking respondents, "How stressed do you usually feel?" Respondents could rate their answer on a 5-point Likert scale ranging from 1 (very much), 2 (a lot), 3 (a little), 4 (not much) and 5 (not at all). We categorized these responses as either 1 (not much) by grouping the responses 3 (a little), 4 (not much), and 5 (not at all) or 2 (very much) by grouping the responses 1 (very much) and 2 (a lot). Loneliness was measured by asking respondents, "In the last 12 months, how often did you feel lonely?" Respondents could rate their answer on a 5-point Likert scale ranging from 1 (never), 2 (rarely), 3 (sometimes), 4 (often) and 5 (always). We categorized these responses as either 1 (rarely) by grouping the responses 1 (never) and 2 (rarely) or 2 (quite often) by grouping the responses 3 (sometimes), 4 (often) and 5 (always).

2.2.3 Covariate variables

The covariates were age, type of school, academic level and perceived health status. Age was classified as 12–15 and 16–18. The type of school was classified as middle or high school. The academic level was classified as high, high-medium, medium, medium-lower or lower. We used respondents' data for age, school type and academic level without making any modifications. Perceived health status was determined by asking respondents, "How healthy do you think you are?" The response options were 1 (very healthy), 2 (healthy), 3 (moderately healthy), 4 (unhealthy), and 5 (very unhealthy). We categorized these responses as either healthy by grouping the responses 1 (very healthy) and 2 (healthy), or unhealthy by grouping the responses 3 (moderately healthy), 4 (unhealthy), and 5 (very unhealthy).

2.3 Data analysis

All statistical analyses were performed using SPSS for Windows (version 23.0; IBM Corp., Armonk, NY, USA). First, we conducted a frequency analysis of respondents' characteristics, such as age, school type and residential area, number of days of participation in physical education classes, BMI, the number of hospital treatments for school violence, depressive symptoms, suicidal ideation, stress and loneliness. Second, we conducted chi-square analyses to identify differences in respondents' characteristics, BMI, the number of hospital treatments for school violence, depressive symptoms, suicidal ideation, stress and loneliness based on the number of days of participation in physical education classes in a week. Third, we performed multivariate logistic regression analyses to examine the association of the number of days of participation in physical education classes in a week with BMI, the number of hospital treatments for school violence, and mental health status. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated. Statistical significance was set at $p < 0.05$.

3. Results

3.1 Respondents' characteristics, number of days of participation in physical education classes, BMI, the number of hospital treatments for school violence, depressive symptoms, suicidal ideation, stress and loneliness

Table 1 presents the details of respondents' characteristics, number of days of participation in physical education classes, BMI, the number of hospital treatments for school violence, depressive symptoms, suicidal ideation, stress and loneliness.

3.2 Differences in respondents' characteristics, BMI, the number of hospital treatments for school violence, depressive symptoms, suicidal ideation, stress and loneliness based on the number of days of participation in physical education classes participation in a week

Table 2 presents the results of chi-square analyses. A statistically significant difference was found in age ($\chi^2 = 3866.612$, $p < 0.001$), school type ($\chi^2 = 4506.476$, $p < 0.001$), academic level ($\chi^2 = 428.502$, $p < 0.001$), perceived health status ($\chi^2 = 389.447$, $p < 0.001$), BMI ($\chi^2 = 173.221$, $p < 0.001$), the number of hospital treatments for school violence ($\chi^2 = 17.173$, $p = 0.046$), suicidal ideation ($\chi^2 = 15.927$, $p = 0.001$), stress ($\chi^2 = 29.327$, $p < 0.001$), and loneliness ($\chi^2 = 17.792$, $p < 0.001$).

3.3 Association between the number of days of participation in school physical education classes in a week and BMI

Table 3 presents the results of the analysis of the association between the number of days of participation in school physical education classes in a week and BMI. The average OR (95% CI) between the number of days of participation in school physical education classes in a week and being healthy was 1.171 (1.034–1.326, $p = 0.013$) among respondents who participated once a week, 1.201 (1.080–1.336, $p = 0.001$) among respondents who participated on two days, and 1.311 (1.181–1.456, $p < 0.001$) among those who participated on three or more days. The average OR (95% CI) between the number of days of participation in school physical education classes in a week and being overweight was 1.157 (1.014–1.320, $p = 0.030$) among respondents who participated on three or more days. The average OR (95% CI) between the number of days of participation in school physical education classes in a week and being obese was 1.139 (1.013–1.281, $p = 0.030$) among respondents who participated on three or more days.

