



## Research Article

## Posture Management Program Based on Theory of Planned Behavior for Adolescents with Mild Idiopathic Scoliosis



Jihe Choi, PhD, RN, CPNP,<sup>1</sup> Hee Soon Kim, PhD, RN, FAAN,<sup>2,\*</sup> Gwang Suk Kim, PhD, RN,<sup>2</sup> Hyejung Lee, PhD, RN,<sup>2</sup> Hye-Seon Jeon, PhD, PT,<sup>3</sup> Kyong-Mee Chung, PhD<sup>4</sup>

<sup>1</sup> Department of Nursing, Wonju College of Medicine, Yonsei University, Wonju, South Korea

<sup>2</sup> College of Nursing, Nursing Policy and Research Institution, Yonsei University, Seoul, South Korea

<sup>3</sup> Department of Physical Therapy, College of Health Science, Yonsei University, Wonju, South Korea

<sup>4</sup> Department of Psychology, Yonsei University, Seoul, South Korea

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## SUMMARY

**Purpose:** The purpose of this study was to evaluate the effects of a devised posture management program based on the Theory of Planned Behavior in adolescents with mild idiopathic scoliosis.

**Methods:** A quasi-experimental study was conducted. It involved a nonequivalent comparison group design with pretest and posttest. Forty-four female adolescents with mild idiopathic scoliosis participated; data from 35 participants (20 for the test group, 15 for the control group) were used for the final analyses. The devised posture management program ran for 6 weeks. Posture management behavioral determinants (attitude, subjective norms, perceived behavioral control, and behavioral intention) as cognitive outcomes and muscular strength and flexibility as physical outcomes were measured three times: at baseline, week 6 and week 8. Cobb's angle as another physical outcome was measured twice: at baseline and week 8. Descriptive analysis, repeated measures analysis of variance and *t* test were used for data analyses.

**Results:** Attitude, perceived control, and behavioral intention were consistently enhanced by the posture management program. The intervention increased flexibility and muscular strength and decreased Cobb's angle, which reduced spinal curvature. Frequency of posture management exercise showed a gradual increase in the test group.

**Conclusion:** The results indicate that the posture management program is effective in maintaining posture management behavior in adolescents with mild idiopathic scoliosis for both cognitive and physical outcomes. The posture management program should be helpful in expanding the role of school nurses in improving the health status of adolescents with mild idiopathic scoliosis.

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## Introduction

Scoliosis is a complex deformity of spine involving an abnormal curvature of the backbone, an abnormally rounded back, and kyphosis that leads to an asymmetric ribcage. It can be diagnosed in radiographic projections of the spine by a Cobb's angle in excess of 10 degrees. Adolescent idiopathic scoliosis (AIS) accounts for 80% of all types of diagnosed scoliosis (Burns, Dunn, Brady, Starr, & Blosser, 2009). The most vulnerable time is around 10 years of age; girls are

affected 3–5 times more than boys are (Sanders et al., 2007). In South Korea, the prevalence rate of adolescent scoliosis changed from 1.3% in 2002 to 6.2% in 2008, that is, the prevalence has increased by more than a factor of four in just 6 years (Suh, Modi, Yang, & Hong, 2011). In particular, Korean public health policy, which requires that every seventh grade student have a chest X-ray check-up for detection of pulmonary tuberculosis, has undoubtedly helped detect AIS at an early age (Chung, 2007).

Idiopathic scoliosis can cause adolescents many physical, psychological, and social problems. First, there are negative physical influences, including differences in appearance, limited physical activities, reduced physical skills, and muscular skeletal pain in the upper body (Burns et al., 2009). Second, there are negative psychological influences, including impact on building a good body image, less interest in life, self-depreciation, depression, and

\* Correspondence to: Hee Soon Kim, PhD, RN, FAAN, Professor, College of Nursing, Nursing Policy and Research Institution, Yonsei University, 250 Seongsanno, Seodaemun-gu, Seoul 120-752, South Korea.

E-mail address: [khssoon@yuhs.ac](mailto:khssoon@yuhs.ac)

problems with interpersonal relationships (Choi, Oh, & Lee, 2011). Third, there are negative social influences, including maladjustment at school and relational difficulties with peers (Lee, Jeong, Kim, & Yoo, 2006).

Regular and continuous exercise designed for AIS to increase flexibility and strength of muscles around the spine plays an important role in the improvement of abnormal spinal curvature (Negrini et al., 2008). However, it is difficult to encourage activity in adolescents because of a major decrease in physical activity during adolescence (Hagger, Chatzisarantis, Biddle, & Orbell, 2001), as they tend to sit for long periods of time studying, and because adolescents with idiopathic scoliosis find less time to exercise than healthy adolescents (Choi et al., 2011). Hence, there is a need to develop a suitable intervention program for Korean adolescents with mild idiopathic scoliosis.

Many previous studies have shown that aggressive interventions in patients with mild idiopathic scoliosis are highly effective in reducing the angle of spinal curvature (Lee, 2008; Negrini et al., 2008). However, in most previous intervention studies changes in the angle of spinal curvature were measured immediately before and immediately after the intervention (Fusco et al., 2011). It is known that AIS can progressively worsen during growth spurts (Negrini et al.). Thus, it is desirable that effects on the angle of spinal curvature are verified repeatedly and consistently after intervention.

