The impact of a stage-matched intervention to promote exercise behavior in participants with type 2 diabetes

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Abstract

This study was designed to develop and evaluate a stage-matched intervention (SMI) in Korean participants with type 2 Diabetes. The SMI was based on main constructs derived from the Transtheoretical Model match to the individual’s stages of readiness for exercise behavior. The SMI was developed according to the results of the content validity tested by an expert group (n = 9). A control group pre- and post-test design was used for evaluating the impact of the SMI: the intervention group (n = 22) participated in the SMI for 3 months, while the control group (n = 23) received usual educational advice. The intervention group, compared to the control group, showed significant improvements in stages of change for exercise behavior (p < 0.001), physical activity levels (p < 0.001), and reductions in FBS (p < 0.05) and HbA1c (p < 0.05). This study yielded evidence for the beneficial impact of the SMI in participants with type 2 Diabetes.

Keywords: Exercise behavior; Psychological theory; type 2 Diabetes

1. Introduction

Diabetes mellitus (DM) has become an increasingly serious health problem, and the prevalence of diabetes in South Korea (SK), among people older than 20 years of age, was about 10.0% in 1999 (KIHSA, 2001). Three major therapies for DM control and management are diet, exercise, and medication. While specific guidelines for diet and pharmacological management in diabetes have been developed (KDA, 1999), such guidelines have yet to be developed for exercise in SK (KACEP, 2000).

Most of the previous studies on exercise for patients with DM in SK have focused on the physiological outcomes (Jun, 2000). It has been well known that regular exercise is the most helpful intervention for improving blood glucose (i.e. fasting blood sugar and glycosylated hemoglobin, etc.) and lipid profiles (i.e. total cholesterol, triglyceride, high density level cholesterol, etc.) (Hwang et al., 2000, 2001; Jun, 1994; Kim, 1989, 1998; Lee, 1990; Na et al., 1993), improving cardiopulmonary function (i.e. maximum oxygen uptake, etc.) (Hwang et al., 2000, 2001; Jun, 1994; Kim, 1989, 1998; Lee, 1990; Na et al., 1993), and improving fat composition (i.e. lean body mass, fat body mass, waist to hip ratio, etc.) (Hwang et al., 2000, 2001).

Despite the many benefits of exercise, the findings from numerous epidemiological and clinical studies reported that over half of those who had participated...
in exercise program discontinued participation within 3–6 months (Dishman, 1991; Hwang, 1999; Lee, 1997). Similarly, Hwang et al. (2001) have reported that 35% of Korean patients with type 2 DM were still doing the exercises 7 months after the start of a 12-week exercise program. In fact, the benefits of exercise do not persist without continued, regular participation. Therefore, researchers are faced with the dual challenges of increasing exercise adoption among sedentary individuals and developing effective approaches to assist individuals in maintaining their exercise habits once these are established (Bock et al., 2001).

Exercise researchers have recommended the use of the Transtheoretical Model (TTM) which includes strategies to assist individuals in making transitions across the various stages of change (SOC) in exercise behavior (Prochaska and Marcus, 1994). A unique strength of applying the TTM to the study of exercise behavior is the dynamic nature of moving from the early stages of behavior adoption to the maintenance stage of the behavior. The main constructs of the TTM include motivational readiness for SOC, self-efficacy (SE), decisional balance (DB), and a number of cognitive and behavioral processes of change (POC) (Prochaska and Marcus, 1994; see Table 1).

The TTM uses the SOC to understand the dynamic process through which an individual transits when making an intentional exercise behavioral change. The stages identified for exercise behavior are pre-contemplation (PC; no intention of exercise), contemplation (C; intending to exercise within the next 6 months), preparation (P; exercising some, but not regularly), action (A; exercising regularly for less than 6 months), and maintenance (M; exercising regularly for 6 months or more). The TTM posits that stage transition results via stage-specific cognitive and behavioral process. The cognitive processes used most in the early stages include consciousness raising, dramatic relief, environmental reevaluation, self-reevaluation, and social liberation. The behavioral processes, more frequently used during the later stages, are counter conditioning, helping relationships, reinforcing management, self-liberation, and stimulus control. Further, each of the stages is characterized by changes in DB, the balance between benefits (pros) and costs (cons) associated with engaging in a behavior. DB is thought to be important for progression within the earlier stages (PC to P). SE, the perceived ability that one can engage in a behavior under given circumstances, is also incorporated into the TTM and is thought to be more important in the later stages (P to M) (Prochaska and Marcus, 1994).

