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Effects of a School-Based Health Education for Cardiovascular Disease Prevention Among High School Girls

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Purpose: We aimed to evaluate effects of a school-based health education for cardiovascular disease (CVD) prevention among high school girls.
Methods: Non-randomized cluster trial was conducted by recruiting two female high schools located in Seoul and allocating one school as a cluster to an experimental group and the other school as the other cluster to a control group. Participants were 169 first-year female high school students in two clusters. Of the participants, 84 were recruited in the experimental group and 85 in the control group. An intervention was an eight-week "School-based Health Education for CVD prevention". The experimental group received the intervention, while the control group received a CVD prevention handout. Measures were knowledge, self-efficacy, and health behaviors for CVD prevention. The pre-test and post-test were conducted.
Results: The experimental group participating in "School-Based Health Education for CVD Prevention" had significantly higher changes in knowledge, self-efficacy scores to prevent CVD, and health behaviors than the control group over eight weeks.
Conclusions: The "School-based Health Education for CVD Prevention" program may improve high school students' knowledge and self-efficacy as determinants of health behaviors as well as health behaviors to prevent cardiovascular disease.

Keywords: Cardiovascular diseases; School nursing; Health education, Knowledge, Self efficacy

Introduction

The death rate from chronic diseases accounts for approximately 70% of the total global death rate, and the rate has been on the rise [1]. The death rate from cardiovascular diseases accounts for the majority of the death rate from chronic diseases [1]. In particular, there were 5.7 million cases of cardiovascular disease-related events and 761,458 deaths among adolescents and young adults worldwide in 2019. Compared to 1990 year, the number of the cases and deaths increased by 45.5% and 21.6%, respectively, indicating that the burden of cardiovascular disease among adolescents and young adults has increased significantly [2].

Cardiovascular disease is preventable because the risk factors of cardiovascular diseases are well known [3]. Of the risk factors, behavioral factors such as smoking, unhealthy eating habits, physical inactivity, and obesity are crucial to be modified for preventing cardiovascular diseases [3]. On the other hand, exposure to cardiovascular disease risk in childhood and adolescence is known to lead to a higher risk of developing cardiovascular diseases in adulthood [4]. In other words, cardiovascular risk factors in childhood may be directly and indirectly related to the development of cardiovascular disease in adulthood [5]. A report that reviewed 210 papers also showed that exposure to risk factors in childhood was strongly associated with the occurrence of cardiovascular disease in adulthood [6]. This link urges effective interventions during childhood for preventing cardiovascular risk fac-

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tors and enhancing healthy behaviors [7]. In this context, it is urgent to prepare and develop population-based community strategies to lower the risk of cardiovascular diseases in the child and adolescent population, and to actively prevent them. As one of the population-based strategies, initiatives for the prevention and management of cardiovascular risk factors should be considered in school-based health education.

The high school years are the last years of regular education; high school students show the highest comprehension level of knowledge through learning at the time of passage to young adulthood and can well cultivate health behaviors through regular health education sessions [8]. The cultivated health behaviors during this time may influence their health behavior throughout entire life, from the early adulthood stage to the early middle age, and further to the older adulthood [9]. Adolescents who receive health education in school have shown higher levels of health awareness and higher rates of health behaviors with a lower likelihood of showing health risk behaviors [10]. However, compared to elementary and middle school students, high school students buckle down to university entrance exam preparations, and so health education is often excluded from the regular curriculum, leading to the negligence of healthy behavioral practice and health promotion of school-age children [11]. Despite such circumstances, high schools have professional personnel and facilities to implement school-based health education such as school health teachers. Base on this, there is high educational effectiveness [12] and, in other words, there have been studies to the effectiveness of health education operated by school health teachers during years of high school [13]. In this context, if systematic school-based health education for cardiovascular disease prevention is implemented during years of high school, students may develop better health behaviors for cardiovascular disease prevention, develop basic knowledge and skills for cardiovascular disease prevention and eventually contribute to the health promotion of the adult population.