The Theory of Planned Behavior (TPB) by Ajzen and Madden (1986) explains relationships between human attitude, purpose, and behavior, and suggests that adolescents who find it difficult to perform actions need continuous practice in goal-oriented behaviors. In particular, it has been demonstrated that such behaviors enhance adolescent physical activities. Meanwhile, several studies have been undertaken to improve exercise levels among adolescents with chronic conditions (Keats, Culos-Reed, Courneya, & McBride, 2007). TPB provides a theoretical basis for development and evaluation of intervention programs, because it promotes the practice of continuous posture control behaviors by reinforcing the attitudes and purposes of these behaviors.

Therefore, in this study, we sought to verify effects on posture management behavioral determinants (attitude, subjective norms, perceived behavioral control, and behavioral intention) as cognitive outcomes and flexibility, muscular strength, and Cobb's angle as physical outcomes by applying an intervention program based on the TPB in the school environment for adolescents with idiopathic scoliosis whose spinal curvature could be reduced by repeated practice of correct posture management behaviors.

## Methods

### Study design

This prospective quasi-experimental study was conducted from October 2011 to June 2012. It involved a nonequivalent comparison group design with pretest and posttest.

### Setting and samples

Seven junior high schools, five located in W city and two in J city, which had similar characteristics as small-to-medium sized cities, and with a similar number of students enrolled were selected for our study. Permission was given to the authors by school principals and school nurses. To prevent contamination of the intervention, schools were selected as a unit and allocated to the test group and the control group.

The authors obtained a list of names of adolescents with mild idiopathic scoliosis from school nurses, and excluded adolescents on the list who were confirmed to have congenital or pathological

scoliosis. Then, three junior high schools in W city were selected as the test groups via convenience sampling. The other schools (two schools in W city and two schools in J city) were classified as the control group.

The participants were selected using the following criteria: Participants were (a) female junior high schools students, (b) with mild AIS (a Cobb's angle of >10 degree and < 20 degree), (c) not currently receiving treatment for AIS, (d) with no other muscular skeletal problem, and (e) received parental consent to participate in the study. The study was limited to female participants because females have 3–5 times the prevalence of AIS than their male counterparts.

Forty-four students met the participant inclusion criteria and were enrolled in the study. For the test group, 28 students from the three junior high schools in W city, selected as the test group schools were allocated as the test group students. Among the participants in the test group, 8 students (21.4%) dropped out (6 students were absent 4 times or more and 2 students refused the second radiology test). Thus data from 20 students were used for the final analyses. The reasons for participant drop out were as follows: time limitation because of attendance at a private tutoring or private educational institute after school ( $n = 5$ ), caught a cold ( $n = 1$ ) and refused the second radiology test ( $n = 2$ ). For the control group, 16 students from the two junior high schools in W city and two junior high schools in J city, selected as the control group schools, participated as the control group students. One student (6.3%) who refused the second radiology test was excluded from the study. Data from 15 students were used for the final analyses.

For the final analyses, data from 35 junior high school students with mild AIS were used. The sample size was calculated using the power analysis program of G-power 3.1.2 (Heinrich-Heine-Universität Düsseldorf, North Rhine-Westphalia, Germany). When conditions were set at a level of .05, power of .80–.95, a medium effect size of .25, the number of groups was 2, the number of measurements was 3, and the correlation among repeated measure was .5 for repeated-measure analysis of variance with within factors, the sample size of 14–22 in each group was satisfactory for evaluating the effects of intervention in the test group and control group according to passage of time.

### Ethical consideration

The study was conducted after receiving approval from the institutional review board (YUCON-IRB 2011-1013). After giving information about the purpose of study, guarantees for anonymity and credibility, voluntary participation and rewards to participate in the study, written informed consents were obtained from all participants and their parents who agreed to engage in the study. Members of the control group were afforded the same intervention program as the test group after completion of the study.

### Measurements

Intervention effect was evaluated using measurements for posture management behavioral determinants as cognitive outcomes, and flexibility, muscular strength, and Cobb's angle as physical outcomes. Data that evaluated the effects of the program were collected using three methods. First, posture management behavioral determinants (attitude, subjective norms, perceived behavioral control, and behavioral intention) were measured using a structured questionnaire developed by the researchers using the direct measurement methods recommended by theorists (Fishbein & Ajzen, 2010). The questionnaire was evaluated for validity prior to data collection from the students in the five junior high school students who were not involved in this study. Second, flexibility

and muscular strength were measured directly by a trained research assistant. Third, Cobb's angle was measured by two orthopedic surgeons using spine posteroanterior X-rays.