The stage-matched intervention (SMI) is based on those main constructs derived from the TTM match intervention to the individual’s stages of readiness for exercise behavior. The TTM is based on the idea that people differ in their levels of readiness to change their behavior. Therefore, the SMI uses differing strategies and techniques to bring about exercise behavior change. Additionally, the SMI’s goals differ based on the individual’s level of motivation for change. The SMI highlights the need to assess physical and psychological issues when designing interventions and helps in the selection of strategies for exercise behavior change that may be most useful for people with different levels of motivation to change (Marcus and Forsyth, 2003).

Both longitudinal and cross-sectional studies have shown that the degree to which individuals endorse these constructs varies systematically with the current participation in exercise behavior (Bock et al., 2001; Marcus et al., 1998). A SMI program is the most effective

### Table 1

<table>
<thead>
<tr>
<th>Main strategies</th>
<th>Definition</th>
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<tbody>
<tr>
<td><strong>Cognitive processes of change</strong></td>
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<tr>
<td>Consciousness raising</td>
<td>An individual undertaking to find out more about exercise behavior</td>
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<td>Dramatic relief</td>
<td>Caring about consequences of inactivity or non-exercise</td>
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<tr>
<td>Environmental reevaluation</td>
<td>Understanding how inactivity affects the physical/social environments</td>
</tr>
<tr>
<td>Self-reevaluation</td>
<td>Seeing oneself as an active person</td>
</tr>
<tr>
<td>Social liberation</td>
<td>Awareness and acceptance of social changes encouraging active lifestyles</td>
</tr>
<tr>
<td><strong>Behavioral processes of change</strong></td>
<td></td>
</tr>
<tr>
<td>Counter-conditioning</td>
<td>Substituting alternatives for inactivity or non-exercise</td>
</tr>
<tr>
<td>Helping relationships</td>
<td>Seeking out social support to help adopt and maintain exercise</td>
</tr>
<tr>
<td>Reinforcement management</td>
<td>Using rewards to encourage or maintain behavior changes</td>
</tr>
<tr>
<td>Self-liberation</td>
<td>Choosing and making commitment to change, believing in one’s ability to change behavior</td>
</tr>
<tr>
<td>Stimulus control</td>
<td>Avoiding or controlling stimuli and other causes that support inactivity or non-exercise</td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>Confidence in being able to be active in a variety of situations</td>
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<tr>
<td><strong>Decisional balance</strong></td>
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<tr>
<td>Pros</td>
<td>Benefits of adopting or maintaining exercise behavior</td>
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<tr>
<td>Cons</td>
<td>Barriers or costs in adopting or maintaining exercise behavior</td>
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program because it can meet all of the individuals' needs based on their stages (Marcus et al., 1998). Whereas other programs are appropriate only to people who already have an intention to do an exercise, the stage-based intervention programs can be applied to all of the population, including people in the pre-contemplation and contemplation stages (Marcus and Simkin, 1993). Further, Ruggiero (2000) has reported that the TTM also provides a useful framework for helping people with diabetes change behavior. However, most previous studies have been conducted on healthy populations in community settings. Little research has specifically examined patients with type 2 DM in SK.

The purpose of this study is to develop the SMI using content validity with an expert group and evaluate the impact of the SMI in type 2 diabetic Korean participants. The SMI will promote the adoption and maintenance of exercise behavior among type 2 diabetic populations. For evaluation of the impact of the SMI, we hypothesize that an intervention group who participated in the SMI, compared to a control group, will show a more advanced SOC, higher physical activity levels, and greater reductions in fasting blood sugar (FBS) and glycosylated hemoglobin (HbA1c).

2. Methods

2.1. Development of the SMI

The TTM was used to guide the SMI design. In order to determine the appropriate content for the SMI, a questionnaire package was distributed to the type 2 diabetic Korean participants (n = 100) to gain data on the following: (a) distribution of SOC including their level of knowledge, attitude, intention and compliance to exercise behavior; (b) which strategies such as POC, SE, and DE are the most used corresponding to the each stage; (c) any specific difficulties and coping strategies in adopting and maintaining exercise behavior. The content for the SMI was determined by the results of the questionnaire package and remarks in the literature (Kim, 2002a).