Meanwhile, there are several highlights to be noted for female high school students rather than male students in terms of health behavior practices. Smoking rates among young women in their 20s has increased rapidly to 8.3% by 2021 [14] over the five years in South Korea, and, furthermore, smoking-related morbidity and mortality may be more vulnerable to adult women than adult men [15]. The prevalence of physical activity on more than five days per week among first-year high school girls was found to be remarkably lower (i.e., 6.9% in 2023) than first-year high school boys (20.6%) [16]. Additionally, its prevalence among first-year middle school girls was found to be 13.1%, which decreased to approximately half of the percentage by the time they entered high school; girls were also found to passively participate in physical activities in school with low interest in physical education classes [17]. Regarding desirable eating habits, female students were also more likely to skip breakfast compared to male students, and obesity rates among first-year high school girls increased significantly from 5.1% in 2014 to 9.2% in 2023 [16]. These changes in health behaviors may contribute a likelihood of higher risk for cardiovascular diseases [18]. Furthermore, when women reach middle age, menopause leads to intra-abdominal fat accumulation from reduced estrogen levels and an increased risk for cardiovascular diseases [19]. Thus, it is necessary to conduct studies targeting healthy high school girls without cardiovascular diseases in their adolescence to raise awareness of the risk factors and strengthen health behavior practices within the health education system. However, there have been little information on the effects of school-based health education with a focus on cardiovascular disease prevention in South Korea.

School-based health education has been known to have positive effects on health-related knowledge and self-efficacy [13]; knowledge and self-efficacy are important determinants of behavior; higher knowledge and self-efficacy were found to be related to more positive health behavior and less risky behaviors [20]. In South Korea, studies regarding cardiovascular disease prevention education have mostly target middle-aged women rather than women in adolescence [21,22]. On the other hand, in other countries, school-based interventions have been conducted to lower cardiovascular disease risks among adolescents in order to provide evidence on the effectiveness of health education or interventions with an emphasis on cardiovascular disease prevention [23-25]. Therefore, it is necessary to verify whether school-based health education for cardiovascular disease prevention in South Korea has positive impacts on students' knowledge, self-efficacy, and health behaviors for cardiovascular disease prevention.

Study purpose

This study aimed to test the effects of "School-Based Health Education for Cardiovascular Disease Prevention" on knowledge, self-efficacy, and health behaviors for cardiovascular disease prevention among female students in a high school in Seoul, South Korea.

Study hypotheses

The hypotheses of this study are as follows. [Hypothesis 1] The experimental group that participated in the eight-week "School-

Based Health Education for Cardiovascular Disease Prevention" would have a higher score on 'knowledge' for cardiovascular disease prevention after eight weeks compared to the control group. [Hypothesis 2] The experimental group that participated in the eight-week "School-Based Health Education for Cardiovascular Disease Prevention" would have a higher score on 'self-efficacy' for cardiovascular disease prevention after eight weeks compared to the control group. [Hypothesis 3] The experimental group that participated in the eight-week "School-Based Health Education for Cardiovascular Disease Prevention" would have a higher score on 'health behaviors' for cardiovascular disease prevention after eight weeks compared to the control group.

Methods

Study design

This study was conducted as a non-randomized cluster trial design. Researchers of this study performed a convenience sampling of two clusters by targeting two co-educational high schools in Seoul (Figure 1). First, one school cluster was assigned as an experimental group, and it was the school where the first author in the study was employed as a school health teacher. Another school cluster was similar to the experimental group considering co-educational status, number of students, and the fact that it provided mandatory health education for first-year high school students, and was assigned as a control group. The intervention of "School-Based Health Education for Cardiovascular Disease Prevention" was applied to the experimental group, whereas the control group was requested to read a handout on cardiovascular prevention. Participants were enrolled in the study for a total of eight weeks of regular health education classes. The pretest and posttest were all performed for both groups. The pretest was performed one week before the intervention was initiated, and the posttest was applied one week after the intervention was completed.

Participants

This study targeted first-year female high school students in two high schools located in Seoul. One hundred sixty-nine (N = 169) female students were finally sampled. We selected first-year female high school students because they are the least influenced by university entrance exams, may have benefits of health educa-