Of the posture management behavioral determinants, attitude is the degree to which performance of the target behavior is positively or negatively valued (Fishbein & Ajzen, 2010). It was measured by means of four items using the stem "Doing posture management exercise for 30 minutes on a regular basis for the next 8 weeks would be..." followed by four adjectives (good, pleasant, interesting, and beneficial), and measured with a 7-point Likert scale (1 = *strongly disagree*, 7 = *strongly agree*) with higher values indicating positive attitude. Subjective norm is the perceived social pressure to engage or not to engage in a target behavior (Fishbein & Ajzen). The four items were measured with a 7-point Likert scale (1 = *strongly disagree*, 7 = *strongly agree*) with higher values indicating higher perceived social pressure. The items were, "Parents/peers think that I should do posture management exercises for 30 minutes on a regular basis for the next 8 weeks", "Parents/peers would approve of my posture management exercises...", "If parents/peers have scoliosis, they will do posture management exercises...", "If parents/peers have scoliosis like me, they must have exercised for ..." Perceived behavioral control refers to people's perceptions of their ability to perform a target behavior (Fishbein & Ajzen). The four items were assessed with a 7-point Likert scale (1 = *strongly disagree*, 7 = *strongly agree*) with higher values indicating higher perceived behavioral control. The items were, "I am confident that I can do posture management exercises for 30 minutes on a regular basis during the next 8 weeks", "My posture management exercises...is completely up to me", "If I really wanted to, I could do posture management exercises...", "For me doing posture management exercise...is under my control." Behavioral intention is an indication of a person's readiness to perform a target behavior (Fishbein & Ajzen). It was assessed by four items with a 7-point Likert scale (1 = *strongly disagree*, 7 = *strongly agree*) with higher values indicating higher behavioral intention. The items were, "I intend to do posture management exercises for 30 minutes on a regular basis during the next 8 weeks", "I will do posture management exercises...", "I am willing to do posture management exercises...", "I plan to do posture management exercise..." Higher values on each variable indicated enhanced posture management behavioral determinants.

For physical results of posture management exercise, it was expected there would be an increase in flexibility of spinal curvature (especially on the spinal concave side), an increase in muscular strength of abdominal muscles that support the spine, and a decrease in the angle of spinal curvature (McIntire, Asher, Burton, & Liu, 2008; Negrini et al., 2008). Flexibility was defined as the mean value of spinal lateral flexion measured using Mellin's (1986) tape method. To measure flexibility, the subject stood in a neutral position with her feet 20 cm apart with hands open against thighs. The position of middle-fingertips were marked on the thigh during maximum lateral bending on the spinal convex side and measured as the distance between the fingertip mark and the floor. Lower values indicated increased flexibility on the spinal concave side. Muscular strength was measured in kilograms using a back strength dynamometer (T.K.K. 5102 Back D; Takei Scientific Instruments, Tokyo, Japan). Higher values indicated increased muscular strength of the back. Flexibility and muscular strength were measured twice and the mean value was used. Cobb's angle is used to evaluate scoliotic curves on posteroanterior radiographic projections of the spine. It is defined as the angle formed between a line drawn parallel to the superior endplate of the most tilted vertebra and a line drawn parallel to the inferior endplate of the most tilted vertebra (Morrissy, Goldsmith, Hall, Kehl, & Cowie, 1990). Higher Cobb's angles indicate more severe scoliosis.

Additionally, the authors requested the frequency of posture management exercises to identify changes in the exercise pattern. The participants were asked to voluntarily mark the date on the calendar when they practiced the posture management exercise. Students received the calendar at the beginning of the study and handed it in at the end of the study.

#### Data collection

Cobb's angle was measured to select study participants for the test and control groups. Data collection for both groups included the following: general characteristics, posture management behavioral determinants (attitude, subjective norms, perceived behavioral control, and behavioral intention), muscular strength, flexibility and frequency of posture management exercises. For the test group, these were measured at baseline, immediately after the intervention (week 6), and 2 weeks after intervention (week 8). For the control group, data were measured at baseline when group members received the written material, then at week 6 and week 8. Cobb's angle was measured twice, at baseline and at week 8 for both groups in order to minimize the risk associated with radiation exposure.

#### Intervention

Intervention content and activities of the posture management program were developed by a review of prior intervention studies that used TPB and studies on the effects of physical activities on spinal curvature in AIS. The posture management program has two purposes: (a) to enhance posture management behavioral determinants as cognitive outcomes and (b) to increase flexibility, muscular strength, and decrease Cobb's angle as physical outcomes by enhancing posture management exercise.

For enhancing posture management behavior, we undertook to strengthen posture management behavioral determinants including attitude, subjective norms, perceived behavioral control, and behavioral intention. First, the strategy to strengthen positive attitudes for posture management behavior included strengthening motivation to participate in posture management program and establishing a sense of belonging, providing information on the necessity and goals of posture management, and sharing positive experiences in the process of participation in the program. The strategy included providing lectures, engaging the students in discussion, or asking them to make a compliment card. Second, in order to strengthen the subjective norms, the intervention strategy included putting up posters in school for promotion of program initiation, writing and distributing a resolution card for participation in the program, and demonstrating posture management for parents or friends. Third, in order to strengthen the perceived behavioral control, the intervention strategy included demonstrating the posture management exercise, making a planning chart and holding a quiz contest on the posture management program. Fourth, in order to strengthen the behavioral intention, the intervention strategy included creating a slogan for the program and writing a pledge of continuous participation in the program (Keats et al., 2007; Murnaghan et al., 2010; Plotnikoff et al., 2011; Tsorbatzoudis, 2005). Table 1 shows some parts of the posture management program that aimed to strengthen the posture management behavioral determinants for adolescents with mild AIS.

