RESEARCH ARTICLE

Effects of school-based *"We Fit"* weight control programme in adolescents

Sun-Mi Chae[1] iD | Ji-Young Yeo[2] iD | Ji-Hye Hwang[1] iD | Hee Sun Kang[3] iD

[1]Seoul National University College of Nursing, The Research Institute of Nursing Science, Seoul, Republic of Korea

[2]Hanyang University School of Nursing, Seoul, Republic of Korea

[3]Red Cross College of Nursing, Chung-Ang University, Seoul, Republic of Korea

Correspondence
Ji-Young Yeo, Hanyang University School of Nursing, 222, Wangsimni-ro, Seongdong-gu, Seoul, 04763, Republic of Korea.
Email: shine73@hanyang.ac.kr

Abstract

Aim: This study examined the effects of a 12-week school-based *"We Fit"* weight control programme.

Design: A nonequivalent control group was used, with a non-synchronized pretest–posttest design.

Methods: In total, 109 Korean high school adolescents participated. The programme comprised exergaming, diet diary and counselling, health education, and social networking service-based group discussions. Anthropometric factors, physiological factors and physical activity (daily steps and sitting time) were measured in the intervention and the control groups before and after the intervention. Programme satisfaction was assessed post-intervention. Data were analysed using descriptive statistics; the chi-square, Mann–Whitney U and *t* tests; and generalized estimating equations.

Results: The intervention group showed a significantly decreased waist circumference, increased skeletal muscle mass, increased high-density lipoprotein cholesterol, decreased low-density lipoprotein cholesterol and reduced weekend sitting time.

Conclusion: This study adds to the evidence for the applicability and effectiveness of healthy weight control programmes using exergames for adolescents in school settings.

KEYWORDS
active video game, adolescents, physical activity, school health, weight control

1 | INTRODUCTION

Adolescence is a critical period for cultivating and practising health behaviours that promote future health and well-being (Patton et al., 2016). Weight control is a health behaviour of major significance to adolescents, regardless of their weight (Boutelle et al., 2007). Many adolescents misperceive their body weight, including one-fifth of American adolescents (Dues et al., 2020), one-third of French adolescents (Deschamps et al., 2015) and 44.5% of Chinese adolescents (Qin et al., 2019). Dues et al. (2020) found that body weight misperceptions were associated with unhealthy diet and physical inactivity in adolescents. Even normal-weight adolescents are likely to engage in unhealthy weight control behaviours, such as fasting, using food substitutes and skipping meals (Deschamps et al., 2015; Leal et al., 2020). Therefore, adolescents should learn and practise healthy weight control behaviours based

on correct body perceptions to maintain a healthy lifestyle and prepare for health in adulthood. School nurses can play a significant role in providing adolescents at school with professional health advice and helping them practise healthy weight control behaviours.

2 | BACKGROUND

The key principle of weight control is energy balance between intake and expenditure. Healthy weight control—achieved through physical activity and a healthy diet—helps prevent chronic illnesses, such as cardiovascular and metabolic diseases, and improves quality of life (Sparling et al., 2013).

Adolescents, regardless of their weight status, often engage in unhealthy dietary behaviours due to misperceptions of their body weight (Deschamps et al., 2015; Dues et al., 2020; Leal et al., 2020). Physical inactivity and sedentary behaviours of adolescents are also a substantial health concern worldwide. A recent study (Wang et al., 2019) reported that Taiwanese adolescents engaged in moderate-to-vigorous physical activity for 22.8 ± 15.7 min per day, whereas their sedentary time was 8.2 ± 2.7 hr per day. Systematic reviews have shown positive associations of physical activity in adolescents with health-related quality of life and mental health, whereas sedentary behaviour was associated with lower psychological well-being (Marker et al., 2018; Rodriguez-Ayllon et al., 2019). Adolescents' unhealthy weight control behaviours, including unhealthy diets and physical inactivity, may result in serious medical or psychosocial consequences, including eating disorders, nutritional imbalances and substance use (Nagata et al., 2018). Therefore, healthcare professionals, including school nurses, should support adolescents to learn and practise healthy weight control behaviours.

School is a promising setting to implement health interventions for adolescents in terms of accessibility and usability of the peer group. Previous studies have found that school-based obesity-prevention interventions, even without family support, were effective for improving adolescents' physical activity, dietary behaviours and body weight (Bauer et al., 2011). In addition to the accessibility of the school setting, peers at school could play a pivotal role for adolescents regarding weight control. In their review of empirical studies, Salvy and Bowker (2014) suggested that using peer networks could be an efficient way to promote healthy eating and physical activity in children and adolescents. Therefore, given the feasibility and effectiveness of programmes for adolescents at school, a school-based weight control programme would be helpful. A study reviewing the effects of lifestyle modification interventions to prevent and manage adolescent obesity reported that combined interventions (e.g. diet and exercise or exercise and behavioural therapy) were effective (Salam et al., 2020). According to the US Centers for Disease Control and Prevention, classroom physical activity during the school day should be provided both to improve students' learning outcomes and to promote physical activity (Centers for Disease Control & Prevention, 2018).

Exergaming shows considerable promise as a way to motivate adolescents' participation in school-based weight control programmes. Exergaming, a portmanteau of exercise and gaming, refers to playing video games that involve physical activity. The physical effects of exergaming a highly similar to those of traditional methods of exercise, as exergaming increases participants' energy expenditure and heart rate (Maddison et al., 2007; Unnithan et al., 2006). Exergaming also has positive social effects, as adolescents who engaged in exergaming with their friends showed strong friend relationships and a lower risk of social isolation (Staiano & Calvert, 2011). Sheehan and Katz (2012) suggested that exergaming at school might both increase adolescents' physical activity level and help introduce them to other types of physical activities. However, little has been reported on adolescents' use of exergaming at school for weight control.

The purpose of this study was to examine the effects of a school-based *We Fit* weight control programme for adolescents on physical activity, anthropometric factors and physiological factors, and investigate programme satisfaction.
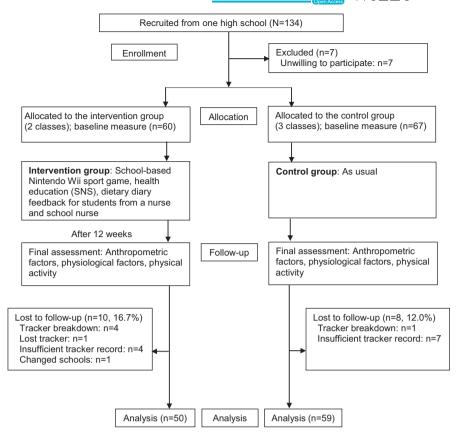
3 | METHODS

3.1 | Study design

A nonequivalent control group was used, with a non-synchronized pretest–posttest design.