For content validity an expert review and a panel discussion were conducted with 9 experts in SK. The expert group consisted of two medical doctors specializing in diabetes and preventive medicine, two nursing faculty also specializing in diabetic care, one diabetic education nurse, two exercise prescription specialists who are knowledgeable about diabetes, one health promotion faculty member who is knowledgeable about the TTM, and one exercise program specialist. The experts were asked to review and score 14 components of the SMI for content validity: (a) theoretical background and goal, (b) definition, (c) methods, (d) setting, (e) assessment tool for the current SOC and physical readiness, (f) five SMI packages, (g) main theme, (h) intervention goal and objectives, (i) main resources and strategies, (j) frequent needs or questions, (k) main counsel or answer guidelines, (l) glossary, (m) examples of exercise behavior, and (n) format of algorithm. They were asked to rate the importance of each component using a 4-point rating scale ranging from 1 (not at all important) to 4 (very important). The content validity index (CVI) of each component was calculated based on the experts’ ratings. The CVI score was computed by summing the percentage agreement scores of all components that were given a rating of “3” or “4” by the experts. Components were considered adequate if there was more than 79% agreement (Lynn, 1986). The mean agreement of the SMI was 90.0% (range: 83.3–97.2%). Finally, the SMI was revised by using the results of the content validity and then completed by the researcher (Kim, 2002b). The final version of SMI protocol is briefly summarized in Fig. 1.

2.2. Evaluation of the impact of the SMI

2.2.1. Research design

A control group pre- and post-test design was used for evaluation of the SMI. The participants were assigned to the two groups by group matching with current SOC. The independent variable was the SMI and the dependent variables were SOC for exercise behavior, physical activity levels, FBS, and HbA1c. The intervention group participated in the SMI during 3 months, while the control group received usual educational advice. The dependent variables were measured at baseline and immediately following completion of the intervention.

2.2.2. Participants and setting

Forty-five participants were recruited from an Outpatient Diabetic Center at a large University Hospital in SK, of whom 22 were in the intervention group and 23 in the control group. The study had ethical approval by the Institutional Review Board for human subject protection. Physicians were asked to review the medical record and condition of each patient and to then refer the eligible patient who met the following inclusion criteria: (a) less than 240 mg/dl of FBS and/or less than 10.0% of HbA1c, (b) less than 20 years of DM history with no chronic complications such as severe retinopathy, nephropathy, or neuropathy, (c) no evidence of heart disease, musculoskeletal disorders, or other disabling diseases that could restrict the exercise behavior training, and (d) no insulin. The researcher met the referred patients and obtained informed consent by those who agreed to participate in the study.
2.2.3. The SMI protocol

The SMI was designed for health providers in outpatient practice to promote the adoption and maintenance of exercise behavior. The 12-week SMI consisted of three components: (a) the stage-matched counseling strategies based on main constructs derived from the TTM such as POC, SE, and DB; (b) exercise behavior training based on an individualized exercise prescription obtained from graded exercise test (GXT) the participants had performed; and (c) telephone counseling.

2.2.3.1. Stage-matched counseling strategies (SMCS).

The SMCS protocols consisted of preplanned exercise counseling strategies that were individually tailored by targeting remarks of the questionnaire package based on the Korean diabetic participant’s use of constructs from the TTM (Kim, 2002a). The SMCS were provided individually to each participant during a 60- to 90-min initial counseling session with the researcher. The SMCS was made up of five packages corresponding to the participant’s current SOC (Kim, 2000b) and main strategies as they applied to exercise behavior: (a) for the PC package consisted of consciousness raising, DB, and SE; (b) for the C package consisted of dramatic relief, environmental reevaluation, self-reevaluation, DB, and SE; (c) for the P package consisted of self-liberation, reinforcement management, DB, and SE; (d) for the A package consisted of reinforcement management, helping relationships, counter-conditioning, stimulus control, and SE; and (e) for the M package consisted of self-liberation, reinforcement management, stimulus control, helping relationships, counter-conditioning, and SE (see Fig. 1).