For reduction of spinal curvature, posture management exercise included motions to increase the flexibility and strength of muscles around the spine and teaching the correct posture; the exercise was accompanied by verbal and written documentation (Lee, 2008; Negrini et al., 2008). The posture management exercise was produced in the form of a DVD, and these were distributed to the test

**Table 1** Part of Posture Management Program for Strengthening Posture Management Behavioral Determinants for Adolescents with Mild Idiopathic Scoliosis

| Subgoal  | Contents of intervention   | Activity of intervention   | Method for intervention                                    |
|--|--|--|--|
| Strengthening of positive attitudes            | Providing information (definition of disease, goal of program, pros and cons of the program, etc.) | Introduction to the characteristics and treatment methods for AIS<br>Explanation of the purpose and goal, the process, the pros and cons for the program   | Lecture  |
|  | Sharing positive experiences during the program  | Participants share conversations about positive experiences and good points of the program with peers  | Group discussion   |
| Enhancement of subjective norms                | Notice for hosting the program   | Participants and their peers put up promotional posters which stirred up interest and questions about the program<br>Informed classes that the participants will attend the program so they can help       | Promotional poster<br>Notice to class teachers             |
|  | Learning and practice of posture management behaviors  | Demonstrate posture management behaviors including the correct movements to be learned.<br>DVD which contained the posture management activities to practice at home is provided                           | Demonstration<br>DVD demonstration                         |
| Strengthening of recognized behavioral control | Navigating colleague's successful strategies and failures  | Participants share conversations with peers about why the program works or does not work   | Group discussion   |
|  | Reinforcement of confidence in recognizing posture control behaviors                               | The winner in the quiz competition on AIS and posture management methods is praised by others  | Quiz contest   |
|  | Reinforcement of confidence and achievement  | A certificate is given after the program   | Certificate  |
| Enhancement of behavioral intention            | Reinforcement of the decision to participate and will to act for the program                       | A written pledge is created in which participants promise to attend and practice the program consistently<br>Participants read the written pledges together and reaffirm the will to act as they have done | Creating written pledge<br>Reaffirmation of written pledge |

Note. AIS = adolescent idiopathic scoliosis.

group to enable them to exercise at home on days when the intervention program was not conducted. In order to increase muscle flexibility, the exercise program included stretching exercises for neck, shoulders, waist, and back. To increase the strength of the paraspinal muscles, movements that enhanced muscular strength of the spinal convex side muscles and abdominal muscles were included. To teach correct postures, movements required to stand, sit, and walk correctly were included (Fusco et al., 2011; Lee; Negrini et al.).

The intervention program was designed for 60 minutes per session, twice a week for 6 weeks. For each program, 30 minutes were allocated for strengthening attitudes, subjective norms, perceived behavioral control and behavioral intention toward posture management behavior; the other 30 minutes were used for posture management exercises. The detailed plan for time and length of the program to strengthen the posture management behavioral determinants (30 minutes, 6 weeks) was developed following previous studies by Darker, French, Eves and Sniehotta (2010) and Keats et al. (2007). These studies showed improvements related to continuous exercise among adolescents according to TPB. Also, the detailed plan of the time and length for the posture management exercise was developed following studies by Jeon, Yang, Kim, Park and Kim (2005), Rhim, Kim, Yoon and Park (2003), and Yang et al. (2003). These studies verified the effects of the exercise of 30 minutes, twice a week and for 6 weeks on scoliosis correction.

The content of the developed posture management program for strengthening posture management behavioral determinants was assessed by a group of experts, three nursing professors, one psychologist and two school nurses, to evaluate content validity index (CVI). CVI was 0.8–1.0 point. The DVD for enhancing posture management exercise was produced by a group of experts including an orthopedic surgeon, two professors in the department of physical therapy, and two nursing professors. Interventions were provided immediately after school in the gymnasiums of each junior high school.

Two registered nurses were trained by the researcher participated as research assistants. The test group took part in the posture management program for 6 weeks, while control group members

were simply provided with information about posture management behavior and written material with photos describing posture management exercise immediately before the study. Control group members were asked to practice the posture management behaviors by themselves for 30 minutes daily.

#### Data analysis

PASW Statistics 18 (SPSS Inc., Chicago, IL, USA) was used for statistical analyses. Descriptive analysis (means, standard deviations, and percentages), Chi-squared test, Fisher's exact test, and *t* test were used for homogeneity testing between the test and control groups. The Kolmogorov-Smirnov test was used to test variable distributions for normality. Repeated measures analysis of variance were used to examine the interaction effect of group over time for the dependent variables, which were measured at baseline, immediately after intervention (week 6) and 2 weeks after intervention (week 8). Bonferroni's correction was used for post hoc analyses. The independent *t* test was used to examine differences in Cobb's angle between baseline and week 8. In addition, comparison of the frequency of posture management exercise between groups per week was evaluated to identify the continuation effect of the intervention. The results were evaluated at 95% confidence level, and statistical significance was accepted for  $p < .05$ .