3.4 Association between the number of days of participation in school physical education classes in a week and the number of hospital treatments for school violence

Table 4 presents the results of analyzing the association between the number of days of participation in school physical education classes in a week and the number of hospital treatments for school violence. Among respondents who received hospital treatments 1–2 times for school violence, no statistically significant OR was found. The average OR (95% CI) between the number of days of participation in school physical education classes in a week and receiving hospital treatment 3–4 times was 0.454 (0.252–0.818, $p = 0.009$) among respondents who participated in physical education classes once a week and 0.556 (0.354–0.876, $p = 0.011$) among those who participated on two days. Furthermore, the average OR (95% CI) between the number of days of participation in school physical education classes in a week and receiving hospital treatment 5 or more times was 0.504 (0.258–0.986, $p = 0.045$) among respondents who participated in physical education classes on two days.

3.5 Association between the number of days of participation in school physical education classes in a week and mental health status

Table 5 presents the results of the analysis of the association between the number of days of participation in school physical education classes in a week and mental health status. The average OR (95% CI) between the number of days of participation in school physical education classes in a week and not experiencing suicidal ideation was 1.259 (1.079–1.468, $p = 0.003$) among respondents who participated once a week. The average OR (95% CI) between the number of days of participation in school physical education classes in a week and not experiencing loneliness was 0.854 (0.776–0.940, $p = 0.001$) among respondents who participated once a week, 0.806 (0.742–0.876, $p < 0.001$) among those who participated on two days, and 0.768 (0.705–0.836, $p < 0.001$) among those who participated three or more days. No statistically significant ORs were found for depressive symptoms and stress.

TABLE 1. Respondents' characteristics, number of days of participation in school physical education classes, body mass index, the number of hospital treatments for school violence, depressive symptoms, suicidal ideation, stress and loneliness (n = 25,749).

Variable	Categories	n (%)
Age		
	12–15	14,956 (58.1%)
	16–18	10,793 (41.9%)
School type		
	Middle school	13,854 (53.8%)
	High school	11,895 (46.2%)
Residential area		
	Large cities	12,712 (49.4%)
	Middle-sized cities	11,518 (44.7%)
	Small-sized cities	1519 (5.9%)
Academic level		
	High	3807 (14.8%)
	High-medium	6418 (24.9%)
	Medium	7461 (29.0%)
	Medium-lower	5507 (21.4%)
	Lower	2556 (9.9%)
Perceived health status		
	Unhealthy	8005 (31.1%)
	Healthy	17,744 (68.9%)
Number of days of participation in school physical education classes in a week		
	None	4326 (16.8%)
	1 day	4075 (15.8%)
	2 days	8030 (31.2%)
	3 or more days	9318 (36.2%)
Body mass index		
	Underweight	4782 (18.6%)
	Healthy	11,217 (43.6%)
	Overweight	3837 (14.9%)
	Obesity	5913 (22.9%)
Number of hospital treatments for school violence		
	None	24,942 (96.9%)
	1–2 times	576 (2.2%)
	3–4 times	153 (0.6%)
	5 or more times	78 (0.3%)
Depressive symptoms		
	No	19,559 (76.0%)
	Yes	6190 (24.0%)
Suicidal ideation		
	No	23,050 (89.5%)
	Yes	2699 (10.5%)
Stress		
	Not much	5351 (20.8%)
	Very much	20,398 (79.2%)
Loneliness		
	Rarely	13,523 (52.5%)
	Quite often	12,226 (47.5%)

TABLE 2. Differences in respondents' characteristics, body mass index, the number of hospital treatments for school violence, depressive symptoms, suicidal ideation, stress, and loneliness based on the number of days of participation in school physical education classes in a week.