3.2 | Participants

Adolescents in the 10th and 11th grades of a high school in Seoul, South Korea, were eligible to participate. Participants were recruited using convenience sampling when the researchers visited their classrooms during school recess and explained the study purpose and procedures. Only adolescents who met the inclusion criteria voluntarily participated in the study. The inclusion criteria were students who were in 10th or 11th grade, were able to understand Korean and perceived themselves as healthy. The exclusion criteria were those who were receiving medical treatment for physical and/or mental illnesses. The study site was a private high school located in Seoul, South Korea, with approximately 1,100 male and female students enrolled. Figure 1 shows the flow of study participant recruitment.

The sample size for this study was calculated using G-Power 3.1 with an effect size of 0.5 (medium), a significance level of 5% and a power of 80%, and a required sample size of 102 was obtained. Considering the potential for dropout, five classes with a total of 127 students were recruited using simple cluster sampling and randomly assigned to two groups. Two classes with 60 students were assigned to the intervention group and three classes with 67 students to the control group. Eighteen students dropped out, yielding 50 participants in the intervention group and 59 in the control group. The reasons for dropping out were loss or breakdown of the activity tracker ($N = 6$), poor compliance with wearing the activity tracker ($N = 11$)

FIGURE 1 Flow of recruiting study participants

and changing schools (N = 1). The final study participants consisted of 109 adolescents: 50 males (45.9%) and 59 females (54.1%). Their ages ranged from 15 to 17 years. Fifty-four were in the 10th grade (49.5%) and 55 were in the 11th grade (50.5%).

3.3 | Data collection procedures

The researchers shared information about the study and invited adolescents to participate. The students were given packets containing informed consent and assent forms at school to take home for obtaining parental permission. In total, 127 students returned the consent and assent forms. To prevent intervention diffusion, data were collected first from the control group during the first semester of 2015 and then from the intervention group during the second semester of 2015. The intervention group received the intervention for 12 weeks, and the control group received no treatment. Anthropometric data, physiological data and physical activity levels were measured in both groups pre- and post-intervention. Programme satisfaction was also examined in the intervention group after programme completion. We used the TREND reporting guidelines (Des Jarlais et al., 2004).

3.4 | Ethical considerations

The study was approved by the Institutional Review Board of the first author's university (No. 1405/002-009). The principal of the

high school also gave permission to conduct the study. Parental informed consent was obtained prior to the beginning of the study. Assent was also obtained from the adolescents. In order to prevent weight-related bias, we recruited interested adolescents regardless of their body weight, with no separate approach to recruit subjects according to their body weight. The data collected from participants were coded anonymously for privacy protection.

3.5 | Intervention: *We Fit* weight control programme

The 12-week *We Fit* programme was developed through the following steps: exploring adolescents' needs regarding weight control at school using focus groups (Chae et al., 2017), conducting a literature review, identifying the associations of weight control behaviours with body mass index in adolescents (Chae et al., 2018) and consulting with school health professionals, including a school principal, physical education teachers, a school nurse and a school dietician. The adolescents suggested a school-based weight control programme wherein all students are encouraged to participate regardless of their weight to prevent stigma associated with overweight or obesity (Chae et al., 2017). In the programme development process, the school health professionals reviewed and provided feedback on the programme content, especially physical activity, healthy dietary behaviours and health behaviours of adolescents.

The *We Fit* programme was developed using the transtheoretical model, which is an integrative framework used to assess an individual's state of health behaviour and to provide strategies to encourage

transitions to healthy behaviours (Prochaska & DiClemente, 2005). The adolescents were assessed to identify their stage of change for weight control pre-intervention and were provided with different interventions accordingly. The adolescents in the stages of pre-contemplation (no intention to control weight) and contemplation (planning to control weight within the next 6 months) were grouped together, and those in the stages of action (actively trying to control weight or having succeeded in weight control for less than 6 months) and maintenance (success in maintaining the desired weight for more than 6 months) were allocated to another group.

The *We Fit* programme included exergaming (playing active video games), a diet diary and counselling, health education and small group discussions via social networking services (SNS). The topics of health education and the small group discussions were targeted to improve processes of change for weight control (Prochaska et al., 1992).

The adolescents played the recommended types of exergaming according to their stage of change for 30 min three times weekly during their lunch break and two times weekly in the regular physical education class. The programme used Nintendo® Wii Sports (bowling, boxing, tennis, cycling, table tennis and basketball). The pre-contemplation/contemplation group played low-intensity sports, such as bowling, tennis and table tennis, while the action/maintenance group played high-intensity sports, such as boxing and basketball. They also kept a 24-hr diet diary twice a week (one weekday and one weekend day) and received individual nutritional counselling by the research team members using text messages every week. Health education on lifestyle factors was provided according to the stage of change groups, including one classroom lesson by the school nurse for 50 min and weekly interactive small group discussions via SNS on aspects of healthy lifestyles or health topics. The SNS discussion groups included 6–11 adolescents, and one research assistant assigned to each group facilitated the discussions and provided answers and information that the adolescents requested.

3.6 | Measurements

3.6.1 | General characteristics

Sociodemographic variables were self-reported using a questionnaire including sex, school year, age, socioeconomic status and academic performance. The stage of change for weight control (O'Connell & Velicer, 1988) was measured using a Korean translation (Chae et al., 2010). This measurement assesses respondents' intent and recent activities for weight control, and consists of four items with "yes" or "no" responses. Based on the results, participants were categorized as being in the pre-contemplation, contemplation, action or maintenance stage.

3.6.2 | Anthropometric and physiological factors

As anthropometric measures, height, weight, skeletal muscle mass, body fat and body mass index (BMI) were measured using InBody

J10 (Biospace Co., Ltd., Seoul, South Korea). Waist circumference was measured using a Tanita retractable ruler. The following physiological factors were measured using the Cholestech LDX® Analyzer, which has shown acceptable performance for measuring lipids (Panz et al., 2005): high-density lipoprotein (HDL) cholesterol, low-density lipoprotein (LDL) cholesterol, total cholesterol, triglyceride and glucose levels. The participants were asked to fast after breakfast or lunch for at least 4 hr before the blood test. Capillary blood samples were obtained using a capillary tube after a fingerstick. All measurements were performed in a designated room at school by qualified research assistants who were licensed registered nurses.

3.6.3 | Physical activity

Physical activity was assessed in terms of adolescents' daily step counts and daily sitting time. The daily step counts were measured using a Fitbit Zip, a pedometer that is considered to be relatively accurate in a school environment (Mooses et al., 2018), for an 8-day period at the baseline and 12-week follow-up. Daily sitting time was also measured by asking the participants how many hours they spent sitting per day.