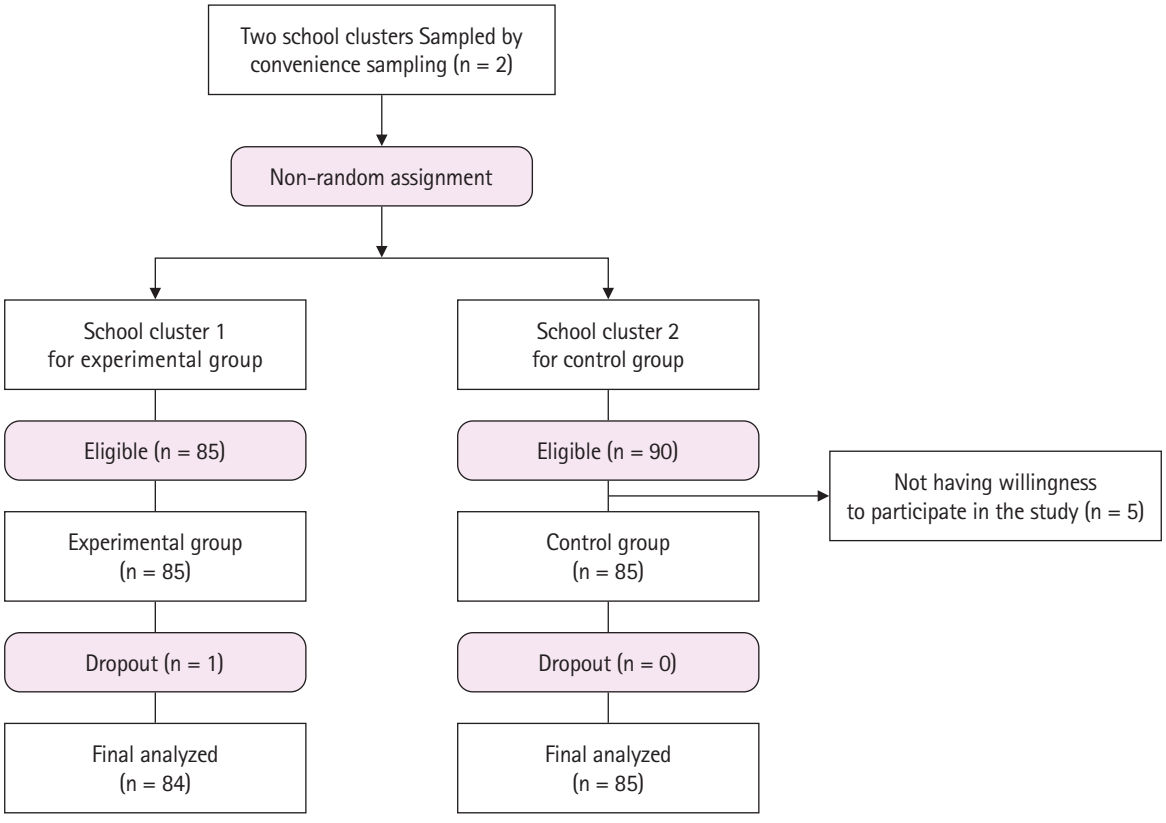


Figure 1. Participants' flow in the study.

tion over high school time, and take regular health classes run by a health teacher. The following students were excluded from this study: students who were suffering from cardiovascular diseases, those who could not continuously participate in this research due to transfer to another school, and dropping schools.

The minimum sample size was calculated based on the effect size from Park (2019)'s study that used the same primary outcome (i.e., health behavior) as the present study did [26]. Sample size of study participants via the G-power program, based on the formula with a two-sided significance level (α) of 0.05, a test power (1-β) of 95%, an effect size of 0.66 between groups, and a standard deviation of the change in the primary outcome variable by group (experimental group 0.443, control group 0.533). Considering a 20% dropout rate, we finally calculated the experimental groups and the control groups consisting of 85 participants, respectively.

Considering the total number of female high school students in the experimental and control groups (85 participants in the experimental group and 90 participants in the control group) (Figure 1), we tried to accommodate all students who had a willingness to participate in this study, and selected 85 students from the experimental group school and 85 students from the control group school. Among them, 84 students in the experimental group and 85 students in the control group were finally selected for the analysis except for one student who dropped out the study due to a health problem.

Intervention: "School-based health education for cardiovascular disease prevention"

The intervention details of "School-Based Health Education for Cardiovascular Disease Prevention" are described in Table 1. The specific details were constructed based on the literature review and reviews by three fellow school health teachers and one professor of nursing who is an expert in cardiovascular disease prevention. The content is based on the high school health textbook, which is an approved textbook according to the revised curriculum, and the American Heart Association's Life's Essential 8 [27]. The first author and corresponding author as a nursing professor prepared a draft of intervention components based on the above references [28] and reviewed the content validity of the intervention components with three health teachers to determine whether it was practically appropriate. The content validity was measured using a validity verification questionnaire to determine whether the intervention components (learning content, learning materials, activity content, topic relevance, and target suitability) were appropriate for improving knowledge, self-efficacy, and health behaviors for preventing cardiovascular diseases using a four-point Likert scale. The coefficient of validity (CVI) was calculated by calculating the number of responses that were 3 or higher. All components were confirmed to be valid with a CVI of 0.8 or higher [29].

