

Research article

Prevalence of obesity in Korean adolescents and its relationship with the weekly frequency of the physical education classes

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Abstract

The purpose of this study was to investigate differences in the prevalence of obesity among Korean adolescents and to determine the relationship of obesity prevalence with weekly frequency of physical education (PE) classes. In 2009, 72,399 students from grades 7 to 12 participated in the fifth Korea Youth Risk Behavior Web-based Survey (KYRBWS-V) project. Body mass index (BMI) and the frequency of PE classes attended were assessed by the KYRBWS-V. BMI was computed to classify the participants as underweight, normal weight, overweight, and obese. The association between the frequency of PE classes and BMI were examined using one-way ANOVA and logistic regression analysis. The differences in the weekly frequency of PE classes and the BMI values among both the boys and girls were significant ($p < 0.001$). A post-hoc test showed that underweight boys and girls attended the PE classes more frequently ($p < 0.001$), and overweight girls attended these classes less frequently ($p < 0.01$) than the other groups did; moreover, obese boys and girls, compared to boys and girls in the other groups, attended less number of PE classes per week while at school ($p < 0.05$). Besides, the odds ratio (95% confidence interval, CI) for normal-weight vs. underweight boys attending 1 PE class, 2 PE classes, and ≥ 3 PE classes per week were 1.168 (1.011–1.349, $p = 0.035$), 1.621 (1.450–1.812, $p < 0.001$), and 3.023 (2.704–3.381, $p < 0.001$), respectively, compared with those for boys who did not attend PE classes. The OR (95% CI) of normal-weight vs. obese boys attending ≥ 3 PE classes attended across normal vs. obese boys was 0.862 (0.762–0.974, $p = 0.017$), compared with those of boys who did not attend PE classes. The OR (95% CI) for normal-weight vs. underweight girls who attended 2 PE classes and ≥ 3 PE classes per week were 1.235 (1.131–1.349, $p < 0.001$) and 2.238 (2.048–2.446, $p < 0.001$), respectively, compared with those of girls who did not attend PE classes. The OR (95% CI) of normal-weight vs. overweight girls who attended ≥ 3 PE classes per week were 0.886 (0.787–0.997, $p = 0.045$) and 0.772 (0.679–0.878, $p < 0.001$), respectively, compared with those of girls who did not attend PE classes. The OR (95% CI) for normal-weight vs. obese girls who attended 2 PE classes and ≥ 3 PE classes per week were 0.788 (0.675–0.919, $p = 0.002$) and 0.709 (0.599–0.838, $p < 0.001$), respectively, compared with those of girls who did not attend the PE class. Increase in the frequency of PE classes should be considered in any attempt for curbing weight-related problems in Korean adolescents.

Key words: Prevalence of obesity, physical education class, adolescents.

Introduction

Overweight and obesity are associated with serious health issues worldwide. According to the World Health Organization report, more than 1.5 billion adults aged 20 years and above are already overweight, and more than 500 million adults are obese. In addition, almost 43 million children aged 5 years and less were classified as overweight in 2010 (WHO, 2011a). Thus, obesity in adolescents and adults is becoming increasingly common (Foti and Lowry, 2010; Patton et al., 2011; Korea Centers for Disease Control and Prevention [KCDCP], 2008).

Adolescence is the period during which lifelong habits are developed. According to several reports, approximately 80% of obese adolescents remain obese even in adulthood. Therefore, it is very important that good health habits be established during adolescence (Daniels et al., 2005; Kvaavik et al., 2003).

Smoking, drinking, physical inactivity, and an increase in food intake can lead to excessive weight gain (Thomas and Albert, 2002). Because obesity is a lifestyle disease, changes in habits that are risk factors can prevent obesity and are also cost-effective strategies (Melin and Rössner, 2003).