2.2.3.2. Exercise behavior training. All participants were assessed for their present stage of readiness for exercise through the assessment tool for SOC. Then a GXT on a model Oxycon Delta treadmill (JAEGER GmbH, Wuerzburg, Germany) and an individualized exercise behavior prescription were performed: (a) Mode—brisk walking, stair climbing, cycling, climbing, jogging or running on treadmill, and household, leisure or job physical activity; (b) Frequency—3–5 days a week; (c) Duration—30 min of aerobic exercise and 5 min for warm-up or cool-down; (d) Intensity—low to moderate intensity, 40–75% VO₂max based on results of the GXT and physical condition of each participant; and (e) Progression—To adjust for cardiovascular and muscular adaptations from training, the program leader reassessed and adjusted participant’s heart rate responses at least for the first 2–3 weeks. Participants in
early stages (PC to P) performed the moderate activity described by the recent CDC/ACSM recommendation on physical activity (Pate et al., 1995). Multiple episodes of moderate intensity physical activity such as brisk walking can be accumulated in sessions of at least 10 min to reach the total of 30 min a day. The participants maintained weekly exercise behavioral logs, indicating the frequency, duration, and kcal for energy expenditure by pedometer. Adherence rate during the SMI was 87.5%.

2.2.3.3. Telephone counseling. Telephone counseling was provided for 10–30 min twice a week by the researcher who encouraged their confidence in being able to exercise in a variety of situations. Problems and concerns in performing the SMI were discussed. If the participant had any problems or concerns, they were informed to call the researcher at any time, and then they searched together for the specific and practical problem solving skills and coping strategies.

2.2.4. Measurement

Demographic variables including age, gender and duration of DM were assessed by the review of medical records upon entry into the study. Repeated measures included SOC for exercise behavior, physical activity levels, FBS, and HbA1c.

SOC were assessed using the stages of readiness for exercise behavior scale (Marcus and Simkin, 1993). The scale requires the subject to choose which of the five statements describes best his or her current exercise pattern and performance. Each of the statements corresponds to one of the SOC from pre-contemplation to maintenance: “I currently do not engage in physical exercise and I am not thinking about starting” (PC); “I currently do not engage in physical exercise but I am thinking about starting” (C); “I currently engage in some physical exercise but not regularly” (P); “I currently engage in regular physical exercise but I have only begun to do so within the last 6 months” (A); “I currently engage in regular physical exercise and I have done so for longer than 6 months” (M). Each stage was assigned a numeric value on a five-point continuous scale, with 1 representing the lowest level of readiness to change (PC) and 5 representing the highest readiness to change (M). This instrument has been shown to have adequate test-retest reliability (Kappa index = 0.78) (Marcus et al., 1992). It has also been shown to have good concurrent validity with the standard interviewer-administered 7-day physical activity questionnaire (Sallis et al., 1985), and construct validity of SOC for exercise behavior and physical activity (Cardinal, 1997; Schumann et al., 2002).

Physical activity levels were assessed using a self-report instrument adapted from the 7-day physical activity questionnaire (Sallis et al., 1985). The activity assessment questionnaire required the participant to recall their exercise starting with the same day 7 days ago. Time markers such as morning and lunchtime were used to increase the accuracy of recall. For each activity listed, the subject completed a section asking how often (frequency), how long (duration) and how intense (intensity) their physical activity bouts were. A physical activity energy score was calculated from time spent in various activities and standard metabolic equivalents (MET) for those types of activities. One MET is considered to be equal to 3.5 ml/kg/min (Sallis et al., 1985).

FBS was measured by BIOSEN 5030 autoCal, (EKF-diagnostic GmbH, Magdeburg, Germany; accuracy, failure <1.5% @ 12 mmol/l) and HbA1c, NycoCard READER II, (Axis-Shield PoC., Oslo, Norway; accuracy, failure <5%).

2.3. Statistical analyses

The SPSS statistical software package (Version 11.0 for Windows, SPSS, Chicago, IL, USA) was used to analyze the data. Descriptive statistics were used to characterize the sample and variables of the study. Chi-square test for categorical variables and t-test or Mann–Whitney U test for continuous variables were used to test differences between the intervention group and the control group, and paired t-tests were used to analyze differences between pre-intervention and post-intervention values.

3. Results

3.1. Participants' characteristics

Demographic characteristics and outcome measurements at baseline for participants are detailed in Table 2 and briefly summarized here. The mean age of the participants was 53.29 years (SD 10.21), and most participants were male (62.2%). The mean duration of diabetes was 7.39 years (SD 6.80). At baseline the two groups did not differ on any outcome measurements, including SOC for exercise behavior, physical activity levels, FBS, and HbA1c.