The purpose of the intervention was to improve high school students' knowledge, self-efficacy, and health behaviors for cardiovascular disease prevention. Four topics of the intervention were selected: understanding of cardiovascular diseases, causes of cardiovascular diseases, types of behaviors to prevent cardiovascular diseases (e.g., non-smoking, non-drinking, healthy eating habits, and increased physical activity), and health behaviors. The duration of the intervention consisted of eight sessions over eight weeks with one session per week. The intervention modes proceeded with face-to-face education, and experiential activities, group discussions, and role-playing were applied to each topic.

The specific intervention content per session is as follows (Table 1). In the first session, we presented the definition of cardiovascular diseases, related statistics, and the importance of its prevention. We lectured on the development process and risk factors of cardiovascular diseases, as well as symptoms and treatment methods. We provided the current status and causes of adolescents' alcohol use, and the current state of drinking behavior in the second session. The session proceeded with the topics about the relationship between alcohol drinking and cardiovascular diseases, mental health problems, injuries, and accidents generated from alcohol consumption. In the third session, students discussed the drinking culture in South Korea and conducted role-playing activities on how to act and react in a situation where drinking is forced as a countermeasure to handle adolescents' alcohol use. In the fourth session, we suggested the current status and causes of adolescents' smoking as well as the current status of smoking. We also explained the relationship between smoking and cardiovascular diseases, and physical changes caused by smoking. In the fifth session, students had discussions on marketing strategies of tobacco companies, learning misconceptions about e-cigarettes, and the benefits of non-smoking. In the sixth session, we explained higher obesity rates among adolescents due to unhealthy diets and the risk of cardiovascular diseases due to obesity, and encouraged students to do activities of planning a dietary management plan and creating a healthy diet plan. In the seventh session, we explained the relationship between less physical activities and obesity, and the effects of physical activities and sedentary lifestyles on cardiovascular diseases. As follow-up activities, we explored exercises that can be implemented in daily

Table 1. Intervention contents for the "School-based Health Education for CVD prevention"

	Headings	Subheadings	Contents	Time (min)	method (media)
1	Understanding CVD	Definition of CVD	☐ Chronic disease terminology and etymology	30	Lecture (PPT)
			☐ CVD mortality rates/disease burden		
			☐ Importance of prevention		
		CVD risk factors	☐ Risk factors and occurrence process	20	
			☐ CVD symptoms and treatment		
2	Behaviors to prevent CVD: Non-drinking	Youth drinking status and causes	☐ Status of youth drinking	25	Lecture (PPT)
			☐ Factors related to the initiation of drinking		
		The harm of drinking alcohol	☐ Alcohol consumption and CVD	25	
			☐ Alcohol and mental health		
			☐ Alcohol and injuries/accidents		
3	Drinking prevention activities	Korean drinking culture	☐ Alcohol advertisements using famous celebrities	20	Debate (Video)
			☐ Drinking culture on TV		
		Alcohol drinking prevention with action plans	☐ Countermeasures against youth drinking	30	Role play (scenario)
			☐ Role-playing for situations where drinking is recommended		
4	Non-smoking behavior and CVD	Youth smoking current status	☐ Data and status of youth smoking	30	Lecture (PPT)
			☐ Youth smoking motives		
			☐ Exposure to second-hand smoke		
		The harm of smoking	☐ Smoking and CVD	20	
			☐ Body function changes caused by smoking		
5	Non-smoking behavior	Tobacco company strategy	☐ Non-Smoking advertisement viewing and advertising strategy	30	Debate (Video)
			☐ Marketing strategies of tobacco companies		
		E-Cigrattes and benefits of non-Smoking	☐ Misconceptions about E- cigarettes	20	Lecture (activity sheet)
			☐ Physical, social and mental benefits from non-smoking		
6	Eating habits	Youth eating habits & self-management plans	☐ Current status of youth eating habits	25	Lecture Debate (PPT, activity sheet)
			☐ Obesity and CVD		
			☐ Checklist for eating habits		
			☐ Regular eating habits and self-management plans		
		Assessment of daily diet and action plans	☐ Assessment of daily diet	25	Debate (activity sheet)
			☐ Saturated fat and CVD		
			☐ Nutrition label analysis		
			☐ Self-design of a healthy diet plan		
7	Exercise habits	Exercise habit and Management	☐ Check your exercise habit	15	Lecture Activity (PPT, (Video)
			☐ Risk factors for youth obesity		
			☐ Exercise and CVD prevention		
		Exercise benefits of stress management	☐ Practice in daily exercise	10	
			☐ Benefits of exercise for stress management: its solutions		
		Activities for adopting with exercise	☐ Make a regular exercise plan	25	Activity (Video)
			☐ Do stretching and gymnastics		
8	CVD prevention and healthy behavior measures	Adopting with healthy behaviors and CVD prevention	☐ The importance of changing healthy lifestyle in their daily life	10	Lecture (PPT)
			☐ Guide to implementing healthy behaviors		
		Healthy behaviors and action plans	☐ Creating a situation scenario when maintaining my lifestyle healthy behaviors	40	Debate Role play
			☐ Group discussion and role play		

