©Journal of Sports Science and Medicine (2012) **11,** 226-230
http://www.jssm.org

Research article

The relationship between school performance and the number of physical education classes attended by Korean adolescent students

Sang-Yeob Kim [1] and Wi-Young So [2]✉
[1] Division of Physical Education, College of Education, Sungkyul University, Anyang-si, Kyounggi-do, Korea
[2] Department of Human Movement Science, Seoul Women's University, Seoul, Korea

Abstract
Increased physical activity (PA) is the relationship with improved cognitive and memory functions of the brain. The physical education (PE) classes held in school comprise a type of PA. However, there is no epidemiological evidence showing a relationship between school performance and the number of PE classes attended per week in adolescent students. Therefore, the purpose of this study is to examine whether the number of PE classes attended per week is related with school performance in Korean adolescent students. In 2009, 75,066 adolescent students from middle school first grade to high school third grade participated in the 5th Korea Youth Risk Behavior Web-based Survey (KYRBWS-V) project. The relationship between school performance and the number of PE classes attended per week was assessed using multivariate logistic regression analysis after adjusting for covariate variables such as gender, age, body mass index, parents' education level, family's economic status, vigorous and moderate PA, and muscle strengthening exercises. The odds ratio (OR) for attending <3 PE classes per week and school performance was 1.125 for good school performance, 1.147 for average school performance, 1.146 for poor school performance, and 1.191 for very poor school performance, when compared to very good school performance. It was concluded that attending ≥3 PE classes per week was positively correlated with improved school performance and that attending <3 PE classes per week was negatively correlated with school performance in Korean adolescent students.

Key words: Adolescent, Korea Youth Risk Behavior Web-based Survey, physical education classes, school performance.

Introduction

Regular physical activity (PA) improves the health of many bodily systems, including the cardiovascular and musculoskeletal systems (Di Stasi et al., 2010; Leung et al., 2008), whereas factors such as physical inactivity lead to a sedentary lifestyle that in turn leads to increased weight (Canoy and Bundred, 2011; Park et al., 2004; Thomas and Albert, 2002) and adverse health effects such as musculoskeletal disorders, cardiac diseases, hypertension, stroke, type II diabetes, obesity, some types of cancers, and metabolic syndrome (Eckel et al., 2005; World Health Organization, 2011). Therefore, increasing PA is considered as an important approach for preventing adult diseases. Many studies have reported that increasing PA is beneficial for improving health outcomes (Baker et al., 2011; Daniels et al., 2005; Keteyian, 2011).

Recently, several studies have reported that increased PA is associated with improved cognitive and memory functions of the brain (Flöel et al., 2010; Ploughman, 2008). The precise mechanisms underlying this association are unclear and inadequately understood. However, there are 3 hypotheses that can explain how PA affects brain function. The first hypothesis is that PA increases oxygen saturation and angiogenesis in the brain areas essential for performing tasks (Kleim et al., 2002; Kramer et al., 1999). The second hypothesis is that PA also increases the activity of brain neurotransmitters such as serotonin and norepinephrine, thereby facilitating information processing (Kubesch et al., 2003; McMorris et al., 2008; Winter et al., 2007). The third hypothesis is that PA upregulates neurotrophins such as brain-derived neurotrophic factor, insulin-like growth factor-I, and basic fibroblast growth factor. These neurotrophins support neuronal survival and differentiation in the developing brain (Schinder and Poo, 2000).

These studies indicated that because PA is related to brain function, increasing PA may improve school performance and academic achievements in adolescent students. However, although PA has been shown to increase brain function and some practical evidence exists on the association between PA and academic performance (Sibley and Etnier, 2003), there is no epidemiological evidence supporting this finding in the literature on adolescent students. Furthermore, although a physical education (PE) class represents a type of PA in school, there is no epidemiological evidence showing that such classes are beneficial for adolescent students. Therefore, the purpose of this study is to examine whether the number of PE classes attended per week is related to school performance in Korean adolescent students. The results will be used to further assess the differences in the school performance of Korean adolescent students according to the frequency of PE classes per week and will then be used to recommend increased PA as an approach for enhancing school performance and achievements.