3.6.4 | Programme satisfaction

Programme satisfaction was assessed in the intervention group three weeks after programme completion, using five open-ended questions: (i) What changes have occurred in your dietary behaviours after participating in the programme? (ii) What changes have occurred in your physical activity after participating in the programme? (iii) What is your plan for maintaining healthy weight control? (iv) What was the most helpful thing in this programme? and (v) What was the most disappointing thing in this programme?

3.7 | Data analysis

All statistical analyses were performed using STATA v14.0. The Kolmogorov–Smirnov test was performed to assess the normality of the variables. Some variables were not normally distributed. Descriptive parameters, including mean, standard deviation and percentage, were used to describe the distributions of demographic data. The chi-square and Mann-Whitney U tests for categorical variables and the Student's t test for continuous variables were used to test for homogeneity between the intervention and control groups. The effects of group, time and group-by-time interactions between the groups were verified using generalized estimating equations (GEEs) to examine the effect of the intervention on the outcomes. A GEE model is designed to analyse repeatedly measured outcome variables in longitudinal data (Ballinger, 2004). After adjusting for age, the patterns of the variables over time

between the control group and the intervention group were analysed. Data of dropouts were excluded from the analysis. Missing data for physical activity were processed by individual-centred data replacement to avoid significantly changing the characteristics of the group data. After classifying a student's weekday step counts and weekend data, missing data were replaced with the average of the student's weekday or weekend step counts, as appropriate (Rowe et al., 2004). A p-value <.05 was considered to indicate statistical significance.

To analyse the qualitative data on programme satisfaction, we also conducted matrix analysis, which is useful for a more integrated understanding of a wide range of qualitative data (Miles & Huberman, 1994). A matrix is a data display method that visualizes data systematically using the set of terms arranged in rows and columns. The matrix in this study included the questions and their responses in rows and columns, respectively, and results were drawn from the matrix.

4 | RESULTS

4.1 | General characteristics of the participants

Of the 109 adolescents who participated in this study, 59 (54.1%) were females and 50 (45.9%) were males, with a mean age of 15.7 years (standard deviation [SD] = 0.61) and 16.0 years (SD = 0.71), respectively. Fifty-four (49.5%) were 10th-grade students and 55 (50.5%) were 11th-grade students (Table 1).

4.2 | Homogeneity of the two groups

Homogeneity testing of the general characteristics between the experimental and control groups only showed a statistically significant difference in age (t = −2.53, p = .013) (Table 1). Accordingly, age was adjusted as a covariate for further analysis. Homogeneity testing of the study variables at baseline showed significant between-group differences in BMI (t = 2.56, p = .012), triglyceride levels (t = 2.44, p = .016), weekday steps (t = 2.45, p = .016) and weekday sitting time (U = 1042.00, p = .008) (Table 2).

4.3 | Summary of the study variables at baseline and post-intervention

Table 2 summarizes the anthropometric and physiological factors and physical activity in both groups. Waist circumference increased in the control from 71.40 cm (SD = 10.36) to 75.85 cm (SD = 11.38) after 12 weeks, while it decreased to 70.88 cm (SD = 7.56) from 72.32 cm (SD = 7.63) in the intervention group. Skeletal muscle mass increased in the intervention from 24.42 kg (SD = 5.93) to 24.88 kg (SD = 5.96), while it decreased in the control group to 25.01 kg (SD = 6.09) from 25.44 kg (SD = 6.07). HDL-cholesterol

in the control group decreased to 49.53 mg/dl (SD = 15.95) from 52.04 mg/dl (SD = 12.09), whereas it increased from 53.26 mg/dl (SD = 20.96) to 58.12 mg/dl (SD = 15.32) in the intervention group. LDL-cholesterol in the control group also steeply increased from 73.28 mg/dl (SD = 20.53) to 84.28 mg/dl (SD = 17.97).

The daily step counts on weekends were remarkably lower than on weekdays in both groups. The weekend steps increased from 5,656.78 (SD = 2,383.88) to 7,711.60 (SD = 3,729.99) steps/day in the intervention group and from 6,360.35 (SD = 3,418.64) to 7,619.71 (SD = 3,607.68) steps/day in the control group. Weekend sitting time increased in the control group from 639.15 (SD = 253.78) to 738.98 min/day (SD = 269.62), whereas it decreased in the intervention group from 662.69 (SD = 234.65) to 601.80 (SD = 235.71) min/day.

4.4 | Effects of the *We Fit* weight control programme on the study variables

The post-intervention changes in each group are shown in Table 3. The GEE analysis revealed significant differences between the groups over time in skeletal muscle mass (β = 0.90, p = .030), waist circumference (β = −5.89, p < .001), HDL-cholesterol (β = 7.14, p = .037), LDL-cholesterol (β = −9.54, p = .014) and weekend sitting time (β = −158.80, p = .003) (Table 3, Figure 2).

Significant group and time interactions were found for skeletal muscle mass (β = 0.90, p = .030) and waist circumference (β = −5.89, p < .001). For HDL-cholesterol and LDL-cholesterol, group and time interactions were also significant. HDL-cholesterol increased over time in the intervention group, while it decreased in the control group, with a significant between-group difference (β = 7.14, p = .037). There was no significant change in LDL-cholesterol in the intervention group over time, but LDL levels increased in the control group, with a significant between-group difference (β = −9.54, p = .014). Weekend daily sitting time significantly decreased over time in the intervention group compared with the control group (β = −158.80, p = .003).

4.5 | Programme satisfaction

Of the 60 adolescents in the intervention group, 59 (excluding one student who transferred to another school) answered the programme satisfaction survey. Forty-three respondents (73%) reported positive changes in their eating habits. They stated that they ate three meals a day more regularly, chose a nutritionally balanced diet and increased their vegetable and fruit consumption. The adolescents also described less consumption of greasy or flour-based foods and snacks after participating in the programme than before. Thirty-one adolescents (53%) answered that they would try to avoid unhealthy eating habits, such as having night-time snacks, and stated that they would practise healthy diet behaviours. *"Starving is not a good method of losing weight, so I will try to exercise more. Also, I will not*

TABLE 1 General characteristics of the participants (N = 109)