CVD=cardiovascular disease; PPT=power point.

life and are appropriate for students, and then they set regular exercise plans and followed stretching and simple gymnastics. In the eighth session, we summarized the contents of the class and guided students to plan and implement preventive activities that they can do every day. As a follow-up activity, we encouraged students to have discussions per group and create scenarios under the assumption that if one's current habit continues in the future, how one's health would be as an elderly person. Two groups presented well-plotted scenarios, and students performed role-playing based on the scenarios.

Measures

The pretest and posttest were performed by using self-report questionnaire. Primary outcome variable was a health behavior for cardiovascular disease prevention, and secondary outcomes variables were knowledge and self-efficacy for cardiovascular disease prevention.

1. Participants' general characteristics

The general characteristics comprised of five items such as gender, age, self-perceived performance, regular exercise, and health education experience. Self-perceived performance refers to students' self-perceived level of learning achievement and was categorized into high, middle, and low and recoded high and middle being grouped as 'High', and low as 'Low'. Regular exercise indicates everyday workout habits and was categorized into 'never,' 'irregular,' and 'regular' and recoded 'never' and 'irregular' being considered as 'No' and 'regular' considered as 'Yes'. Health education experience was analyzed by categorizing whether the students had received health education within the last one year as 'Yes' or 'No'.

2. Knowledge for cardiovascular disease prevention

This study employed the Heart Healthy Information Questionnaire (HHIQ) developed by Choo et al. (2023) [30]. The questionnaire has a total of 50 questions and was developed to measure the knowledge level of information about cardiovascular disease prevention of a healthy individual and each question consists of a scale of 'true', 'false', and 'no idea'. The scores of each question are summed up and calculated as 0-50 points. The reliability of the tool is KR-20 = 0.85, and in this study, Cronbach's α was found to be 0.88.

3. Self-efficacy for cardiovascular disease prevention

The self-efficacy tool was a general self-efficacy measure developed by Sherer et al. (1982) [31], and in this study, we used the modified tool by Jung (2002) [32]. In the questionnaire for this study, participants were asked to indicate their confidence in taking cardiovascular disease prevention behaviors. The tool is effective for measuring how successful a person can perform activities, consisting of a total of 13 questions. The scores range from Point 1 ('No confident at all' to Point 5 ('half confident'), to Point 10 ('completely confident'); the higher the score the higher the self-efficacy, and the scores of each question are summed up to calculate points (out of 130 points). The reliability of the tool is as follows: Cronbach's α is .913; this study was found to have Cronbach's α of .934.

4. Health behaviors for cardiovascular disease prevention

We used the instrument developed by Kang (2010) as it can comprehensively evaluate the lifestyle of subjects with metabolic syndrome in terms of health behaviors [33]. The tool consists of 36 questions: eight questions about 'physical activities and weight control', 16 questions on 'eating habits', three questions about 'drinking and smoking', three questions about 'stress', two questions about 'sleep and rest' and four questions about 'medicine and physical examination'. Based on a 4-point Likert scale ranging from "Never" to "Always," each question's score is summed and divided by the number of questions to use the average value. Higher scores indicate higher health behavior scores. The reliability of the tool is Cronbach's α of .92, and this study showed Cronbach's α of 0.89.

Data collection

This study was performed with the cooperation and permission of the principals of experimental and control group schools from October 31 to December 31, 2022. As the study participants were high school students, we obtained their legal representatives' consent for recruitment and consent, as well as the students' consent to voluntarily participate in this study after they understood the purpose of the study. It took approximately 25 minutes for them to answer the questionnaire.