Variable	Categories	Number of days of participation in school physical education classes in a week				χ^2 (p)
		3 or more days	2 days	1 day	None	
Age						
	12–15	7766 (51.9%)	3584 (24.0%)	1616 (10.8%)	1990 (13.3%)	3866.612 (<0.001***)
	16–18	1552 (14.4%)	4446 (41.2%)	2459 (22.8%)	2336 (21.6%)	
School type						
	Middle school	7581 (54.7%)	3021 (21.8%)	1426 (10.3%)	1826 (13.2%)	4506.476 (<0.001***)
	High school	1737 (14.6%)	5009 (42.1%)	2649 (22.3%)	2500 (21.0%)	
Residential area						
	Large cities	4579 (36.0%)	4015 (31.6%)	1984 (15.6%)	2134 (16.8%)	9.477 (0.148)
	Middle-sized cities	4143 (36.0%)	3578 (31.0%)	1862 (16.2%)	1935 (16.8%)	
	Small-sized cities	596 (39.2%)	437 (28.8%)	229 (15.1%)	257 (16.9%)	
Academic level						
	High	1782 (46.8%)	1025 (26.9%)	491 (12.9%)	509 (13.4%)	428.502 (<0.001***)
	High-medium	2530 (39.4%)	2013 (31.4%)	956 (14.9%)	919 (14.3%)	
	Medium	2530 (33.9%)	2433 (32.6%)	1231 (16.5%)	1267 (17.0%)	
	Medium-lower	1749 (31.8%)	1800 (32.7%)	938 (17.0%)	1020 (18.5%)	
	Lower	727 (28.4%)	759 (29.7%)	459 (18.0%)	611 (23.9%)	
Perceived health status						
	Unhealthy	2325 (29.0%)	2503 (31.3%)	1394 (17.4%)	1783 (22.3%)	389.447 (<0.001***)
	Healthy	6993 (39.4%)	5527 (31.2%)	2681 (15.1%)	2543 (14.3%)	
Body mass index						
	Underweight	1973 (41.3%)	1332 (27.8%)	656 (13.7%)	821 (17.2%)	173.221 (<0.001***)
	Healthy	4214 (37.6%)	3559 (31.7%)	1740 (15.5%)	1704 (15.2%)	
	Overweight	1285 (33.5%)	1227 (32.0%)	655 (17.1%)	670 (17.4%)	
	Obesity	1846 (31.2%)	1912 (32.4%)	1024 (17.3%)	1131 (19.1%)	
Number of hospital treatments for school violence						
	None	9014 (36.1%)	7805 (31.3%)	3953 (15.9%)	4170 (16.7%)	17.173 (0.046*)
	1–2 times	211 (36.6%)	169 (29.3%)	96 (16.7%)	100 (17.4%)	
	3–4 times	60 (39.2%)	39 (25.5%)	16 (10.5%)	38 (24.8%)	
	5 or more times	33 (42.3%)	17 (21.8%)	10 (12.8%)	18 (23.1%)	
Depressive						
	No	7101 (36.3%)	6119 (31.3%)	3121 (16.0%)	3218 (16.4%)	7.311 (0.063)
	Yes	2217 (35.8%)	1911 (30.9%)	954 (15.4%)	1108 (17.9%)	
Suicide ideation						
	No	8347 (36.2%)	7192 (31.2%)	3699 (16.1%)	3812 (16.5%)	15.927 (0.001**)
	Yes	971 (36.0%)	838 (31.1%)	376 (13.9%)	514 (19.0%)	
Stress						
	Not much	2094 (39.1%)	1589 (29.7%)	846 (15.8%)	822 (15.4%)	29.327 (<0.001***)
	Very much	7224 (35.4%)	6441 (31.6%)	3229 (15.8%)	3504 (17.2%)	
Loneliness						
	Rarely	5008 (37.0%)	4076 (30.2%)	2122 (15.7%)	2317 (17.1%)	17.792 (<0.001***)
	Quite often	4310 (35.3%)	3954 (32.3%)	1953 (16.0%)	2009 (16.4%)	

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$, assessed through chi-square analyses.*

TABLE 3. Association between the number of days of participation in school physical education classes in a week and body mass index.

Variable		Body mass index (odds ratios and 95% confidence intervals)		
		Healthy	Overweight	Obesity
Number of days of participation in school physical education classes in a week	None	1.000	1.000	1.000
	1 day	1.171 (1.034–1.326) $p = 0.013$*	1.111 (0.955–1.292) $p = 0.174$	1.086 (0.948–1.244) $p = 0.235$
	2 days	1.201 (1.080–1.336) $p = 0.001$**	1.055 (0.926–1.202) $p = 0.421$	1.060 (0.943–1.191) $p = 0.330$
	3 or more days	1.311 (1.181–1.456) $p < 0.001$***	1.157 (1.014–1.320) $p = 0.030$*	1.139 (1.013–1.281) $p = 0.030$*

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$, assessed through multivariate logistic regression analysis.*

TABLE 4. Association between the number of days of participation in school physical education classes in a week and the number of hospital treatments for school violence.