	Control group (N = 59)	Intervention group (N = 50)	χ^2 or t (p-value)
	N (%) or mean (SD)	N (%) or mean (SD)	
Sex			
Female	32 (54.2)	27 (54.0)	.00 (.980)
Male	27 (45.8)	23 (46.0)	
School year			
10th grade	29 (49.2)	25 (50.0)	.01 (.930)
11th grade	30 (50.8)	25 (50.0)	
Age (years)			
	15.7 (0.61)	16.0 (0.71)	−2.53 (.013)
Socioeconomic status			
Low	4 (6.8)	2 (4.0)	.41 (.814)
Middle	40 (67.8)	35 (70)	
High	15 (25.4)	12 (24)	
Academic performance			
Low	3 (5.1)	3 (6.0)	3.08 (.545)
Middle-low	15 (25.4)	13 (26.0)	
Middle	15 (25.4)	18 (36.0)	
Middle-high	12 (20.3)	10 (20.0)	
High	14 (23.7)	6 (12.0)	
Stages of Change			
Pre-contemplation	29 (49.1)	24 (48.0)	3.56 (.313)
Contemplation	17 (28.8)	11 (22.0)	
Action	4 (6.8)	9 (18.0)	
Maintenance	9 (15.3)	6 (12.0)	

Abbreviations: N, number of respondents; SD, standard deviation.

have late-night snacks (ID 58)." "I became more conscious of my eating habits, and now I eat instant noodles less often (ID 9)."

Thirty-four adolescents (58%) reported a recent increase in the time and effort they spent on physical activity, while 27 adolescents (46%) reported increased physical activity levels after participation in the programme, "Our high school life prevents us from exercising much, but when we played Nintendo Wii during the lunch break, I felt that my stress was relieved and my physical activity level increased (ID 49)."

The adolescents reported that playing Nintendo Wii Sports (37%, N = 22) and wearing a Fitbit (29%, N = 17) were the most helpful activities that motivated them to be physically active at school. "It was fun to play Nintendo with friends at lunch (ID 55)." "I didn't do anything after lunch before (participating in the program), but when I played Wii Sports, I became more active. Now I regularly run on the track with my friends after lunch (ID 57)."

Despite the advantages of Wii Sports, some adolescents described its limitations. Approximately 20% of the adolescents (N = 13) pointed out the low intensity of Wii Sports exercises and were doubtful about its effectiveness. They also reported that limited numbers of sports games were available and that a short time was allocated for playing Wii. "I felt like Wii Sports could be used only for upper body movements, especially the arms. So it would be a little insufficient to do 'exercise' with only Wii Sports (ID 31)."

5 | DISCUSSION

The 12-week We Fit programme resulted in decreased sitting time on weekends, increased HDL-cholesterol levels, decreased LDL-cholesterol levels, decreased waist circumference and increased skeletal muscle mass. These findings suggest that the We Fit

TABLE 2 Comparison of the study variables between the two groups

	Time variables	Mean (SD) Control (N = 59)	Intervention (N = 50)	t or U (p-value)
Anthropometric factors				
Body mass index (kg/m^2)	Baseline	22.79 (3.81)	21.17 (2.60)	2.56 (.012)
	Post-intervention	22.70 (3.88)	21.52 (2.69)	
Body fat (%)	Baseline	16.55 (7.81)	14.32 (5.60)	0.84 (.403)
	Post-intervention	16.96 (8.08)	14.92 (5.81)	
Skeletal muscle mass (kg)	Baseline	25.44 (6.07)	24.42 (5.93)	1325.00 (.362)
	Post-intervention	25.01 (6.09)	24.88 (5.96)	
Waist circumference (cm)	Baseline	71.40 (10.36)	72.32 (7.63)	1298.50 (.283)
	Post-intervention	75.85 (11.38)	70.88 (7.56)	
Physiological factors				
Blood glucose (mg/dl)	Baseline	94.83 (11.06)	96.63(25.13)	1259.00 (.250)
	Post-intervention	98.32 (16.67)	97.20 (10.78)	
Total cholesterol (mg/dl)	Baseline	154.51 (27.53)	157.36 (32.70)	1410.00 (.693)
	Post-intervention	161.40 (28.70)	160.00 (25.71)	
Triglyceride (mg/dl)	Baseline	149.48 (95.19)	110.26 (66.70)	2.44 (.016)
	Post-intervention	130.96 (77.53)	100.84 (42.06)	
HDL-cholesterol (mg/dl)	Baseline	52.04 (12.09)	53.26 (20.96)	−0.38 (.074)
	Post-intervention	49.53 (15.95)	58.12 (15.32)	
LDL-cholesterol (mg/dl)	Baseline	73.28 (20.53)	81.25 (24.45)	901.00 (.054)
	Post-intervention	84.28 (17.97)	82.60 (22.34)	
Physical activity				
Weekday steps/day	Baseline	10,522.52 (2,353.53)	9,213.59 (3,218.35)	2.45 (.016)
	Post-intervention	8,602.95 (3,067.03)	7,789.00 (3,265.10)	
Weekend steps/day	Baseline	6,360.35 (3,418.64)	5,656.78 (2,383.88)	1.13 (.262)
	Post-intervention	7,619.71 (3,607.68)	7,711.60 (3,729.99)	
Weekday sitting time (min/d)	Baseline	875.42 (207.51)	813.8 (144.09)	1042.00 (.008)
	Post-intervention	814.75 (189.99)	807.6 (180.80)	
Weekend sitting time (min/d)	Baseline	639.15 (253.78)	662.69 (234.65)	−0.50 (.621)
	Post-intervention	738.98 (269.62)	601.80 (235.71)	

Abbreviations: HDL, high-density lipoprotein; LDL, low-density lipoprotein; SD, standard deviation.

programme caused positive changes in adolescents' sedentary and dietary behaviours. In particular, an individualized approach to the adolescents through SNS was helpful as a way to give feedback and information on participants' diet and health behaviours, as well as to reward them for keeping diet diaries. A previous study also reported that using SNS for a nutritional intervention was effective in adolescents and early adults (Chau et al., 2018). SNS offers a unique and meaningful method of reaching out to adolescents (Park & Calamaro, 2013). Our results provide evidence that SNS can be useful for boosting the effectiveness of school-based weight control interventions in adolescents. The programme satisfaction survey showed that the We Fit programme changed dietary behaviours and increased adolescents' levels of physical activity, as 73% of adolescents reported dietary behavioural changes and

58% reported increased physical activity. The adolescents reported that they learned how to maintain a healthy diet through feedback on their diet diary. They also came to understand that healthy weight control involves both engaging in exercise and consuming a healthy diet, not fasting or restricting their food intake to lose weight.