#### Results

##### Characteristics of participants and homogeneity between groups

Characteristics of the participants are shown in Table 2. Average values for general characteristics of the test group were as follows: age 13.3 years, height 156.37 cm, weight 44.84 kg, menarche 11.93 years, age at diagnosis of scoliosis 13.05 years, percentage diagnosed by school health screening 95%, percentage that had not experienced hospital-based therapeutic management 85%. Mean values for test variables of the test group were as follows: attitude 5.38, subjective norm 5.16, perceived behavioral control 5.39, behavioral intention 5.09, flexibility 40.12 cm, muscular strength 33.48 kg, and Cobb's angle 14.90°.

**Table 2** Characteristics of Participants and Homogeneity between Groups (N = 35)

| Categories  | Test group (n = 20) | Control group (n = 15) | $\chi^2/t$        | p                 |
|---|---------------------|------------------------|-------------------|-------------------|
|   | n (%) or M $\pm$ SD | n (%) or M $\pm$ SD    |                   |                   |
| General characteristics                                   |                     |                        |                   |                   |
| Age (yr)  | 13.30 $\pm$ 0.57    | 13.10 $\pm$ 0.46       | 1.34              | .189              |
| Height (cm)   | 156.37 $\pm$ 7.41   | 158.62 $\pm$ 5.30      | -1.00             | .325              |
| Weight (kg)   | 44.84 $\pm$ 6.96    | 47.57 $\pm$ 7.38       | -1.12             | .270              |
| Age of menarche (yr)                                      | 11.93 $\pm$ 0.59    | 11.86 $\pm$ 0.83       | 0.25              | .803              |
| Age of AIS diagnosis (yr)                                 | 13.05 $\pm$ 0.83    | 13.20 $\pm$ 0.77       | -0.56             | .589              |
| Diagnosis by  |                     |                        |                   |                   |
| Parental notice   | 1 (5.0)             | 0 (0)                  | 0.77 <sup>a</sup> | .380              |
| School screening  | 19 (95.0)           | 15 (100.0)             |                   |                   |
| History of hospital-based treatment                       | No                  | 17 (85.0)              | 13 (86.7)         | 0.02 <sup>a</sup> |
|   | Yes                 | 3 (15.0)               | 2 (13.3)          |                   |
| Estimated total general exercise (hours per week)         | 0.92 $\pm$ 0.48     | 0.96 $\pm$ 0.37        | -0.14             | .896              |
| Posture management behavioral determinant characteristics |                     |                        |                   |                   |
| Attitude  | 5.38 $\pm$ 0.66     | 5.38 $\pm$ 0.27        | -0.05             | .960              |
| Subjective norm   | 5.16 $\pm$ 0.56     | 5.12 $\pm$ 0.74        | 0.20              | .836              |
| Perceived behavioral control                              | 5.39 $\pm$ 0.83     | 5.35 $\pm$ 0.63        | 0.15              | .885              |
| Behavioral intention                                      | 5.09 $\pm$ 0.94     | 4.70 $\pm$ 0.72        | 1.33              | .193              |
| Posture management physical characteristics               |                     |                        |                   |                   |
| Flexibility (cm)  | 40.12 $\pm$ 3.77    | 40.10 $\pm$ 4.44       | 0.01              | .991              |
| Muscular strength (kg)                                    | 33.48 $\pm$ 7.92    | 34.40 $\pm$ 6.25       | -0.58             | .565              |
| Cobb's angle (degrees)                                    | 14.90 $\pm$ 3.09    | 14.08 $\pm$ 1.66       | 1.00              | .324              |

Note. AIS = adolescent idiopathic scoliosis.

<sup>a</sup> Fisher's exact test.

Average values for general characteristics of the control group were as follows: age 13.1 years, height 158.62 cm, weight 47.57 kg, menarche 11.86 years, age at diagnosis of scoliosis 13.2 years, percentage diagnosed by school health screening 100%, percentage that had not experienced hospital-based therapeutic management 86.7%. Mean values for test variables of the control group were as follows: attitude 5.38, subjective norm 5.12, perceived behavioral control 5.35, behavioral intention 4.70, flexibility 40.10 cm, muscular strength 34.40 kg, and Cobb's angle 14.08°. Homogeneity between the test and control groups of variables was identified ( $p > .05$ ).