Variable		Number of hospital treatments for school violence (odds ratios and 95% confidence intervals)		
		1–2 times	3–4 times	5 or more times
Number of days of participation in school physical education classes in a week	None	1.000	1.000	1.000
	1 day	1.087 (0.817–1.446) $p = 0.567$	0.454 (0.252–0.818) $p = 0.009$**	0.626 (0.288–1.365) $p = 0.239$
	2 days	0.959 (0.745–1.234) $p = 0.742$	0.556 (0.354–0.876) $p = 0.011$*	0.504 (0.258–0.986) $p = 0.045$*
	3 or more days	0.938 (0.728–1.209) $p = 0.622$	1.044 (0.671–1.626) $p = 0.848$	1.041 (0.559–1.942) $p = 0.898$

*$p < 0.05$, **$p < 0.01$, assessed through multivariate logistic regression analysis.*

TABLE 5. Association between the number of days of participation in school physical education classes in a week and mental health status.

Variable		Mental health status (odds ratios and 95% confidence intervals)			
		Depressive symptoms (no)	Suicidal ideation (no)	Stress (no)	Loneliness (no)
Number of days of participation in school physical education classes in a week	None	1.000	1.000	1.000	1.000
	1 day	1.071 (0.958–1.197) $p = 0.229$	1.259 (1.079–1.468) $p = 0.003$**	1.090 (0.972–1.223) $p = 0.139$	0.854 (0.776–0.940) $p = 0.001$**
	2 days	1.082 (0.983–1.191) $p = 0.109$	1.079 (0.949–1.228) $p = 0.247$	1.027 (0.929–1.135) $p = 0.605$	0.806 (0.742–0.876) $p < 0.001$***
	3 or more days	0.978 (0.887–1.080) $p = 0.665$	1.123 (0.984–1.281) $p = 0.085$	1.102 (0.997–1.219) $p = 0.058$	0.768 (0.705–0.836) $p < 0.001$***

**$p < 0.01$, ***$p < 0.001$, assessed through multivariate logistic regression analysis.*

4. Discussion

4.1 Interpretation of the findings

This study examined the association of the number of days of participation in school physical education classes in a week with BMI, the number of hospital treatments for school violence, and mental health status among Korean male adolescents. The results revealed that the more Korean male adolescents participate in school physical education classes in a week, the more likely they are to report that they were healthy, overweight and obese. The more they participate in school physical education classes in a week, the less often they are treated for school violence in hospitals. Furthermore, the more they participate in school physical education classes in a week, the less likely they are to experience suicidal ideation but more likely to feel lonely.

We first found that the more Korean male adolescents participate in school physical education classes in a week, the more likely they are to report that they were healthy, overweight and obese. This finding indicates that physical activity alone is unlikely to reduce weight or prevent obesity in adolescents. These findings are partly consistent with those of Sabia *et al.* [10] who found that despite a 10%–13% increase in school physical education time, there was no effect on weight loss among adolescents. Bednar *et al.* [11] used data from the 2010–2011 Early Child Longitudinal Survey Kindergarten Class to examine the effect of physical education classes on children's weight. They found no direct effect on the weight of elementary school students in the United States. These findings suggest that participating in physical activity in physical education classes does not help adolescents lose weight or prevent obesity. Some studies have reported that physical activity alone is not effective for weight loss and obesity prevention; rather, physical activity combined with diet control are most effective [12]. Meanwhile, Erfle *et al.* [9] conducted a study on the effect of participation in physical education classes on adolescents' physical fitness and weight and found that participation in physical education has a greater effect on strengthening physical fitness than reducing weight. In other words, the results of this study and previous studies suggest that participating in physical education classes is more effective for improving physical fitness than reducing weight and that dietary education should be combined to prevent and manage obesity in adolescents.

Second, we found that the more Korean male adolescents participate in school physical education classes, the less often they are treated in hospitals for school violence. Locke, who reinterpreted Juvenalis' proposition, said, "A sound mind in a sound body" or a healthy body leads to a sound mind. According to Juvenalis' thesis, since school violence is a negative behavior related to the mind and virtue, it will decrease if the body is healthy [13]. Many studies have reported that adolescents' participation in physical education classes reduces school violence, which is partially consistent with the results of this study, and school sports should be considered a fundamental and practical solution for school violence [7, 8]. It is important to solve problems, and the best solution is to prevent and minimize the occurrence of problems. Therefore, it may be possible to prevent school violence by developing and implementing programs in physical education classes to curb school violence.