The We Fit programme showed positive effects on physiological indicators and anthropometric measurements, demonstrating that it effectively promoted healthy weight control. HDL-cholesterol levels and skeletal muscle mass in the intervention group increased after participation in the programme, while they decreased in the control group. Increased HDL-cholesterol levels indicate reduced cardiovascular disease risk (Di Angelantonio et al., 2009; Lee et al., 2017). Adolescents with hyperlipidaemia are at risk of developing

TABLE 3 Effects of the intervention on the study variables

Variables	Post-intervention difference		Generalized estimating equations coefficient (*p-value*)		
	Control (N = 59)	Intervention (N = 50)	Time	Group	Time × Group
Anthropometric factors					
Body mass index (kg/m²)	−0.09	0.35	−0.09 (.733)	−1.46 (.032)	0.45 (.260)
Body fat (%)	0.41	0.60	0.41 (.362)	−1.80 (.204)	0.18 (0.781)
Skeletal muscle mass (kg)	−0.43	0.46	−0.43 (.122)	−1.02 (.405)	0.90 (.030)
Waist circumference (cm)	4.45	−1.44	4.45 (<0.001)	1.57 (.416)	−5.89 (<.001)
Physiological factors					
Blood glucose (mg/dl)	3.49	0.57	3.49 (.208)	2.70 (.415)	−2.92 (.477)
Total cholesterol (mg/dl)	6.89	2.64	6.34 (.052)	3.38 (.560)	−3.70 (.438)
Triglyceride (mg/dl)	−18.52	−9.42	−18.50 (.020)	−38.39 (.011)	9.08 (.435)
HDL-cholesterol (mg/dl)	−2.51	4.86	−2.28 (0.328)	0.82 (.801)	7.14 (.037)
LDL-cholesterol (mg/dl)	11.00	1.35	11.03 (<.001)	7.65 (.087)	−9.54 (.014)
Physical activity					
Weekday steps/day	−1919.57	−1424.59	−1919.57 (<.001)	−1329.51 (.026)	494.99 (.440)
Weekend steps/day	1259.36	2054.82	1250.64 (.039)	−375.60 (.598)	810.43 (.360)
Weekday sitting time (min/d)	−60.67	−6.20	−60.68 (.056)	−70.84 (.051)	54.48 (.245)
Weekend sitting time (min/d)	99.83	−60.89	99.83 (.005)	24.31 (.628)	−158.80 (.003)

Abbreviations: HDL, high-density lipoprotein; LDL, low-density lipoprotein.

cardiovascular disease or metabolic syndrome in adulthood (Daniels et al., 2011; Stewart et al., 2020). Muscle mass is also associated with metabolic risk in adolescents. Muscle mass plays a critical role in systemic glucose metabolism, and increased muscle mass reduces the risk of obesity (Kim et al., 2016).

The daily step count was used as an index of physical activity in this study. Increasing daily steps is easier than following an exercise regimen as a way to increase overall physical activity in adolescents (Woo, 2008). According to the 2010 World Health Organization recommendations, adolescents should spend more than 60 min daily performing moderate-to-vigorous physical activity (Kantanista et al., 2015), which is reported to be equivalent to an average of 10,000–11,700 steps/day (Tudor-Locke et al., 2011). Other studies have also recommended 12,000 steps/day (Colley et al., 2012) and 10,000 steps/day (Kim et al., 2005; Parra Saldías et al., 2018) for adolescents. In the present study, adolescents' daily step count was much lower than 10,000 steps/day. Furthermore, their daily sitting time was

10 hr or higher per day during the weekend and 13 hr or more on weekdays. The Physical Activity Guide for Koreans recommends less than 2 hr per day of sedentary behaviour for adolescents (Kim, 2012). However, Korean high school students spend most of their time sitting as they study for the college entrance examination (Shin et al., 2016). An intense focus on studying for college entrance examinations is also common in other Asian countries (Chen & Glaude, 2017). In addition, the high school curriculum in Korea generally focuses on the courses needed to prepare for the college entrance examination, and physical education is commonly neglected (Lee & Cho, 2014). Governmental support for adolescents should be developed to increase their physical activity as recommended by the guidelines (Kim, 2012). Adolescents' physical activity should be highlighted as they study for the college entrance examination, and sufficient time for physical activity should be maintained in the school curriculum.

In this study, the weekend step count in the control group was lower than their weekday step count; similarly, Shin et al. (2016)
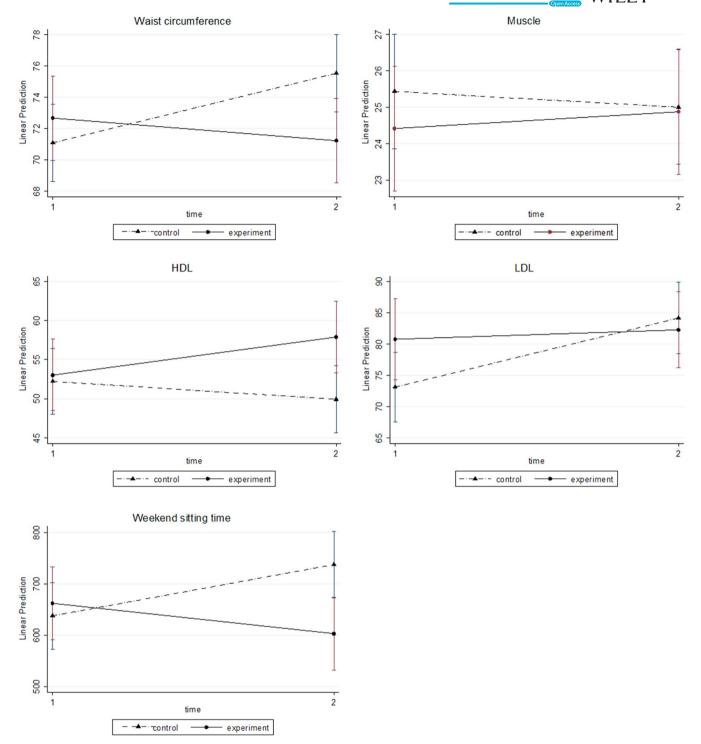
FIGURE 2   Changes of the variables over time in intervention and control groups

reported that Korean high school students had significantly higher weekday step counts (12,837 ± 3,653) than weekend step counts (6,661 ± 4,937). In contrast, the weekend step count of the intervention group in this study was approximately the same as their weekday step count (i.e. 7,800 steps) after participation in the programme. Furthermore, the intervention group showed a greater increase in their weekend step count and significantly less sitting time on the weekends after programme completion, compared with the control group. These results indicate that *We Fit* programme was effective for changing participants' sedentary behaviour at home on the weekend. These findings also imply that school-based interventions could improve participants' health behaviours at home, as well as at school.