Ethical considerations

Before conducting this study, we obtained approval from the Korea University Institutional Review Board (IRB No. KUIRB-2022-0334-01) for ethical considerations regarding the subjects. After specifically explaining the purpose and details of the study to the participants, we recruited participants (posted in each school as a notice), and sent a school newsletter to the students' families. Whenever they showed a willingness to participate in this study, we provided a consent form for participation in re-

search (for parents) and a consent form for participation in research (for students). We also informed the participants that they could withdraw from the study without any penalty if they wanted to stop participating in the study even after completing the consent form.

Data analysis

The collected data for this study were statistically analyzed by the SPSS window version 26.0 program (SPSS Inc, Chicago, IL, USA). The general characteristics of the participants were analyzed by frequency (percentage) and mean (standard deviation) as descriptive statistics. The test of homogeneity for general characteristics was analyzed by independent t-test and chi-square test. The pre- and post-test mean differences in knowledge, self-efficacy, and health behaviors for cardiovascular disease prevention in each of experimental and control groups were analyzed by paired t-test. In the pre-test, the scores for the two variables of 'prior experience of health education' and 'self-efficacy' differed significantly between experimental and control groups. After adjusting the two variables, the linear mixed model was performed to test hypotheses with the inclusion of a "school cluster" as a random factor and "group" and "time" as fixed factors. Between-group differences over time in all the outcome variables were tested by the significances of the interaction effects of group and time.

Results

Participants' general characteristics and their homogeneity between groups

As for general characteristics, the age of the participants was 15.79 years old in the experimental group and 15.86 years old in the control group; as for the self-perceived performance, 142 participants (84.0%) recorded 'High', and 27 participants (16.0%) recorded 'Low' (Table 2). For regular exercise, 147 participants (87.0%) answered 'No' and 22 (13.0%) responded 'Yes'. There were 94 participants (55.6%) responding 'Yes' to the health education experience, and 75 participants (44.4%) responding 'No' to the experience.

As a result of testing the homogeneity of general characteristics between the experimental and control groups, we found there was no statistically significant differences in self-perceived performance and regular exercise (Table 2). On the other hand, there was a significant difference in the health education experience between those two groups, and the experimental group had more experience than the control group ($x^2 = 8.26$; $p = .004$).

Homogeneity between groups on study variables

The "cardiovascular disease prevention knowledge" scores did not differ significantly by group: the experimental group scored 33.26 points (out of 50 points), whereas the control group had 34.96 points (Out of 50 points) (Table 3). The 'self-efficacy regarding health behaviors to prevent cardiovascular disease' differed significantly by group ($t = -2.43$; $p = .016$): experimental group scored 72.83 points (Out of 130 points) and the control group scored 81.38 points (Out of 130 points. The 'health behaviors to prevent cardiovascular disease' did not differ significantly by group: the experimental group scored 2.24 points (Out of 4 points) and the control group had 2.35 points (Out of 4 points).

Hypothesis tests

[Hypothesis 1.] The experimental group that participated in the eight-week "School-Based Health Education for Cardiovascular Disease Prevention" would have a higher score on 'knowledge' after

Table 2. Participants' general characteristics: Homogeneity between groups (N=169)

Variables	Total	Experimental group (n = 84)	Control group (n = 85)	t/x^2	p
	Mean ± SD or N (%)				
Age (years)	15.83 ± 0.38	15.79 ± 0.41	15.86 ± 0.35	-1.24	.216
Learning achievement				1.17	.279
High	142 (84.0)	68 (81.0)	74 (87.1)		
Low	27 (16.0)	16 (19.0)	11 (12.9)		
Regular exercise				0.89	.345
Yes	22 (13.0)	13 (15.5)	9 (10.6)		
No	147 (87.0)	71 (84.5)	76 (89.4)		
Health education				8.26	.004
Yes	94 (55.6)	56 (66.7)	38 (44.7)		
No	75 (44.4)	28 (33.3)	47 (55.3)		

Table 3. Study variables: Homogeneity between groups (*N*=169)

Variables†	Total (*N*=169)	Experimental group (n=84)	Control group (n=85)	t	*p*
	Mean ± SD				
Knowledge	34.11 ± 9.0	33.26 ± 10.89	34.96 ± 6.51	-1.23	.220
Self-efficacy	77.11 ± 23.2	72.83 ± 23.78	81.38 ± 21.97	-2.43	.016
Behavioral practice	2.30 ± 0.44	2.24 ± 0.44	2.35 ± 0.45	-1.62	.108

†All variables are scores for cardiovascular disease prevention.

eight weeks compared to the control group.