Third, we found that the more Korean male adolescents participate in school physical education classes, the less likely they are to experience suicidal ideation. This finding aligns with that of previous studies that found that adolescents' participation in physical activity helps reduce suicidal ideation [14, 15]. Furthermore, our finding is partly consistent with those of Felez *et al.* [16], who explored the association between physical activity and suicide attempts among adolescents in 48 countries. Felez *et al.* [16] found that, in contrast to female adolescents, male adolescents are less likely to attempt suicide if they engage in high levels of physical activity, suggesting that participation in school physical education classes is effective for improving the mental health of male adolescents. Potential ways to prevent suicide have not been investigated, but physical activity may help prevent it [15]. Engaging in physical activity can be a low-cost solution, and unlike traditional mental health interventions, it is generally non-stigmatizing [17]. Since physical activity can reduce suicidal ideation among adolescents, it is necessary to increase the number of days of physical education classes in schools.

Finally, we found that the more Korean male adolescents participate in school physical education classes, the more likely they are to feel lonely. Pels *et al.* [18] conducted a systematic review of the association between participation in physical activity and loneliness and found that increased participation in physical activity reduces loneliness. Thus, further research is required to determine the effect of physical activity on loneliness.

4.2 Practical implications of the study

Adolescents' participation in physical activity contributes to their health and well-being throughout their lives, from adolescence in the short term to adulthood in the long term. In particular, physical activity has several benefits, including improved physical fitness and muscle strength, reduced chronic pain, improved bone density, reduced risk of cardiovascular disease, improved weight control and boosted immunity [19]. In addition, on a psychological level, physical activity improves mental health and quality of life, reduces stress and anxiety, lowers the risk of depression and improves sleep quality [20]. In other words, physical activity is associated with overall physical, mental and social health and well-being [21].

Despite these benefits of physical activity, from 2020 to 2022, COVID-19 distancing measures led to a decrease in physical activity and an increase in sedentary time. Gradually, these behaviors have become habits and adolescents' physical activity habits are in danger of breaking down [19]. Decreased physical activity is associated with the increased likelihood of cardiovascular diseases, weight gain, diabetes, psychosocial problems and negative physical and mental health, which can extend into adulthood [22]. Therefore, the World Health Organization has set a goal of reducing the prevalence of physical inactivity by 15% by 2030 and has provided guidelines for promoting physical activity at the national level [23]. The majority of adolescents meet the recommended standards of

physical activity through physical education classes in school. As the lack of physical activity among adolescents is becoming a problem around the world, it is necessary to focus on physical education classes in schools as a measure to promote physical activity among them.

Korea's physical education curriculum specifies the number of physical education classes adolescents must attend. According to the number of hours of instruction one must receive, students are required to participate in physical education classes at least three times a week [24, 25]. Nonetheless, this study found that 16.8% of Korean male adolescents did not participate in physical education classes, while 15.8%, 31.2% and 36.2% participated once, twice and thrice a week, respectively. This shows that 36.2% of Korean male adolescents participate in physical education classes thrice a week. However, it also shows that 63.8% of Korean male adolescents participate in physical education classes less than three times a week. This means that adolescents participate in physical education classes according to the curriculum but do not engage in active physical activity. This result is a percentage of the number of days that men participate in physical education classes. However, considering that women are not as active as men, it is predicted that Korean adolescents will not participate in physical education classes in schools. In other words, since only 36.2% of adolescents participate in school physical education classes thrice a week, it is necessary to identify measures that increase students' involvement in physical education classes.

On 31 October 2023, the Korean Ministry of Education announced the 2nd Master Plan for Student Health Promotion [4]. This plan aims to increase the number of physical education classes for elementary, middle and high school students and increase their physical activity [4]. According to the plan, a new physical education curriculum will be established for the first and second grades of primary school, and the current 80 hours will be increased to 144 hours [4]. In middle schools, the number of sports clubs will be increased, and in high schools, credits for physical education will be mandated [4]. It is desirable to establish a physical education curriculum, increase the number of hours students can participate in physical activities, and form a lifelong habit of exercising by making physical activity a habit from an early age. However, since students do not meet the current curriculum's requirement of participating in school physical education classes thrice a week, efforts must be made to increase physical education time and students' participation in physical activities.