Methods

Participants

The 5th Korea Youth Risk Behavior Web-based Survey

Received: 03 November 2011 / Accepted: 01 February 2012 / Published (online): 01 June 2012

(KYRBWS-V) was conducted in 2009 as a cross-sectional epidemiological *study* with a complex sample design that included multistage sampling, clustering, and stratification. The KYRBWS-V consisted of questions about PA based on the International Physical Activity Questionnaire (IPAQ) of the World Health Organization (Craig *et al.*, 2003). It was a national school-based survey conducted by the Korea Centers for Disease Control and Prevention (KCDCP) to determine the prevalence of health risk behavior in Korean adolescent students (Korea Centers for Disease Control and Prevention, 2010). A representative sample of students from middle school first to high school third (age, 13–18 years) was selected; this sample included 76,937 students from 24,000 classrooms (secondary sampling units) of 800 middle and high schools (primary sampling units) and from 192 strata that were identified using the stratified multistage cluster sampling method. After sample determination, classroom teachers assigned each participating student a unique identification number that was used by the students to access the survey web page. On the web page, the students were first asked about their willingness to participate in the survey. Students who were willing to participate in the survey were asked to answer a self-administered questionnaire, which they completed anonymously in school. Students who did not wish to participate were not asked to answer the questionnaire. Furthermore, because private information was not collected by the KYRBWS-V, ethical approval was not required for this study.

All the details pertaining to data collection procedures have been reported by the KCDCP (Korea Centers for Disease Control and Prevention, 2010), and the reliability and validity of the data obtained using the questionnaire have been evaluated in other studies (Bae et al., 2010a; 2010b).

The present study obtained data from the KYRBWS-V to evaluate the association between the number of PE classes attended per week and school performance, taking into consideration potential covariate variables such as gender, age, body mass index (BMI), parents' education level, family's economic status, vigorous and moderate PA, and muscle strengthening exercises. Thus, 75,066 adolescent students (39,612 boys and 35,454 girls) participated in the study, and the response rate was 97.6%. The characteristics of the subjects are shown in Table 1.

Table 1. The characteristics of the subjects. Data are expressed as mean ± SD or N (%).

Variables		Boys (n = 39,612)	Girls (n = 35,454)	Total (n = 75,066)
Age (years)		15.00 ± 1.73	15.12 ± 1.77	15.06 ± 1.75
Height (m)		1.70 ± .09	160 ± .05	165 ± .08
Weight (kg)		60.14 ± 11.72	51.47 ± 7.67	56.04 ± 10.91
Body mass index (kg/m^2)		20.80 ± 3.21	20.05 ± 2.58	20.45 ± 2.95
Family's economic status N (%)	Very rich	2,923 (7.4)	1,434 (4.0)	4,357 (5.8)
	Rich	8,985 (22.7)	6,908 (19.6)	15,893 (21.2)
	Average	17,743 (44.7)	17,706 (49.9)	35,449 (47.2)
	Poor	7,150 (18.1)	7,090 (20.0)	14,240 (19.0)
	Very poor	2,811 (7.1)	2,316 (6.5)	5,127 (6.8)
Father's education level N (%)	Unknown	7,297 (18.4)	5,321 (15.0)	12,618 (16.8)
	Middle school or lower	2,707 (6.8)	2,483 (7.0)	5,190 (6.9)
	High school	14,294 (36.1)	13,915 (39.2)	28,209 (37.6)
	College or higher	15,314 (38.7)	13,735 (38.8)	29,049 (38.7)
Mother's education level N (%)	Unknown	8,069 (20.4)	5,059 (14.3)	13,128 (17.5)
	Middle school or lower	2,447 (6.2)	2,490 (7.0)	4,937 (6.6)
	High school	17,745 (44.7)	18,212 (51.4)	35,957 (47.9)
	College or higher	11,351 (28.7)	9,693 (27.3)	21,044 (28.0)
School performance N (%)	Very good	4,958 (12.5)	3,454 (9.7)	8,412 (11.2)
	Good	9,172 (23.2)	8,411 (23.7)	17,583 (23.4)
	Average	10,544 (26.6)	9,675 (27.3)	20,219 (26.9)
	Poor	9,661 (24.4)	9,477 (26.7)	19,138 (25.5)
	Very poor	5,277 (13.3)	4,437 (12.5)	9,714 (12.9)
The number of PE classes attended per week N (%)	No PE class	3,133 (7.9)	3,988 (11.2)	7,121 (9.5)
	Once per week	3,231 (8.2)	3,376 (9.5)	6,607 (8.8)
	Twice per week	19,138 (48.3)	16,271 (45.9)	35,409 (47.2)
	≥3 classes per week	14,110 (35.6)	11,819 (33.3)	25,929 (34.5)
City size N (%)	Large cities	21,014 (53.0)	18,273 (51.5)	39,287 (52.3)
	Middle-sized cities	13,802 (34.9)	12,605 (35.6)	26,407 (35.2)
	small-sized cities	4,796 (12.1)	4,576 (12.9)	9,372 (12.5)
Grade N (%)	Middle school first	6,933 (17.5)	5,781 (16.3)	12,714 (16.9)
	Middle school second	6,965 (17.6)	5,903 (16.6)	12,868 (17.1)
	Middle school third	7,035 (17.7)	5,792 (16.3)	12,827 (17.1)
	High school first	6,890 (17.4)	5,587 (15.8)	12,477 (16.6)
	High school second	6,104 (15.4)	6,323 (17.9)	12,427 (16.6)
	High school third	5,685 (14.4)	6,068 (17.1)	11,753 (15.7)