The experimental group scored 33.26 points out of 50 points in the pretest for 'cardiovascular disease prevention knowledge', and 42.26 points, which is a 9.00 point increase, in the posttest, showing a statistically significant increase (t=7.1; $p<.001$). The control group scored 34.96 points in the pretest for the knowledge to prevent cardiovascular diseases, and 35.59 points in the posttest, showing no statistically significant difference. The experimental group that participated in the eight-week intervention showed a statistically significant increase in the 'cardiovascular disease prevention knowledge' score, compared to the control group (F=19.21; $p<.001$). Thus, [Hypothesis 1] was supported.

[Hypothesis 2.] The experimental group that participated in the eight-week "School-Based Health Education for Cardiovascular Disease Prevention" would have a higher score on 'self-efficacy' after eight weeks compared to the control group.

The experimental group scored 72.83 points (Out of 130 points) in the pretest for 'self-efficacy regarding health behaviors to prevent cardiovascular disease', and 90.90 points in the posttest, showing a statistically significant increase (t=5.03, $p<.001$). The control group scored 81.83 points in the pretest and 82.31 points in the posttest, presenting a statistically insignificant difference. The experimental group that participated in the eight-week intervention showed a statistically significant increase in the 'self-efficacy regarding health behaviors to prevent cardiovascular disease' score, compared to the control group (F=14.91; $p<.001$). Thus, [Hypothesis 2] was supported.

[Hypothesis 3.] The experimental group that participated in the eight-week "School-Based Health Education for Cardiovascular Disease Prevention" would have a higher score on 'health behaviors' after eight weeks compared to the control group.

The experimental group scored 2.24 points (out of 4 points) in the pretest for 'health behaviors to prevent cardiovascular disease', and 2.49 points in the posttest, showing a statistically significant increase (t=3.66; $p<.001$). The control group scored 2.35 points in the pretest, and 2.39 points in the posttest, showing a non-significant difference. The experimental group participating in the eight-week intervention showed statistically significant increases in the scores in 'health behaviors to prevent cardiovascular disease', compared to the control group (F=4.83; $p=.029$). Thus, [Hypothesis 3] was supported.

Discussion

This study was conducted with first-year female high school students to examine the effects of the eight-week "School-Based Health Education for Cardiovascular Disease Prevention" on the knowledge, self-efficacy, and health behaviors to prevent cardiovascular diseases. We found that the experimental group showed significant increases in the knowledge, self-efficacy, and health behaviors for cardiovascular disease prevention over time, compared to the control group (Table 4).

First of all, our finding showed that the experimental group that participated in the eight-week intervention of "School-Based Health Education for Cardiovascular Disease Prevention", showed significant increases in the 'cardiovascular disease prevention knowledge' score compared to the control group. Such a result implies that "School-Based Health Education for Cardiovascular Disease Prevention" may be effective for high school female students to effectively understand cardiovascular disease itself and its prevention. It also underpins the existing theoretical background arguing that health education is a prerequisite to improving health knowledge [34,35]. Thus, the positive effect of health education on health knowledge is an expected result, but it also implies that education on cardiovascular disease prevention can be applied through the system of school-based health education.

The experimental group with the "School-Based Health Education for Cardiovascular Disease Prevention" showed a significant increase in the 'self-efficacy regarding health behaviors to prevent cardiovascular disease' score compared to the control group. Such a finding is consistent with the finding of the previous study that school-based health education cultivated appropriate health knowledge and increases in self-efficacy among stu-

Table 4. Effects of a school-based health education for cardiovascular disease prevention among high school girls (N=169)

Variables†		Baseline	After 8 weeks	t§(p)	Group	Time	Group x time
		Mean‡ ± SD			F‖(p)		
Knowledge	Experimental	33.26 ± 10.89	42.26 ± 9.31	7.06 (< .001)	7.29 (.007)	25.36 (< .001)	19.21 (< .001)
	Control	34.96 ± 6.51	35.59 ± 8.25	0.58 (.563)			
Self-efficacy	Experimental	72.83 ± 23.78	90.9 ± 20.91	5.03 (< .001)	0.09 (.766)	18.42 (< .001)	14.91 (< .001)
	Control	81.38 ± 21.97	82.31 ± 25.13	0.26 (.796)			
Health behaviors	Experimental	2.24 ± 0.44	2.49 ± 0.5	3.66 (< .001)	0.13 (.720)	9.30 (.002)	4.83 (.029)
	Control	2.35 ± 0.45	2.39 ± 0.53	0.57 (.572)			