Physical education classes in schools are the primary means of satisfying the physical activity requirements of children and adolescents [26]. Nonetheless, as this study shows, students do not fully participate in physical education classes thrice a week, the minimum number of hours of instruction required as per the curriculum. Previous studies have cited fear of failure, low athletic performance, lack of self-confidence, and negative reactions from peers as reasons students avoid participating in physical education classes [27, 28]. There can be many reasons adolescents avoid participating in physical education classes. To engage them in class, it is necessary to increase their motivation to participate and encourage them to initiate physical activity instead of eliminating avoidant factors [29]. Considering that the Korean Ministry of Education has announced an expansion in the number of physical education classes, Korea must find ways to create and support an environment where adolescents can take the lead in physical activities. In other words, as the number of physical education classes and consequently, opportunities to engage in physical activity increase, specific and systematic planning and support will be required to realize actual physical movement.

Physical education classes that consider individuality emphasize respecting individual characteristics and motor skill levels to increase the youth's active and voluntary participation. Digital technology-based physical education classes can encourage adolescents to participate in physical activities voluntarily and proactively. Such classes can allow adolescents to participate in physical activities based on their characteristics. Moreover, they are the need of the hour, considering that we are living in the Fourth Industrial Revolution [30–32]. Flipped learning allows students to learn online at home and enables the implementation of physical education classes that consider individuality at school [32]. Adolescents can choose and practice different levels of activities online at home and participate in physical activities based on their characteristics at school [33]. Additionally, apps and wearable devices can be used to promote physical activity by providing programs tailored to one's body [34, 35]. Wearable healthcare technology can measure vital aspects such as heart rate and exercise level with Near-field communication technology and help users manage their fitness and health; thus, they can garner positive responses from students and build their interest in physical activity [36]. In other words, adolescents' voluntary and active participation can be increased if they are allowed to engage in physical activities tailored to their characteristics through digital technology at schools. However, digitalized physical education classes cannot be realized without the efforts of teachers. Korean teachers are aware of the need for digitalized physical education classes, but they do not know how to design and operate such classes [37]. Therefore, case-based, participatory and practical teacher-training programs are required [38]. Korean physical education teachers are expected to be reborn as experts in planning and managing physical activities rather than being just instructors [39].

4.3 Limitation

This study had several limitations. First, it focused on Korean male adolescents and did not include Korean female adolescents. Therefore, the results cannot be generalized to all Korean adolescents. Second, since this was a cross-sectional and secondary study, it was not possible to establish causal relationships between the variables. Nonetheless, this study holds significance because it focused on the number of days of participation in physical education classes in schools, which has been overlooked in previous studies, and explored its association with BMI, the number of hospital treatments for school violence and mental health status. Furthermore, the results of this study can help determine the direction of physical activity and school sports among Korean adolescents. They can also be used as basic data to develop plans for improving adolescents' health in countries other than Korea.

5. Conclusions

The more Korean male adolescents participate in school physical education classes in a week, the more likely they are to become healthy, overweight and obese. The more they participate in school physical education classes in a week, the less often they are treated for school violence in hospitals. The more they participate in school physical education classes in a week, the less likely they are to experience suicidal ideation but more likely to feel lonely. These findings suggest that physical education classes in schools are more effective in improving physical fitness than reducing weight, and eating habits should be taught in tandem to prevent and manage obesity in adolescents. It may be possible to stop school violence by developing and implementing school violence-related programs in physical education classes. The number of days of physical education classes should be increased to reduce suicidal ideation among adolescents. Furthermore, increasing the number of physical education classes may be a desirable solution for addressing adolescents' health problems. However, since it requires adolescents' active and voluntary participation, efforts must be made to increase their participation in physical education classes.

ABBREVIATIONS

BMI, body mass index; PE, physical education.

AVAILABILITY OF DATA AND MATERIALS

The data that support the findings of this study are available from the corresponding author on reasonable request.

AUTHOR CONTRIBUTIONS

JK and JJ—conceptualization; methodology; data collection; formal analysis; investigation; project administration; writing–original draft preparation; writing–review and editing; visualization; validation; supervision. All the authors contributed to the reading and approval of the submitted version.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The 2022 KYRBS was conducted after obtaining consent from the study participants and their guardians and was approved by the Institutional Review Board of the Korea Disease Control and Prevention Agency (Approval number: 117058), Republic of Korea, and was conducted in accordance with the Declaration of Helsinki. All participants and their guardians were informed about the study procedure and its purpose and voluntarily signed an informed consent form.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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