BMI, Body Mass Index; PE, Physical Education

Table 2. The multivariate logistic regression analysis of school performance for the ≥3 classes per week and <3 classes per week groups in Korean adolescents

	School performance	ß	S.E.	OR	95% CI	p
<3 PE classes (yes / no)	Very good	Ref.				
	Good	.118	.041	1.125	1.038-1.220	.004**
	Average	.137	.042	1.147	1.058-1.245	<.001***
	Poor	.136	.042	1.146	1.055-1.244	.001**
	Very poor	.175	.049	1.191	1.082-1.311	<.001***

S.E, Standard Error; OR, Odd Ratio; CI, Confidence Interval; PE, Physical Education
** $p < 0.01$ *** $p < 0.001$ tested by multivariate logistic regression analysis after adjustments for covariate variables such as gender, age, BMI, parents' education level, family's economic status, vigorous and moderate PA, and muscle strengthening exercises

Independent variables

To determine the number of PE classes attended per week by all the subjects, the following question was asked in the KYRBWS-V survey: "(Q1) How many PE classes do you attend per week in school?," with the following response options: (1) no PE class, (2) once per week, (3) twice per week, and (4) ≥3 times per week. Next, these responses were classified into the following 2 groups for multivariate logistic regression analyses: (1) ≥3 PE classes per week and (2) <3 PE classes per week.

Dependent variables

Self-reported school performances were evaluated for each adolescent student by asking 1 question: "(Q2) In the past 12 months, how has your average school performance been?" The response options were (1) very good, (2) good, (3) average, (4) poor, and (5) very poor.

Covariate variables

The covariate variables were as follows:

1. Gender: The 2 response options were (1) male and (2) female.

2. Age: Data pertaining to the ages of the students, as defined by the KYRBWS-V, were used without any modifications.

3. BMI: The students were asked to self-record their height and weight. BMI (kg/m^2) was calculated from the data recorded by each student.

4. Parents' education level: The 4 response options were (1) unknown, (2) middle school or lower, (3) high school and (4) college or higher.

5. Family's economic status: The 5 responses ranged from (1) very rich, (2) rich, (3) average, (4) poor, and (5) very poor.

6. Frequency of vigorous PAs such as digging, aerobics, heavy lifting, or fast cycling during the week: The 6 responses ranged from (1) no, (2) once per week, (3) twice per week, (4) thrice per week, (5) 4 times per week, and (6) over 5 times per week.

7. Frequency of moderate PAs such as bicycling at a regular pace, carrying light loads, or playing doubles tennis during the week: The 6 responses ranged from (1) no, (2) once per week, (3) twice per week, (4) thrice per week, (5) 4 times per week, and (6) over 5 times per week.

8. Frequency of muscle strengthening exercises such as sit-ups, push-ups, and weight lifting or weight training during the week: The 6 responses ranged from (1) no, (2) once per week, (3) twice per week, (4) thrice per week, (5) 4 times per week, and (6) over 5 times per week.

Statistical analysis

All the results are presented in terms of mean ± standard deviation values. Multivariate logistic regression analyses were performed to determine whether the number of PE classes attended per week was related to school performance in the participants of this study, after adjusting for the covariate variables. Statistical significance was set at $p < 0.05$, and all the analyses were performed using SPSS ver. 12.0 (SPSS, Chicago, IL, USA).