Wii Sports was included in the intervention during lunchtime and physical education classes to increase adolescents' awareness of and interest in physical activity. Even though six different types of sports were provided based on participants' stages of change, no

difference in daily steps was found between the control and intervention groups. As shown by the satisfaction survey results, active video games like *Wii Sports* are helpful to motivate adolescents to participate in physical activity; however, their effects on physiological factors may not persist over time. A systematic review of the effectiveness of physical activity interventions using active video games reported that three out of 13 studies showed an effective increase in physical activity, while the others demonstrated inconsistent results, with no differences between the control and intervention groups or slightly increased physical activity in the control group (Peng et al., 2013). Some adolescents in this study stated that the exercise intensity of *Wii Sports* was insufficient. This is consistent with a previous study (Haddock et al., 2009; Roopchand-Martin & Nelson, 2016) reporting that children perceived the intensity of physical activity interventions using active video games as low, and university students perceived the intensity of treadmill running significantly higher than that of active video games (Roopchand-Martin & Nelson, 2016). Active video games may encourage participants to exercise but are not as vigorous as the treadmill (Xian et al., 2014). Nonetheless, the adolescents in this study enjoyed playing *Wii Sports* with their peers at school. A systematic review on active video games in children and youth reported that active video games offer opportunities for group play, helping to increase the acceptance and enjoyment of physical activities (Biddiss & Irwin, 2010). Therefore, active video games could be incorporated at the beginning of a school-based physical activity intervention to shift participants' sedentary lifestyle towards active participation in physical activity.

5.1 | Limitations and recommendations

The generalizability of these results is limited because the study was conducted at a single high school in South Korea. To confirm the effectiveness and sustainability of school-based weight control programmes, further studies should be conducted in various school settings. Another limitation of the current study is the reliance on self-report measures, with a possibility of recall and social desirability bias. A further limitation is the low-intensity exercises offered by *Wii Sports*; therefore, a physical programme with higher-intensity activities should be considered in the future.

This study used a non-synchronized design to prevent experimental treatment diffusion, testing the control group first and the intervention group later. Due to the long intervention period (12 weeks), it was not possible to examine both groups in the same semester. A previous study reported that college students' daily step count was affected by the timing of the survey in terms of season and semester (Suh, 2006), implying that this study's findings should be confirmed through research that would test both groups at the same time point. Lastly, this study did not use percentiles or Z-scores of growth parameters, since it examined changes in the study variables between the groups over time. We recommend that future studies should consider using percentiles or Z-scores of growth parameters in children in order to interpret their growth status.

6 | CONCLUSIONS

The *We Fit* programme, a school-based weight control programme, resulted in a significant decline in weekend sitting time, increased HDL-cholesterol, decreased LDL-cholesterol and increased muscle mass in adolescents. A school-based programme can be an effective way to improve adolescents' healthy weight control. This study also provides evidence supporting the applicability and effectiveness of exergaming and SNS in a school setting. School nurses could consider using these technological devices or services to deliver healthcare or health education. Teachers, including school nurses, should also recognize the importance of this programme and encourage students to participate in order to improve their healthy weight control behaviours. To successfully deliver a school-based weight control programme, schools need to prepare appropriate equipment, space and time for participation. Governmental support may be a crucial factor in implementing this intervention at schools.

CONFLICT OF INTEREST

There are no conflicts of interest to declare.

AUTHOR CONTRIBUTIONS

SMC designed the study and supervised all study projects. YJY and HJH carried out the school-based programme. HSK gave critical feedback and revised the manuscript. All four authors discussed the results and contributed to the final version of the manuscript. All authors meet at least one of the following criteria [recommended by the ICMJE (http://www.icmje.org/recommendations/)]: substantial contributions to conception and design, drafting the article or revising it critically for important intellectual content, final approval of the version to be published, agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

ETHICAL APPROVAL

This study was approved by the first author's institutional review board (IRB No. 1405/002-009).

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are not publicly available due to privacy or ethical restrictions.

ORCID

Sun-Mi Chae (iD) https://orcid.org/0000-0002-3010-2265
Ji-Young Yeo (iD) https://orcid.org/0000-0001-6375-4668
Ji-Hye Hwang (iD) https://orcid.org/0000-0002-1136-5481
Hee Sun Kang (iD) https://orcid.org/0000-0003-3808-306X

REFERENCES

Ballinger, G. A. (2004). Using generalized estimating equations for longitudinal data analysis. *Organizational Research Methods*, 7(2), 127–150. https://doi.org/10.1177/1094428104263672

Bauer, K. W., Neumark-Sztainer, D., Hannan, P. J., Fulkerson, J. A., & Story, M. (2011). Relationships between the family environment and school-based obesity prevention efforts: Can school programs help adolescents who are most in need? *Health Education Research*, 26(4), 675–688. https://doi.org/10.1093/her/cyr027

Biddiss, E., & Irwin, J. (2010). Active video games to promote physical activity in children and youth: A systematic review. *Archives of Pediatrics & Adolescent Medicine*, 164(7), 664–672. https://doi.org/10.1001/archpediatrics.2010.104

Boutelle, K. N., Hannan, P. J., Neumark-Sztainer, D., & Himes, J. H. (2007). Identification and correlates of weight loss in adolescents in a national sample. *Obesity*, 15(2), 473–482. https://doi.org/10.1038/oby.2007.501

Centers for Disease Control and Prevention. (2018). Strategies for classroom physical activity in schools (CDC Publication No. CS296182-A). https://schoolspringboard.org/wp-content/uploads/2018/11/ClassroomPAStrategies_508.pdf

Chae, S.-M., Kim, M. J., Park, C. G., Yeo, J.-Y., Hwang, J.-H., Kwon, I., & Han, S.-Y. (2018). Association of weight control behaviors with body mass index in Korean adolescents: A quantile regression approach. *Journal of Pediatric Nursing*, 40, e18–e25. https://doi.org/10.1016/j.pedn.2018.01.021

Chae, S.-M., Kwon, I., Kim, C.-J., & Jang, J. (2010). Analysis of weight control in Korean adolescents using the transtheoretical model. *Western Journal of Nursing Research*, 32(4), 511–529. https://doi.org/10.1177/0193945909355996

Chae, S.-M., Yeo, J.-Y., Hwang, J.-H., Lee, J.-H., Lim, J., & Kwon, I. (2017). Weight control in adolescents: Focus groups with Korean adolescents and their teachers. *Journal of Pediatric Nursing*, 33, 4–9. https://doi.org/10.1016/j.pedn.2016.12.003

Chau, M. M., Burgermaster, M., & Mamykina, L. (2018). The use of social media in nutrition interventions for adolescents and young adults—a systematic review. *International Journal of Medical Informatics*, 120, 77–91. https://doi.org/10.1016/j.ijmedinf.2018.10.001

Chen, X., & Glaude, M. W. (2017). Academic stress among chinese adolescents: Can psychological stress theory explain this tragedy? *International Journal of Humanities and Social Science*, 7(2), 17–25.