Increase in physical activity is a good and cost-effective strategy to prevent obesity (Dishman et al., 2004). Longitudinal (Dietz and Gortmaker, 1985; Gortmaker et al., 1996) and cross-sectional studies (Obarzanek et al., 1994; Shannon et al., 1991) have shown that activities such as watching TV, indicative of physical inactivity, increase obesity rates. Furthermore, the time spent watching TV is associated with an increase in snack consumption (Taras and Gage, 1995; Clancy-Hepburn et al., 1974). Because the frequency of physical education (PE) classes attended per week in school represents the extent of physical activity, this frequency should be considered an important variable in the prevention of obesity in schoolchildren.

However, the impact of the differences in the frequency of attending PE classes on obesity prevention is unclear. Therefore, the purpose of this study was to investigate the prevalence of obesity among Korean adolescents and its relationship with the weekly frequency of PE classes.

Methods

Study design

The raw data of the 2009 fifth Korea Youth Risk Behavior Web-based Survey (KYRBWS-V), obtained on request, were used in this study (KCDCP, 2010). KYRBWS-V was a cross-sectional survey conducted among the middle- and high-school students in Korea. This survey was conducted to evaluate the current health status of adolescents and their habits that are risk factors for obesity. An index for a health promotion project plan was calculated, and the values obtained for this study population were compared with those for other countries. Examples of other surveys include the Youth Risk Behavioral Survey (YRBS) (Eaton et al., 2010) and the Global School-based Student Health Survey (GSHS) (WHO, 2011b) of the US Centers for Disease Control and Prevention (CDC); the Health Behavior in School-aged Children Study (HBSC) (Currie et al., 2001) of WHO Europe; and the KYRBWS of KCDCP (KCDCP, 2010).

The KYRBWS-V was administered to a nationally representative sample comprising of middle-school and high-school students, using a complex sample design that includes clustering, stratification and multistage sampling. A representative sample of students from grades 7 to 12 was selected; this sample population was spread across 24,000 classrooms (secondary sampling units) from 800

middle and high schools (primary sampling units) and from 192 strata identified using the stratified multistage cluster sampling method (KCDCP, 2010).

After sample determination, the students were assigned unique identification (ID) numbers by their respective classroom teachers. The students accessed the survey web-page by using their ID numbers and responded to a question about their willingness to participate in the survey. Those students, who were willing to participate, self-administered the questionnaire anonymously at the school, whereas those unwilling to participate did not progress further. The KYRBWS-V was administered in September, and 75,066 responses were collected, with a response rate of 97.6%; students who had been absent from school for a long period and those with dyslexia and dysgraphia were excluded. In addition, 2,667 students who did not enter their weight or height for body mass index (BMI) calculation were excluded from the analysis. In all, 72,399 students (38,152 boys and 34,247 girls) were included in this study. The characteristics of these subjects are shown in Table 1. Because the KYRBWS-V did not collect any personal information, ethical approval was not required.

The KYRBWS-V contained 14 categories, including drinking, smoking, obesity/weight control, physical activity, eating habits, damage prevention, drug use, sexual behavior, mental health, oral health, atopy/asthma,

Table 1. Characteristics of subjects.