Results

The results of the multivariate logistic regression analyses of school performance for the groups of Korean adolescents participating in ≥3 and <3 PE classes per week are shown in Table 2. This table compares the information about the Korean adolescents who attended <3 PE classes per week to that of Korean adolescents who attended ≥3 PE classes per week, according to school performances that ranged from (1) very good to (5) very poor after adjusting for covariate variables such as gender, age, BMI, parents' education level, family's economic status, vigorous and moderate PA, and muscle strengthening exercises.

Results show that for students attending <3 PE classes per week, good school performance increased by 12.5%, average school performance increased by 14.7%, poor school performance increased by 14.6%, and very poor school performance increased by 19.1% as compared to very good school performance.

Discussion

The aim of this study is to investigate the association between school performance and attending <3 PE classes per week in Korean adolescents. The results of our study show that attending <3 PE classes per week was associated with poor school performance in Korean adolescent students, despite adjusting for school performance-related covariate variables.

Several cross-sectional studies have shown that less PA is associated with poor cognitive function and memory functions of the brain (Flöel et al., 2010; Ploughman, 2008). Thus, the results of our epidemiological study indicate that PE classes represent PA, which may increase the cognitive and memory functions of the brain. Furthermore, they indicate that increasing the frequency of PE classes positively affects school performance in Korean adolescent students.

School performance may be highly associated with

the reading, speaking, writing, and understanding levels of individuals, which in turn are related to brain activities and functioning. Here, our cross-sectional study showed that school performance was associated with the frequency of attending PE classes.

Limitations and future research

This study has several limitations. First, the KYRBWS-V was conducted using online methods; consequently, the parents' education level and the family's economic status were recorded by the students themselves, and these data may therefore be inaccurate. Second, this study was a cross-sectional epidemiology study. Therefore, we could not elucidate the cause-and-effect relationship but could only assess the interrelationship between school performance and the frequency of attending PE classes. However, because our study sample comprised 75,066 students from all parts of Korea and was thus highly representative of the Korean adolescent population, the relationship between school performance and the number of PE classes attended per week could be generalized to all Korean adolescents.

However, in the future, better-designed studies should be performed to determine the extent to which these variables, including the covariate variables, affect the school performance of Korean adolescents.

Conclusion

It was concluded that in Korean adolescents, attending ≥3 PE classes per week was positively correlated with school performance; in contrast, attending <3 PE classes per week was negatively correlated with school performance.

References

Bae, J., Joung, H., Kim, J.Y., Kwon, K.N., Kim, Y.T. and Park, S.W. (2010a) Test-retest reliability of a questionnaire for the Korea Youth Risk Behavior Web-based Survey. *Journal of Preventive Medicine and Public Health* **43**(5), 403-410.

Bae, J., Joung, H., Kim, J.Y., Kwon, K.N., Kim, Y. and Park, S.W. (2010b) Validity of self-reported height, weight, and body mass index of the Korea Youth Risk Behavior Web-based Survey questionnaire. *Journal of Preventive Medicine and Public Health* **43**(5), 396-402.

Baker, P.R., Francis, D.P., Soares, J., Weightman, A.L. and Foster, C. (2011) Community wide interventions for increasing physical activity. *Cochrane Database of Systematic Reviews (Online)* **13**(4), CD008366.

Canoy, D. and Bundred, P. (2011) Obesity in children. *Clinical Evidence (Online)* 2011, pii: 0325.

Craig, C.L., Marshall, A.L., Sjöström, M., Bauman, A. E., Booth, M.L., Ainsworth, B.E., Pratt, M., Ekelund, U., Yngve, A., Sallis, J. F. and Oja, P. (2003) International physical activity questionnaire: 12-country reliability and validity. *Medicine and Science in Sports and Exercise* **35(8)**, 1381-1395.

Daniels, S.R., Arnett, D.K., Eckel, R.H., Gidding, S.S., Hayman, L.L., Kumanyika, S., Robinson, T.N. and Scott, B.J. (2005) Overweight in children and adolescents pathophysiology, consequences, prevention, and treatment. *Circulation* **111,** 1999-2012.

Di Stasi, S.L., MacLeod, T.D., Winters, J.D. and Binder-Macleod, S.A. (2010) Effects of statins on skeletal muscle: a perspective for physical therapists. *Physical Therapy* **90**(10), 1530-1542.

Eckel, R.H., Scott, M.G. and Zimmet, P. (2005) The metabolic syndrome. *The Lancet* **365,** 1415-1428.