#### Posture management behavioral determinants as cognitive outcomes

The raw mean and standard deviation values of posture management behavioral determinants for the test and control groups at week 6 and week 8 are shown in Table 3. The mean value of attitude changed significantly by group ( $F = 4.65$ ,  $p = .038$ ), by time ( $F = 12.51$ ,  $p < .001$ ) and interaction of group by time ( $F = 11.56$ ,

$p < .001$ ). According to the results of post hoc analysis, a 0.77 point increase was observed at week 8 as compared with that of week 6 in the test group ( $p < .05$ ), which showed that the intervention had a continued effect 2 weeks later. The mean value of perceived behavioral control changed significantly by group ( $F = 4.48$ ,  $p = .042$ ), by time ( $F = 7.50$ ,  $p = .001$ ) and interaction of group by time ( $F = 8.07$ ,  $p = .001$ ). The behavioral intention changed significantly by group ( $F = 5.20$ ,  $p = .008$ ), by time ( $F = 5.20$ ,  $p = .008$ ) and interaction of group by time ( $F = 6.73$ ,  $p = .001$ ). According to the results of post hoc analysis, the above two variables increased significantly by 0.76 points ( $p < .05$ ) and 0.74 points ( $p < .05$ ), respectively, at week 8 compared with baseline values, showing that the intervention had a continued effect a fortnight after the intervention. However, subjective norms differed significantly only in the two groups by time between the week 6 and week 8 ( $F = 3.29$ ,  $p = .043$ ). Between groups ( $F = 4.48$ ,  $p = .042$ ) and interaction of group by time ( $F = 2.13$ ,  $p = .127$ ) were not significantly different. According to the results of post hoc analysis in the test group, the effect of the posture management program increased significantly by .43 points at week 8 as compared with baseline ( $p < .05$ ).

**Table 3** Effects of Posture Management Program on Posture Management Behavioral Determinants as Cognitive Outcomes (N = 35)

| Variables                    | Group (n)    | Baseline <sup>a</sup> | Week 6 <sup>b</sup> | Week 8 <sup>c</sup> | Sources             | F     | p       |
|------------------------------|--------------|-----------------------|---------------------|---------------------|---------------------|-------|---------|
|                              |              | M $\pm$ SD            |                     |                     |                     |       |         |
| Attitude                     | Test (20)    | 5.38 $\pm$ 0.66       | 5.18 $\pm$ 0.54     | 5.95 $\pm$ 0.58     | Group               | 4.65  | .038    |
|                              | Control (15) | 5.38 $\pm$ 0.27       | 5.01 $\pm$ 0.46     | 5.13 $\pm$ 0.54     | Time                | 12.51 | <.001   |
| Subjective norm              | Test (20)    | 5.16 $\pm$ 0.56       | 5.49 $\pm$ 0.41     | 5.59 $\pm$ 0.59     | Group $\times$ Time | 11.56 | <.001   |
|                              | Control (15) | 5.12 $\pm$ 0.74       | 5.18 $\pm$ 0.72     | 5.15 $\pm$ 0.65     | Group               | 2.26  | .142    |
| Perceived behavioral control | Test (20)    | 5.39 $\pm$ 0.83       | 5.63 $\pm$ 0.77     | 6.15 $\pm$ 0.32     | Time                | 3.29  | .043    |
|                              | Control (15) | 5.35 $\pm$ 0.63       | 5.33 $\pm$ 0.48     | 5.33 $\pm$ 0.51     | Group $\times$ Time | 2.13  | .127    |
| Behavioral intention         | Test (20)    | 5.09 $\pm$ 0.94       | 5.48 $\pm$ 0.66     | 5.83 $\pm$ 0.52     | Group               | 4.48  | .042    |
|                              | Control (15) | 4.70 $\pm$ 0.72       | 4.70 $\pm$ 0.60     | 4.70 $\pm$ 0.64     | Time                | 7.50  | .001    |
|                              |              |                       |                     |                     | Group $\times$ Time | 8.07  | .001    |
|                              |              |                       |                     |                     |                     |       | (a < c) |
|                              |              |                       |                     |                     |                     |       | (a < c) |
|                              |              |                       |                     |                     |                     |       | (a < c) |

Note. <sup>a,b,c</sup> Indicate a significant difference among the time points by Bonferroni in the test group.

**Table 4** Effects of Posture Management Program on Flexibility and Muscular Strength as Physical Outcomes (N = 35)

| Variables              | Group (n)    | Baseline <sup>a</sup> | Week 6       | Week 8 <sup>b</sup> | Sources      | F     | p     |
|------------------------|--------------|-----------------------|--------------|---------------------|--------------|-------|-------|
|                        |              | M ± SD                |              |                     |              |       |       |
| Flexibility (cm)       | Test (20)    | 40.12 ± 3.77          | 37.33 ± 3.71 | 35.30 ± 3.60        | Group        | 5.64  | .023  |
|                        | Control (15) | 40.10 ± 4.44          | 40.63 ± 3.80 | 40.53 ± 3.78        | Time         | 11.28 | <.001 |
|                        |              |                       |              |                     | Group × Time | 16.56 | <.001 |
| Muscular strength (kg) | Test (20)    | 33.48 ± 7.92          | 37.40 ± 8.52 | 41.63 ± 8.26        | Group        | 0.85  | .362  |
|                        | Control (15) | 34.40 ± 6.25          | 35.73 ± 5.91 | 35.07 ± 6.24        | Time         | 25.89 | <.001 |
|                        |              |                       |              |                     | Group × Time | 24.24 | <.001 |

Note. <sup>a,b</sup> Indicate a significant difference among the time points by Bonferroni in the test group.