Colley, R. C., Janssen, I., & Tremblay, M. S. (2012). Daily step target to measure adherence to physical activity guidelines in children. *Medicine & Science in Sports & Exercise*, 44(5), 977–982. https://doi.org/10.1249/MSS.0b013e31823f23b1

Daniels, S. R., Pratt, C. A., & Hayman, L. L. (2011). Reduction of risk for cardiovascular disease in children and adolescents. *Circulation*, 124(15), 1673–1686. https://doi.org/10.1161/CIRCULATIONAHA.110.016170

Des Jarlais, D. C., Lyles, C., Crepaz, N., & the TREND Group. (2004). Improving the reporting quality of nonrandomized evaluations of behavioral and public health interventions: The TREND statement. *American Journal of Public Health*, 94(3), 361–366. https://doi.org/10.2105/AJPH.94.3.361

Deschamps, V., Salanave, B., Chan-Chee, C., Vernay, M., & Castetbon, K. (2015). Body-weight perception and related preoccupations in a large national sample of adolescents. *Pediatric Obesity*, 10(1), 15–22. https://doi.org/10.1111/j.2047-6310.2013.00211.x

Di Angelantonio, E., Sarwar, N., Perry, P., Kaptoge, S., Ray, K. K., Thompson, A., Wood, A. M., Lewington, S., Sattar, N., Packard, C. J., Collins, R., Thompson, S. G., & Danesh, J. (2009). Major lipids, apolipoproteins, and risk of vascular disease. *JAMA*, 302(18), 1993–2000. https://doi.org/10.1001/jama.2009.1619

Dues, K., Kandiah, J., Khubchandani, J., & Haroldson, A. (2020). Adolescent body weight perception: Association with diet and physical activity behaviors. *The Journal of School Nursing*, 36(5), 339–347. https://doi.org/10.1177/1059840518824386

Haddock, B. L., Siegel, S. R., & Wikin, L. D. (2009). The addition of a video game to stationary cycling: The impact on energy expenditure in overweight children. *The Open Sports Sciences Journal*, 2, 42–46. https://doi.org/10.2174/1875399X00902010042

Kantanista, A., Król-Zielińska, M., Borowiec, J., Glapa, A., Lisowski, P., & Bronikowski, M. (2015). Physical activity of female children and adolescents based on step counts: Meeting the recommendation and relation to BMI. *Biomedical Human Kinetics*, 7, 1–8. https://doi.org/10.1515/bhk-2015-0011

Kim, K., Hong, S., & Kim, E. Y. (2016). Reference values of skeletal muscle mass for Korean children and adolescents using data from the Korean national health and nutrition examination survey 2009–2011. *PLoS One*, 11(4), e0153383. https://doi.org/10.1371/journal.pone.0153383

Kim, S.-H., Lee, J.-P., & Oh, J.-K. (2005). Relationship between steps per day and obesity index in middle-school girls. *Journal of Korean Association of Physical Education and Sport for Girls and Women*, 19(1), 67–75.

Kim, Y. (2012). *Development of physical activity guidelines and self-prescription guides for Korean* (Health Promotion Research Report, Vol. No. 12–37). Korea Health Promotion Institution.

Leal, G. V. S., Philippi, S. T., & Alvarenga, M. S. (2020). Unhealthy weight control behaviors, disordered eating, and body image dissatisfaction in adolescents from São Paulo, Brazil. *Brazilian Journal of Psychiatry*, 42(3), 264–270. https://doi.org/10.1590/1516-4446-2019-0437

Lee, J. S., Chang, P.-Y., Zhang, Y., Kizer, J. R., Best, L. G., & Howard, B. V. (2017). Triglyceride and HDL-C dyslipidemia and risks of coronary heart disease and ischemic stroke by glycemic dysregulation status: The strong heart study. *Diabetes Care*, 40(4), 529–537. https://doi.org/10.2337/dc16-1958

Lee, K.-C., & Cho, S.-M. (2014). The Korean national curriculum for physical education: A shift from edge to central subject. *Physical Education and Sport Pedagogy*, 19(5), 522–532. https://doi.org/10.1080/17408989.2014.915299

Maddison, R., Mhurchu, C. N., Jull, A., Jiang, Y., Prapavessis, H., & Rodgers, A. (2007). Energy expended playing video console games: An opportunity to increase children's physical activity? *Pediatric Exercise Science*, 19(3), 334–343. https://doi.org/10.1123/pes.19.3.334

Marker, A. M., Steele, R. G., & Noser, A. E. (2018). Physical activity and health-related quality of life in children and adolescents: A systematic review and meta-analysis. *Health Psychology*, 37(10), 893–903. https://doi.org/10.1037/hea0000653

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook*, 2nd ed. Sage.

Mooses, K., Oja, M., Reisberg, S., Vilo, J., & Kull, M. (2018). Validating Fitbit Zip for monitoring physical activity of children in school: A cross-sectional study. *BMC Public Health*, 18, 858. https://doi.org/10.1186/s12889-018-5752-7

Nagata, J. M., Garber, A. K., Tabler, J. L., Murray, S. B., & Bibbins-Domingo, K. (2018). Differential risk factors for unhealthy weight control behaviors by sex and weight status among U.S. adolescents. *Journal of Adolescent Health*, 63(3), 335–341. https://doi.org/10.1016/j.jadohealth.2018.03.022

O'Connell, D., & Velicer, W. F. (1988). A decisional balance measure and the stages of change model for weight loss. *The International Journal of the Addictions*, 23(7), 729–750. https://doi.org/10.3109/10826088809058836

Panz, V. R., Raal, F. J., Paiker, J., Immelman, R., & Miles, H. (2005). Performance of the CardioChek[TM] PA and Cholestech LDX[®] point-of-care analysers compared to clinical diagnostic laboratory methods for the measurement of lipids: Cardiovascular topic. *Cardiovascular Journal of South Africa*, *16*(2), 112–116. https://doi.org/10.10520/EJC23980

Park, B. K., & Calamaro, C. (2013). A systematic review of social networking sites: Innovative platforms for health research targeting adolescents and young adults. *Journal of Nursing Scholarship*, *45*(3), 256–264. https://doi.org/10.1111/jnu.12032

Parra Saldías, M., Mayorga-Vega, D., López-Fernández, I., & Viciana, J. (2018). How many daily steps are really enough for adolescents? A cross-validation study. *Retos: Nuevas Tendencias En Educación Física. Deporte Y Recreación*, *33*, 241–246.