Flöel, A., Ruscheweyh, R., Krüger, K., Willemer, C., Winter, B., Völker, K., Lohmann, H., Zitzmann, M., Mooren, F., Breitenstein, C. and Knecht, S. (2010) Physical activity and memory functions: are neurotrophins and cerebral gray matter volume the missing link? *Neuroimage* **49**(3), 2756-2763.

Keteyian, S.J. (2011). Exercise training in congestive heart failure: risks and benefits. *Progress in Cardiovascular Diseases* **53** (6), 419-428.

Kleim, J.A., Cooper, N.R. and VandenBerg, P.M. (2002) Exercise induces angiogenesis but does not alter movement representations within rat motor cortex. *Brain Research* **934,** 1–6.

Kramer, A.F., Hahn, S., Cohen, N.J., Banich, M.T., McAuley, E., Harrison, C.R., Chason, J., Vakil, E., Bardell, L., Boileau, R.A. and Colcombe, A. (1999). Ageing, fitness and neurocognitive function. *Nature* **400,** 418-419.

Korea Centers for Disease Control and Prevention. (2010) *The Statistics of 5th Korea Youth Risk Behavior Web-based Survey (KYRBWS) in 2009*. Korea Centers for Disease Control and Prevention. Available fro URL: http://yhs.cdc.go.kr/

Kubesch, S., Bretschneider, V., Freudenman, R., Weidenhammer, N., Lehmann, M., Spitzer, M. and Gron, G. (2003) Aerobic endurance exercise improves executive functions in depressed patients. *Journal of Clinical Psychiatry* **64,** 1005-1012.

Leung, F.P., Yung, L.M., Laher, I., Yao, X., Chen, Z.Y. and Huang, Y. (2008) Exercise, vascular wall and cardiovascular diseases: an update (Part 1). *Sports Medicine* **38** (12), 1009-1024.

McMorris, T., Collard, K., Corbett, J., Dicks, M. and Swain, J.P. (2008) A test of the catecholamines hypothesis for an acute exercise-cognition interaction. *Pharmacology and Biochemistry of Behavior* **89,** 106-115.

Park, Y.S., Lee, D.H., Choi, J.M., Kang, Y.J. and Kim, C.H. (2004) Trend of obesity in school age children in Seoul over the past 23 years. *Korean Journal of Pediatrics* **47**(3), 247-257.

Ploughman, M. (2008) Exercise is brain food: the effects of physical activity on cognitive function. *Developmental Neurorehabilitation* **11**(3), 236-240.

Schinder, A.F. and Poo, M. (2000) The neurotrophin hypothesis for synaptic plasticity. *Trends in Neuroscience* **23,** 639-645.

Sibley, B.A. and Etnier, J.L. (2003) The relationship between physical activity and cognition in children: A meta-analysis. *Pediatric Exercise Science* **15**, 243-256.

SPSS (Version 12.0). Chicago, IL, USA

Thomas, A.W. and Albert, J.S. (2002) *Handbook of obesity treatment.* 3rd edition. New York: Guilford Press. USA.

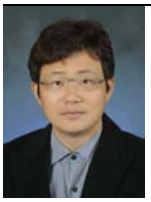
Winter, B., Breitenstein, C., Mooren, F.C., Voelker, K., Fobker, M., Lechtermann, A., Krueger, K., Fromme, A., Korsukewitz, C., Floel, A. and Knecht, S. (2007) High impact running improves learning. *Neurobiology Learning and Memory* **87,** 597-609.

World Health Organization. (2011) *Obesity and Overweight. Global Strategy on Diet, Physical Activity and Health*. Available from URL: http://www.who.int/mediacentre/factsheets/fs311/en/

Key points

- Korean adolescents, attending ≥3 PE classes per week was positively correlated with school performance
- Korean adolescents, attending <3 PE classes per week was negatively correlated with school performance

AUTHORS BIOGRAPHY



Sang-Yeob KIM

Employment

Adjunct Professor, Division of Physical Education, College of Education, Sungkyul University

Degree

PhD

E-mail: 100sprinter@hanmail.net

Wi-Young SO
Employment
Assistant Professor, Department of Human M ovement Science, Seoul Women's University, Seoul, Korea
Degree
PhD
E-mail: wowso@swu.ac.kr

✉ **Wi-Young So, PhD**
Assistant Professor, Department of Human Movement Science, Seoul Women's University, Seoul, Korea