Variables	Boys, Mean (\pm SD) (n = 38,152)	Girls, Mean (\pm SD) (n = 34,247)	Total, Mean (\pm SD) (n = 72,399)
Age (years)	15.00 \pm 1.73	15.12 \pm 1.77	15.06 \pm 1.75
Height (m)	1.70 \pm .08	1.60 \pm .05	1.65 \pm .08
Weight (kg)	60.14 \pm 11.72	51.47 \pm 7.67	56.04 \pm 10.91
BMI ($\text{kg}\cdot\text{m}^{-2}$)	20.80 \pm 3.21	20.05 \pm 2.58	20.45 \pm 2.95
Weight state	Boys, N (%)	Girls, N (%)	Total, N (%)
Underweight (BMI < 18.5)	9719 (25.5)	10012 (29.2)	19731 (27.3)
Normal weight (18.5 \leq BMI < 23)	19685 (51.6)	19655 (57.4)	39340 (54.3)
Overweight (23 \leq BMI < 25)	4382 (11.5)	2967 (8.7)	7349 (10.2)
Obesity (25 \leq BMI)	4366 (11.4)	1613 (4.7)	5979 (8.3)
Family economic state	Boys, N (%)	Girls, N (%)	Total, N (%)
High	2691 (7.1)	1337, (3.9)	4028 (5.6)
Middle high	8768 (23.0)	6719 (19.6)	15487 (21.4)
Average	17229 (45.2)	17259 (50.4)	34488 (47.6)
Middle low	6890 (18.1)	6825 (19.9)	13715 (18.9)
Low	2574 (6.7)	2107 (6.2)	4681 (6.5)
City size	Boys, N (%)	Girls, N (%)	Total, N (%)
Large	20252 (53.1)	17708 (51.7)	37960 (52.4)
Middle	13303 (34.9)	12153 (35.5)	25456 (35.2)
Small	4597 (12.0)	4386 (12.8)	8983 (12.4)
Grade	Boys, N (%)	Girls, N (%)	Total, N (%)
Middle 1st	6711 (17.6)	5615 (16.4)	12326 (17.0)
Middle 2nd	6722 (17.6)	5727 (16.7)	12449 (17.2)
Middle 3rd	6767 (17.7)	5615 (16.4)	12382 (17.1)
High 1st	6626 (17.4)	5369 (15.7)	11995 (16.6)
High 2nd	5889 (15.4)	6102 (17.8)	11991 (16.6)
High 3rd	5437 (14.3)	5819 (17.0)	11256 (15.5)
PE class frequency	Boys, N (%)	Girls, N (%)	Total, N (%)
No class per week	2961 (7.8)	3815 (11.1)	6776 (9.4)
1 PE class per week	3064 (8.0)	3236 (9.4)	6300 (8.7)
2 PE classes per week	18479 (48.4)	15738 (46.0)	34217 (47.2)
\geq 3 PE classes per week	13648 (35.8)	11458 (33.5)	25106 (34.7)

BMI, Body Mass Index; PE, Physical education.

Table 2. Differences in the frequency of PE classes per week relative to the BMI standard.

Group	Normal	Underweight	Overweight	Obesity	Overall, F	Overall, P*
Boys, Mean (\pm SD)	2.05 (.87)	2.35 (.78) †††	2.04 (.86)	2.01 (.88) †	310.311	< .001
Girls, Mean (\pm SD)	1.95 (.94)	2.21 (.89) †††	1.88 (.95) ††	1.82 (.97) †††	226.770	< .001
Total population	2.00 (.91)	2.28 (.84) †††	1.97 (.90)	1.96 (.91) ††	497.730	< .001
N (%)	Normal	Underweight	Overweight	Obesity	Total population	
Boys	19,685 (51.6)	9,719 (25.5)	4,382 (11.5)	4,366 (11.4)	38,152 (100.0)	
Girls	19,655 (57.4)	10,012 (29.2)	2,967 (8.7)	1,613 (4.7)	34,247 (100.0)	
Total population	39,340 (54.2)	19,731 (27.3)	7,349 (10.2)	5,979 (8.3)	72,399 (100.0)	

BMI, Body Mass Index. * by one-way ANOVA. †, †† and ††† denote $p < 0.05$, $p < 0.01$ and $p < 0.001$, respectively, compared to normal group by Scheffe test.

personal hygiene, internet addiction, and abundance of families; the reliability and validity of the data obtained using the survey have been evaluated in other studies (Bae et al., 2010a; 2010b).

Independent variables

The height and weight of the subjects were self-recorded, and the body mass index (BMI; $\text{kg}\cdot\text{m}^{-2}$) was calculated from the data recorded for each participant. According to the WHO Asia-Pacific standard of obesity, subjects with BMI <18.5 , ≥ 18.5 to <23 , ≥ 23 to <25 , and ≥ 25 were defined as underweight, normal, overweight, and obese, respectively (WHO/IASO/IOTF, 2000).