†All variables are scores for cardiovascular disease prevention.
‡Mean difference indicates differences in the scores of study variables from baseline to eight weeks.
§paired t-test for significant differences in study variables from baseline to eight weeks.
‖Linear mixed model adjusting for prior health education experience and baseline self-efficacy with the school as a random factor.

dents [36,37]; although there are differences in characteristics of the population and specific measures, the finding is also consistent with the result of the study that measured exercise-related self-efficacy after conducting a cardiovascular disease prevention education program for middle-aged women [26]. We confirmed an increase in self-efficacy of students through health education, and assumed that the health education contributed to establishing confidence leading to changes in cardiovascular lifestyle habits. Fook et al. [38] reported that experiential activities and discussion learning may have a great contribution to promoting self-efficacy of university students in learning. In the link with the results from Fook et al. [38], the intervention applied in this study did not merely function as a means for educating students and transferring knowledge, but had high influences for achieving higher self-efficacy due to experience-based learning by utilizing discussions, scenario creation, and role-playing that were implemented in the present study. Furthermore, the experimental group had significantly lower scores in self-efficacy than the control group before the intervention began. However, the control group showed almost no change after the intervention ended, while the experimental group showed a significant increase in self-efficacy. These findings may be partly attributed to the action plans of the intervention that gave students the opportunity to write their own behavioral plans to improve specific skills for health behaviors to prevent cardiovascular disease.

Finally, the experimental group with "School-Based Health Education for Cardiovascular Disease Prevention" showed significant increases in 'health behaviors to prevent cardiovascular disease' score compared to the control group. This finding was fairly consistent with following previous finding. Naserpoor et al. [39] reported that school-based health education with a topic of nutrition and eating behaviors was significantly effective on changes in eating behaviors by using the educational methods of in-class lectures, Q&A, and group discussions among high school female students. In this study, the changes in health behaviors among high school girls may be attributed to the following intervention factors. First, the intervention may have fostered the competence to practice in daily life outside of school, although the intervention in this study was a short program with eight weeks. Moreover, increased scores in knowledge and self-efficacy for preventing cardiovascular disease ultimately led to healthy cardiovascular prevention behaviors among high school female students [40]. Since high school female students have cognitive and intellectual abilities similar to those before adulthood, health education may have helped them sufficiently cultivate health-related knowledge and self-efficacy. Second, the design of behavioral action plans for each behavior (i.e., smoking cessation, abstinence of alcohol drinking, healthy eating, or physical activity) with in-class group discussions and role plays may have enhanced self-efficacy for behavioral changes [41].

This study has several limitations. First, since we could not secure the homogeneity of the participants at baseline by non-randomly assigning the experimental and control groups as schools, the results should be carefully interpreted. The future study should be conducted in a randomized controlled trial. Second, the tool for measuring health behaviors and experiences for cardiovascular prevention had a couple of items inappropriate for high school students (i.e., 'medicine and physical examination' and 'work or household chores'), and it is necessary to use a tool that fully reflected the content of the "School-Based Health Education for Cardiovascular Disease Prevention". Moreover, regarding a questionnaire item of educational experiences, the item may have been specified by the frequency and duration of health education. Third, one of major limitations of this study is that the interventionist who provided the intervention to the experimental group was the researcher of this study and a school nurse who

worked at the school. This could give bias for the validity of the study due to the expectations of the experimenter. Finally, since this study targeted 169 first-year female high school students from two high schools in Seoul, it should be careful in generalizing the results.

Conclusion

The 8-week "School-Based Health Education for Cardiovascular Disease Prevention" targeting first-year female high school students had significant effects on cardiovascular disease prevention knowledge, self-efficacy, and health behaviors for cardiovascular disease prevention. Based on these study results, we expect that school-based health education for preventing cardiovascular disease could be included and disseminated within a school-based education system in South Korea.

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Conflict of interest

The authors declared no conflict of interest.

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Authors' contributions

Minah Kang contributed to data curation, formal analysis, project administration, writing-original draft, investigation, resources, and validation. Jina Choo contributed to conceptualization, funding acquisition, methodology, visualization, writing – original draft, review & editing, and supervision.

Data availability

Please contact the corresponding author for data availability.

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