Patton, G. C., Sawyer, S. M., Santelli, J. S., Ross, D. A., Afifi, R., Allen, N. B., Arora, M., Azzopardi, P., Baldwin, W., Bonell, C., Kakuma, R., Kennedy, E., Mahon, J., McGovern, T., Mokdad, A. H., Patel, V., Petroni, S., Reavley, N., Taiwo, K., ... Viner, R. M. (2016). Our future: A Lancet commission on adolescent health and wellbeing. *The Lancet*, *387*(10036), 2423–2478. https://doi.org/10.1016/S0140-6736(16)00579-1

Peng, W., Crouse, J. C., & Lin, J.-H. (2013). Using active video games for physical activity promotion: A systematic review of the current state of research. *Health Education & Behavior*, *40*(2), 171–192. https://doi.org/10.1177/1090198112444956

Prochaska, J. O., & DiClemente, C. C. (2005). The transtheoretical approach. In J. C. Norcross, & M. R. Goldfried (Eds.), *Handbook of psychotherapy integration*, 2nd ed. Oxford University Press.

Prochaska, J. O., Norcross, J. C., Fowler, J. L., Follick, M. J., & Abrams, D. B. (1992). Attendance and outcome in a work site weight control program: Processes and stages of change as process and predictor variables. *Addictive Behaviors*, *17*(1), 35–45. https://doi.org/10.1016/0306-4603(92)90051-V

Qin, T.-T., Xiong, H.-G., Yan, M.-M., Sun, T., Qian, L., & Yin, P. (2019). Body weight misperception and weight disorders among Chinese children and adolescents: A latent class analysis. *Current Medical Science*, *39*(5), 852–862. https://doi.org/10.1007/s11596-019-2116-1

Rodriguez-Ayllon, M., Cadenas-Sánchez, C., Estévez-López, F., Muñoz, N. E., Mora-Gonzalez, J., Migueles, J. H., Molina-García, P., Henriksson, H., Mena-Molina, A., Martínez-Vizcaíno, V., Catena, A., Löf, M., Erickson, K. I., Lubans, D. R., Ortega, F. B., & Esteban-Cornejo, I. (2019). Role of physical activity and sedentary behavior in the mental health of preschoolers, children and adolescents: A systematic review and meta-analysis. *Sports Medicine*, *49*, 1383–1410. https://doi.org/10.1007/s40279-019-01099-5

Roopchand-Martin, S., & Nelson, G. A. (2016). Is the WII fit free run activity a feasible mode of exercise for regular exercisers: A comparison with treadmill running? *The Journal of Sports Medicine & Physical Fitness*, *56*(10), 1120–1124.

Rowe, D. A., Mahar, M. T., Raedeke, T. D., & Lore, J. (2004). Measuring physical activity in children with pedometers: Reliability, reactivity, and replacement of missing data. *Pediatric Exercise Science*, *16*(4), 343–354. https://doi.org/10.1123/pes.16.4.343

Salam, R. A., Padhani, Z. A., Das, J. K., Shaikh, A. Y., Hoodbhoy, Z., Jeelani, S. M., Lassi, Z. S., & Bhutta, Z. A. (2020). Effects of lifestyle modification interventions to prevent and manage child and adolescent obesity: A systematic review and meta-analysis. *Nutrients*, *12*(8), 2208. https://doi.org/10.3390/nu12082208

Salvy, S.-J., & Bowker, J. C. (2014). Peers and obesity during childhood and adolescence: A review of the empirical research on peers, eating, and physical activity. *Journal of Obesity & Weight Loss Therapy*, *4*(1), 207. https://doi.org/10.4172/2165-7904.1000207

Sheehan, D., & Katz, L. (2012). The practical and theoretical implications of flow theory and intrinsic motivation in designing and implementing exergaming in the school environment. *Loading... The Journal of the Canadian Game Studies Association*, *6*(9), 53–68.

Shin, H. M., Jeon, J. H., & Kim, E.-K. (2016). Assessment of pedometer counts, physical activity level, energy expenditure, and energy balance of weekdays and weekend in male high school students. *Journal of the Korean Dietetic Association*, *22*(2), 131–142. https://doi.org/10.14373/JKDA.2016.22.2.131

Sparling, P. B., Franklin, B. A., & Hill, J. O. (2013). Energy balance: The key to a unified message on diet and physical activity. *Journal of Cardiopulmonary Rehabilitation and Prevention*, *33*(1), 12–15. https://doi.org/10.1097/HCR.0b013e3182721568

Staiano, A. E., & Calvert, S. L. (2011). Exergames for physical education courses: Physical, social, and cognitive benefits. *Child Development Perspectives*, *5*(2), 93–98. https://doi.org/10.1111/j.1750-8606.2011.00162.x

Stewart, J., McCallin, T., Martinez, J., Chacko, S., & Yusuf, S. (2020). Hyperlipidemia. *Pediatrics in Review*, *41*(8), 393–402. https://doi.org/10.1542/pir.2019-0053

Suh, B. D. (2006). Influencing factors of exercise behavior change in nursing students. *Korean Journal of Adult Nursing*, *18*(4), 573–581.

Tudor-Locke, C., Craig, C. L., Beets, M. W., Belton, S., Cardon, G. M., Duncan, S., Hatano, Y., Lubans, D. R., Olds, T. S., Raustorp, A., Rowe, D. A., Spence, J. C., Tanaka, S., & Blair, S. N. (2011). How many steps/day are enough? for children and adolescents. *International Journal of Behavioral Nutrition and Physical Activity*, *8*, 78. https://doi.org/10.1186/1479-5868-8-78

Unnithan, V. B., Houser, W., & Fernhall, B. (2006). Evaluation of the energy cost of playing a dance simulation video game in overweight and non-overweight children and adolescents. *International Journal of Sports Medicine*, *27*(10), 804–809. https://doi.org/10.1055/s-2005-872964

Wang, W.-Y., Hsieh, Y.-L., Hsueh, M.-C., Liu, Y., & Liao, Y. (2019). Accelerometer-measured physical activity and sedentary behavior patterns in Taiwanese adolescents. *International Journal of Environmental Research and Public Health*, *16*(22), 4392. https://doi.org/10.3390/ijerph16224392

Woo, U. H. (2008). Comparison and analysis of physical activity steps per day according to the level of BMI in high school male students. *The Korean Journal of Growth and Development*, *16*(2), 103–110.

Xian, Y., Kakinami, L., Peterson, E. D., Mustian, K. M., & Fernandez, I. D. (2014). Will Nintendo "Wii Fit" get you fit? An evaluation of the energy expenditure from active-play videogames. *Games for Health Journal*, *3*(2), 86–91. https://doi.org/10.1089/g4h.2013.0078