3.2. Impact of the SMI

Significant increases in overall SOC ($t = -3.53, p < 0.001$) and physical activity levels ($t = -4.78, p < 0.001$) in the two groups are shown in Table 3. The intervention group advanced (+ 0.95 score), whereas the control group did not change significantly. The percentage of participants who progressed from baseline in the intervention group was 77.4%, while in the control group it was only 4.3%. Significant differences in the
contemplation ($Z = -2.00, p < 0.05$), preparation ($Z = -2.52, p < 0.01$), and action stages ($Z = -2.43, p < 0.05$) between the two groups are shown in Table 4. Physical activity levels in the intervention group increased (+14.78 METs x h/week), whereas the control group did not change significantly.

Significant reductions in FBS ($t = 2.26, p < 0.05$) and HbA1c ($t = 2.44, p < 0.05$) between the two groups are shown in Table 3. In the intervention group FBS decreased ($-17.18$ mg/dl), whereas in the control group it increased ($+10.61$ mg/dl). With regard to HbA1c, the intervention group decreased ($-0.88$%), whereas the control group increased ($+0.41$%).

4. Discussion

This is the first controlled SMI based on the TTM designed to promote the adoption and maintenance of exercise behavior in SK. This study showed that the SMI for type 2 diabetic Korean participants improved SOC for exercise behavior and physical activity levels, and also decreased FBS and HbA1c.

The findings of this study were consistent with those reported in Western countries (Calfas et al., 1996, 1997; King et al., 2000; Lewis and Lynch, 1993; Marcus et al., 1997). In terms of SOC, our findings are similar to the significant differences in SOC that were found between a control group and those who received a stage-based intervention in the primary care setting (Calfas et al., 1996, 1997; Lewis and Lynch, 1993; Marcus et al., 1996, 1997). A high percentage (77.4%) of the intervention group in our study progressed in their SOC from baseline, whereas Lewis and Lynch (1993) reported that only 52% in their intervention group progressed. When comparing SOC of the present study with previous research, we also find that higher shift in stage is comparable to a previous study where 26% of a worksite health promotion project sample progressed a stage, 15% regressed or relapsed and 59% maintained (Calfas et al., 1997). It is important to note that our study did find that staged
approaches also resulted in a shift in stage in a clinical setting.

Significant changes in SOC resulted in concomitant changes in physical activity levels. Both physical activity levels and SOC also increased in our study. This finding is similar to the results of other studies (Calfas et al., 1996; King et al., 2000; Marcus and Simkin, 1993). This finding also supports previous result that found significant increases in both SOC and physical activity levels when physical activity was measured by walking and accelerometer scores (Calfas et al., 1996). The intervention group in our study increased physical activity levels from 14.65 to 29.43 METs x h/week. This finding in our study for all stages (PC to M) is higher than in a previous study for only sedentary patients (PC to P) with type 2 DM (Loreto et al., 2003). Loreto et al. (2003) have reported that their diabetic intervention group after having participated in a 2-year physician-based physical activity counseling program increased physical activity levels from 0.8 to 27.1 METs x h/week.

Recently, American College of Sports Medicine (ACSM) developed a new protocol to promote health through an accessible exercise program that includes populations with various chronic diseases (ACSM, 2000). For example, some studies report that even moderate physical activity is also useful (Burns, 1996; Houde and Melillo, 2000). Moderate physical activities are the same as walking 3–4 miles/h, consuming about 3–6 METs. This intensity is the one with which most people feel comfortable. Thirty minutes of continued physical activity or the sum of at least 30 min of intermittent exercise, 8–10 min per session, are considered moderate physical activities. Grounded in this background, the present study was done for participants in the early stages (PC to C) who had difficulty engaging in exercise. The types of moderate physical activities in our study were brisk walking, step climbing, taking a walk, and household, leisure, and job activity. The initial goal was set to at least 5 min of physical activity and then gradually increased to reach 30 min.