Dependent variables

A question in the KYRBWS-V that was used to determine the number of hours of PE classes attended per week by all subjects were as follows: “Q1) How many PE classes are attended per week?” with the response options of “1) No PE class,” “2) Once per week,” “3) Twice per week,” or “4) 3 or more classes per week.”

Statistical analysis

Descriptive data are presented as mean (standard deviation). One-way ANOVA was used to verify the intergroup differences in the frequency of PE classes attended per week according to the categories of BMI — underweight group (UWG), normal-weight group (NG), overweight group (OWG), and obesity group (OG). Post-hoc testing (Scheffe test) was used to identify the specific groups showing differences when a significant difference between groups occurred. Logistic regression analyses were conducted to evaluate the effect of the frequency of PE class per week according to (a) NG vs. UWG, (b) NG vs. OWG, and (c) NG vs. OG, in the order of increasing PE class frequency. In addition, all analyses were stratified by sex. Statistical significance was set at $p < 0.05$. All analyses were performed using SPSS ver.12.0 (SPSS, Chicago, IL, USA).

Results

Differences in the frequency of PE classes attended per week relative to the BMI standard

The differences in the frequency of PE classes attended per week relative to the BMI standard are shown in Table 2. According to BMI values, boys and girls showed significant differences in the frequency of PE classes attended per week ($p < 0.001$). Accordingly, a post-hoc test

showed that the frequency of PE classes attended per week at their respective schools was as follows: the frequency for underweight boys and girls was higher ($p < 0.001$), for overweight girls was lower ($p < 0.01$), and for obese boys and girls was even lower ($p < 0.05$).

Logistic regression analysis of the frequency of PE classes attended per week according to the BMI standard

The logistic regression analysis of the frequency of PE classes per week according to the BMI standard is shown in Table 3. The odds ratio (OR) and 95% confidence interval (CI) for boys and girls from all the study groups were compared with those for boys and girls in the normal group. The OR (95% CI) for normal-weight vs. underweight boys attending 1 PE class, 2 PE classes, and ≥ 3 PE classes were 1.168 (1.011–1.349, $p = 0.035$), 1.621 (1.450–1.812, $p < 0.001$), and 3.023 (2.704–3.381, $p < 0.001$), respectively, compared with those for boys who did not attend PE class. The OR (95% CI) for normal-weight vs. obese boys attending ≥ 3 PE classes per week was 0.862 (0.762–0.974, $p = 0.017$) compared with those of boys who did not attend PE classes. The OR (95% CI) for normal-weight vs. underweight girls who attended 2 PE classes and ≥ 3 PE classes per week were 1.235 (1.131–1.349, $p < 0.001$) and 2.238 (2.048–2.446, $p < 0.001$), respectively, compared with those for girls who did not attend PE classes. The OR (95% CI) for normal-weight vs. overweight girls who attended ≥ 3 PE classes per week were 0.886 (0.787–0.997, $p = 0.045$) and 0.772 (0.679–0.878, $p < 0.001$), respectively, compared with those of girls who did not attend PE classes. The OR (95% CI) for normal-weight vs. obese girls who attended 2 PE classes and ≥ 3 PE classes per week were 0.788 (0.675–0.919, $p = 0.002$) and 0.709 (0.599–0.838, $p < 0.001$), respectively, compared with those of girls who did not attend PE classes.

Discussion

The aim of this study was to determine the relationship between the frequency of PE classes per week in schools and the prevalence of obesity in Korean adolescents. The results of this study, for both boys and girls, showed that lower-weight (UG) tended to be associated with a high frequency of PE classes per week, and higher weight (OWG and OG) tended to be associated with a low frequency of PE classes per week, compared to the association observed for students with a normal BMI (NG).

Moreover, because the frequency of PE class was

Table 3. The physical education class frequency per week according to the BMI standard.