*Flexibility, muscular strength and Cobb's angle as physical outcomes*

Changes in measured flexibility and muscular strength before and after the posture management program are shown in Table 4. According to the results of repeated measures analysis of changes in measured flexibility, significant changes were found by group ( $F = 5.64, p = .023$ ), by time ( $F = 11.28, p < .001$ ) and for interaction of group by time ( $F = 16.56, p < .001$ ). Furthermore, there were significant decreases in measured values at week 8 as compared with baseline by post hoc analysis in the test group ( $p < .001$ ), which confirmed a constant increase in flexibility in the test group after the intervention. There were also significant differences in muscular strength by time ( $F = 25.89, p < .001$ ) and interaction of group by time ( $F = 24.24, p < .001$ ), but not by group ( $F = .85, p = .362$ ). According to the results of post hoc analysis, muscular strength at week 8 was 8.15 kg higher than at baseline, and this result was significant, confirming that intervention had a long-term effect on muscular strength ( $p < .05$ ).

Table 5 shows that the Cobb's angle in the test group decreased by as much as 1.67° after the intervention, whereas Cobb's angle in the control group had increased by 0.57° by the end of the intervention. According to these results, Cobb's angle in the test group was significantly lower than in the control group at week 8, showing that the intervention reduced spinal curvature ( $p < .001$ ).

*Changes in frequency of posture management exercise*

The mean value for frequency of posture management exercise per week in the test group was 3.45 in the first week. While it increased to 4.55 in the second week, it decreased to 3.55 in the fifth week, and increased again to 3.60 in the sixth week. These results include the number of the interventional dose (twice per week) for which the students participated in the posture management program implemented in school for 6 weeks. The frequency of posture management exercise in the seventh week and eighth week was 3.90 and 4.00 respectively, even though the participants were required to voluntarily practice at home without the school-based program. For the control group for whom written materials were provided, the mean value of frequency of posture management exercise per week was 1.60 in the first week. While it decreased to 0.53 in the fifth week, it increased slightly to 0.60 in the sixth week, and decreased again to 0.47 in the seventh week and to 0.40 in the eighth week. These results show that the posture

**Table 5** Effects of Posture Management Program on Cobb's Angle as Physical Outcomes (N = 35)

| Group (n)    | Baseline     | Week 8       | Week 8–<br>baseline difference | t     | p     |
|--------------|--------------|--------------|--------------------------------|-------|-------|
|              | M ± SD       |              |                                |       |       |
| Test (20)    | 14.90 ± 3.09 | 13.23 ± 3.22 | -1.67 ± 1.36                   | -5.65 | <.001 |
| Control (15) | 14.08 ± 1.66 | 14.64 ± 1.87 | 0.56 ± 0.78                    |       |       |

management program continuously enhanced the voluntary posture management behavior for the test group compared to that of the control group (Figure 1).

**Discussion**

The results of this study showed that the posture management program is effective in adolescents with mild idiopathic scoliosis. The observed effects were as follows: enhanced posture management behavioral determinants as cognitive outcomes, encouragement of participants to practice posture management exercise, and reduced spinal curvature as physical outcomes. Lee (2008) developed an intervention program based on Bandura's (1985) self-efficacy theory to enhance cognitive judgment and the perceptions of adolescents with idiopathic scoliosis. The program was found to be effective in terms of strengthening exercises that decrease spinal curvature. However, considering of the nature of expanding human and social relations in adolescence, enhancing the positive attitude to the target behavior and increasing the subjective norms from meaningful significant others are more important in supporting purposive behavior in adolescents than only enhancing self-efficacy (Keats et al., 2007; Raudsepp, Viira, & Hannus, 2010). In a previous study, in which behavioral attitude and perceived behavioral control were found to effectively improve continuity of physical activity, Plotnikoff et al. (2011) found that TPB was the most desirable theory for developing intervention programs that improved adolescent posture management behavior.

In this study, the posture management program based on TPB was found to be consistently effective in promoting positive attitude to posture management behavior, perceived behavioral control, and behavioral intention in adolescents with idiopathic scoliosis. The results show similarity with the following studies: Murnaghan et al. (2010) in which improvements in a positive attitude were shown to affect adolescent behavioral practice in the

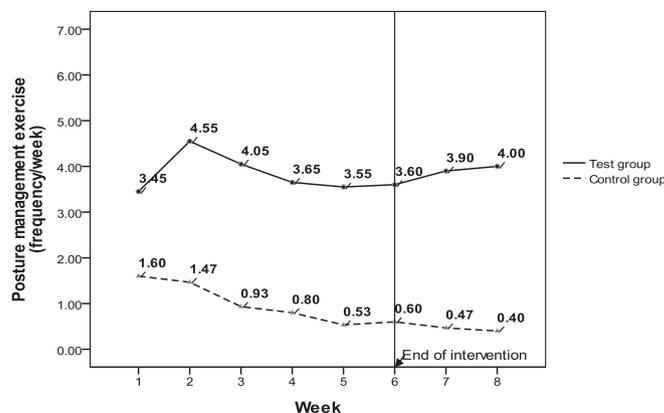


Figure 1. Changes in frequency of posture management exercise.