Significant differences in FBS and HbA1c were shown between the two groups in this study. These findings were consistent with those reported in previous studies among Korean diabetic participants (Hwang et al., 2000, 2001; Jun, 1994; Kim, 1989; Lee, 1990; Na et al., 1993). These findings are also similar to those of Western countries. For example, Agurs et al. (1997) reported that FBS and HbA1c decreased in type 2 diabetic participants after 12 weeks of aerobic exercise. In a moderate circuit training exercise study (Honkola et al., 1997) for type 2 diabetic participants, the intervention group significantly decreased HbA1c, compared to the control group. With regard to the clinical significance of our study, the observed outcome such as the reduction of HbA1c to below 7% can prevent diabetic complication. Similarly, data from the United Kingdom prospective diabetes study demonstrated that improving glycemic control by 0.9% reduced complications by 12% (i.e. diabetic retinopathy, nephropathy, and peripheral neuropathy, etc.) (Natarajan et al., 2002).

Some limitations of this study deserve mention. First, our sample was very small for conducting any meaningful analyses because individuals are categorized into SOC. The average of effect size changes in our study was calculated 0.92 (SD 0.40, range 0.61–1.49). However, large numbers of samples are required because there are

<table>
<thead>
<tr>
<th>SOC</th>
<th>Intervention group (n = 22)</th>
<th>Control group (n = 23)</th>
<th>Z</th>
<th>p</th>
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</thead>
<tbody>
<tr>
<td>Pre-contemplation stage</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>1.00</td>
<td>1.00</td>
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<tr>
<td>Posttest</td>
<td>3.00</td>
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<td>−1.83</td>
<td>0.07</td>
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<tr>
<td>Contemplation stage</td>
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<tr>
<td>Baseline</td>
<td>2.00</td>
<td>2.00</td>
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<tr>
<td>Posttest</td>
<td>4.00</td>
<td>2.25</td>
<td>−2.00</td>
<td>0.046</td>
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<tr>
<td>Preparation stage</td>
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<tr>
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<td>3.00</td>
<td>3.00</td>
<td>−2.52</td>
<td>0.01</td>
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<tr>
<td>Posttest</td>
<td>4.00</td>
<td>2.83</td>
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<td>Action stage</td>
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<td>4.00</td>
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<tr>
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<tr>
<td>Posttest</td>
<td>5.00</td>
<td>5.00</td>
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SOC denotes “stages of change”, SP denotes “stage progressed”, SM denotes “stage maintained”, and SR denotes “stage regressed”.

Table 4
Group differences in movement through the SOC
five categories in the TTM. Also, We had differences in SD for age between the intervention and the control groups in our study because of the lack of random assignment. This convenience sampling procedures used to recruit participants increased the possibility of bias.

Nevertheless, the importance of the SMI to nursing theory is the use of theoretical framework such as TTM-derived constructs to apply the exercise behavior change intervention. Most exercise interventions are designed without theoretical framework or for individuals who only do some exercise (P to A stages). When there is a mismatch between participants’ stages of readiness for change and the intervention strategy used, they are more likely to drop out of the program (Marcus et al., 1992; Marcus and Forsyth, 2003). Matching intervention strategies to people’s stages of readiness for change, such as the SMI, can improve not only the likelihood that they will regularly attend a program but also decreases the likelihood that they will stop participating in the program.

Another potential importance of the SMI to nursing practice is its usefulness for participants (PC to C) who are likely to most need change, yet few opportunities for change are offered to them. Many times these people are not motivated enough to seek out opportunities on their own. However, more than half the population is in early stages (PC to C). For instance, we studied a sample of Korean participants with type 2 diabetes (Kim, 2002a), and classified 15% in pre-contemplation stage, 33% in contemplation stage, 17% in preparation stage, 16% in action stage, and 19% in maintenance stage. Health providers in nursing practice or medical settings also need to be interested in helping people lead more active lives and need to think about other types of programs, such as the SMI, to offer participants who are in early stages.

5. Conclusions

The findings of this study conclude that the SMI may be useful by improving SOC for exercise behavior and physical activity levels, and also by decreasing FBS and HbA1c in participants with type 2 Diabetes. Future studies are suggested: (a) a study including a larger sample size; (b) a study examining its effectiveness in a variety of settings; (c) a study investigating the methods of delivering intervention; and (d) a comparative study examining the effectiveness of these two types of exercise behavior: thirty minutes of continued exercise behavior versus the sum of at least 30 min of intermittent exercise behavior, 8–10 min per session.

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