Group	Category	Boys					Girls				
		B	S.E.	OR	95% CI	P *	B	S.E.	OR	95% CI	P *
Normal Vs. Underweight	No PE class										
	One PE class per week	.155	.073	1.168	1.011-1.349	.035	.029	.060	1.029	.915-1.157	.633
	Two PE classes per week	.483	.057	1.621	1.450-1.812	<.001	.211	.045	1.235	1.131-1.349	<.001
	Over three PE classes per week	1.106	.057	3.023	2.704-3.381	<.001	.806	.045	2.238	2.048-2.446	<.001
Normal Vs. Overweight	No PE class										
	One PE class per week	.019	.080	1.019	.872-1.192	.809	-.089	.081	.915	.781-1.072	.271
	Two PE classes per week	.065	.061	1.068	.947-1.204	.285	-.121	.060	.886	.787-.997	.045
	Over three PE classes per week	-.045	.064	.956	.843-1.085	.485	-.258	.066	.772	.679-.878	<.001
Normal Vs. Obesity	No PE class										
	One PE class per week	-.034	.078	.967	.830-1.125	.661	.150	.098	1.162	.950-1.407	.125
	Two PE classes per week	-.047	.059	.954	.849-1.072	.425	-.239	.078	.788	.675-.919	.002
	Over three PE classes per week	-.149	.063	.862	.762-.974	.017	-.344	.086	.709	.599-.838	<.001

BMI; Body Mass Index; S.E, Standard Error; OR, Odd Ratio; CI, Confidence Interval; PE, Physical Education. The association of the frequency of PE classes and BMI category, by sex. * tested by logistic regression analysis.

directly linked to the amount of physical activity and increased energy expenditure, Story (1999) reported that reduction of BMI was linked to an increase in the frequency of PE classes. Strong et al. (2005) have also reported that an increase in physical activity was beneficial for preventing cardiovascular disease, including metabolic syndrome and high blood pressure; improving mental health, including lowering depression and anxiety; and improving body image. The results of this study were also supported by those of previous studies that showed that increased physical activity would positively control the weight status of an individual (Story, 1999; Strong et al. 2005). In addition, increase in the frequency of PE classes could prevent obesity from persisting in adulthood.

In the future, well-designed studies are necessary, because adolescent obesity is also affected by factors such as sedentary lifestyle; unhealthy eating habits; socio-economic, environmental, and genetic variables; as well as lack of physical activity. The results also vary, depending on the research method. However, increase in the frequency of PE classes for both boys and girls proved to be an effective intervention for the prevention of obesity, suggesting that if a good exercise program imposed in the PE class could reduce the prevalence of obesity (Datar and Sturm, 2004).

Interestingly, the results of the logistic regression analyses indicate more consistent and stronger associations between the frequency of PE classes and overweight or obese status for girls than for boys. This might be attributed to the fact that boys like to indulge in physical activity during their leisure time, even after school, but, girls do not. Therefore, girls are usually physically less active than boys are. Hence, even an hour of PE class for girls is more effective in reducing weight-related issues than it is for boys.

The limitations of this study were as follows: First, this study was conducted online, and therefore, the height and weight values of the adolescents were not measured directly, but recorded by the students themselves. These raw data might result in lower reported levels of obesity, because adolescents tend to increase height and decrease

weight values when self-reporting measurements (Bae et al., 2010a). Second, because this study was a cross-sectional study, it did not examine the cause and effect of obesity, but only the relationship between BMI indices and the frequency of PE classes attended per week. However, this study, in contrast to a smaller-scale previous regional case study, investigated data for the whole country and included 72,399 subjects. To our knowledge, it is one of the most extensive and representative studies dealing with the relationship between obesity in Korean adolescents and the frequency of PE classes.

Adolescence is an important period for establishing healthy habits (Daniels et al., 2005; Kvaavik et al., 2003; Thomas and Albert, 2002). Therefore, various PE programs should be developed and implemented in schools, to help prevent obesity in adolescents.

Conclusion

We concluded that increase in the frequency of PE classes is a factor that should be considered to improve weight status in Korean adolescents.

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Key point

- Increase in the frequency of PE classes is a factor that should be considered to improve weight status

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