long term, and a study by Tsorbatzoudis (2005) in which a variety of positive experiences were shown effective at forming positive attitudes. In addition, the measured value of perceived behavioral control for posture management behavior was higher compared to the measured value of attitude or subjective norm variables. This finding is similar to that found by Murnaghan et al. and Plotnikoff et al. (2011), in which the most effective factors of behavioral practice were found to be perceived behavioral control and behavioral intention among adolescents. In particular, the result of the post hoc analysis showed a significant increase in the test group at 2 weeks after intervention as compared with the baseline values, confirming that 6 weeks of intervention maintained perceived behavioral control and behavioral intention. In contrast, there was no effect by group and interaction of group by time in subjective norms. This is contrary to the results of Keats et al. (2007), where subjective norms of exercise were shown to improve by a similar intervention method used in this study. It is difficult to determine whether this disparity was due to a marginal effect of the intervention or the characteristics of participants. A revalidation of the effects by applying a direct and powerful intervention on posture management behavioral practice is required.

Effectiveness was observed for increasing both the flexibility and the muscular strength around the spine as in previous studies (Negrini et al., 2008). Repeated measures analysis of variance showed significant changes between measured values before intervention and 2 weeks after intervention, while the posture management program continued to increase flexibility and muscular strength. The effect on degree of spinal curvature by the intervention program was confirmed by comparing Cobb's angle reductions between baseline and after 2 weeks of intervention. During intervention, Cobb's angle in the test group decreased by 1.67°, but only decreased slightly in the control group. This concurs with the results of previous studies which found a decrease in spinal curvature after similar exercise interventions (Lee, 2008; McIntire et al., 2008). This confirms that a decrease in spinal curvature was achieved by enhanced flexibility and spinal muscular strength and by the formation of correct posture habits in adolescence. In the case of mild AIS, it should be possible to advocate the need for active therapeutic interventions or health care policy to reduce spinal curvature in place of regular checkups that observe changes of spinal curvature, as is the current policy.

Frequency of posture management exercise in the test group shows the continuation of the interventional effectiveness. On the first week of the study, both groups showed some increase in frequency. After that, the test group showed gradually increasing frequency up to week 7 and week 8 when the school program had finished. In contrast, the frequency gradually decreased almost down to zero in the control group. This suggests that passive educational information like written material is much less effective than a planned intervention for adolescent physical activity even though the students have a diagnosed disease. Therefore, developing an intervention program aimed at enhancing the cognitive and behavioral aspects based on TPB can help increase posture management behavior and eventually decrease spinal curvature in AIS.

Nevertheless, there are some limitations in this study. The posture management program was provided as an after-school intervention program in junior high school due to school curriculum. Thus, the dropout rate in the test group (21.4%) was higher than the control group (6.3%). These results demonstrate that the intervention needs to be strongly supported within the school curriculum to enhance its importance and provide the necessary attitude toward posture management behavior aimed at improvement in scoliosis. The program should target not only the adolescents but also their parents. In addition, the results also

demonstrate that there is a need to support interventions that enable strengthening the social norms for posture management behavior among adolescents, parents and schools. This may be achieved by continuously putting an emphasis on the fact that the early adolescence is the optimal time to make improvement in spinal health among adolescents with mild AIS and that posture management behavior enables an improvement in symptoms. Lastly, there is a limitation on generalizability of the study results as only a minimal number of students participated in this study due to difficulties in recruitment. In consideration of the risk that adolescents may have in the wake of frequent exposure to radiation, Cobb's angle was measured only twice, before the intervention and 2 weeks after the intervention. Then, the measurement results were compared. Therefore, there is a limitation to explanations of the continuous effects that the TPB-based posture management program has on Cobb's angle. Consequently, it is necessary to conduct further study in order to verify the long-term effects that the intervention program has on Cobb's angle among the adolescents with AIS.

The TPB-based posture management program strengthened cognitive and physical outcomes for the adolescents with mild idiopathic scoliosis. It is expected that school nurses will utilize the intervention program, which was developed in this study, in an efficient way for the purpose of improving spinal health in adolescents with AIS who are left in a blind spot in the context of medical treatment. It may be expected that the role of school nurses as health managers will be expanded to home, school and local community for the purpose of improving spinal health among Korean adolescents and increasing awareness of the importance of disease prevention in cases of mild AIS.

## Conclusion

The effects of a posture management program were analyzed in two parts using posture management behavioral determinants as cognitive outcomes, and muscular strength, and Cobb's angle as physical outcomes. The results indicate that the program is effective at enhancing posture management behavioral determinants (attitude, perceived behavioral control, and behavioral intention) and in providing physical benefits to adolescents with idiopathic scoliosis. The program enhanced flexibility and muscular strength and reduced spinal curvature. Consequently from the cognitive and physical outcomes, the intervention program is also found to be effective at maintaining posture management behavior in adolescents with mild idiopathic scoliosis.

## Conflict of interest

The authors declare no conflicts of interest.

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