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Effects of Interactive Pictorial Education on Community Dwelling Older Adult's Self Efficacy and Knowledge for Safe Medication

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Purpose: The purpose of this study was to examine the effects of interactive pictorial education on community dwelling older Korean adults' self-efficacy and knowledge for safe medication. **Methods:** A quasi-experimental, three-group pre- and post-intervention design was used in this study. The interactive pictorial education was designed to suit the learning patterns and psychomotor skills of older adults. The education content, dealing with safe medication, was delivered over three sessions. A total of 136 older adults from local senior centers were assigned to one of the three groups: a) interactive pictorial education plus information booklet (experimental); b) education only with information booklet (conventional); or c) no intervention (control). **Results:** Participants receiving interactive pictorial education had significantly higher self-efficacy ($F=24.32$, $p<.001$) and knowledge ($F=24.26$, $p<.001$) scores than the information booklet or control group at post intervention. Post-hoc analyses indicated that both the interactive pictorial and the information booklet groups had significantly higher self-efficacy and knowledge scores than the control group at the post-test point ($p<.05$). Furthermore, the interactive pictorial group had higher self-efficacy and knowledge scores than the information booklet group at the post-test point ($p<.05$). **Conclusion:** These results suggest that the interactive pictorial education is an innovative approach that provides a means for older adults to learn appropriate medication use to improve their own health. It empowers older adults with different literacy levels to enhance their self-efficacy and knowledge for the safe use of medication.

Key words: Medication, Education, Aged, Self efficacy, Knowledge

INTRODUCTION

Korean older adults living in communities often experience chronic illness and take multiple medications, such as over-the-counter (OTC) medicines, nutritional supplements, and prescription medicines. Therefore, they are potentially at high risk of adverse drug interactions (Ministry of Health and Welfare, 2009). According to the Korean Elderly Survey conducted by the Ministry of Health and Welfare, 84.5% of people older than 65 years take over-the-counter (OTC) medicines, nutritional supplements, or prescription medicines. In addition, 27.5% of them take more than three types of medicines. Adverse drug interactions resulting from polypharmacy raise major concerns for the optimal health of older adults. Thus, medication complexity and adverse effects resulting from polypharmacy have been associated with increased number of hospital admissions (Han, 2007).

The administration of medications and the monitoring of their effects in elderly patients are important nursing roles and nurses have to demonstrate professional knowledge, skills and increased responsibility (Neafsey et al., 2009). Several studies in Korea have highlighted the role of the nurse in educating or assisting the elderly clients to develop appropriate knowledge and behaviors required for self medica-

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tion. When the elderly clients were provided with both verbal and written instructions, in group or at individual level, knowledge and compliance behaviors improved (Katz, Kripalani, & Weiss, 2006). However, education on self management of medication is typically delivered with written and verbal information and may not be fully understandable by all older adults, who have different literacy levels and expectations (Lee & Park, 2007; Shin, Kim, Kim, & Yi, 2005). Low functional health literacy has been found to be an important factor of medication non-adherence, leading to poor health outcomes (Lee & Kang, 2008; Lee & Park, 2010). People with low health literacy will have difficulty learning information from many written medical materials, including medication instructions (Dimateo, 2004). The limited literacy skills of a large proportion of the Korean elderly present a significant barrier to accessing and understanding medicine information necessary for the degree of adherence required for a successful health outcome (Lee & Park, 2010). The challenge facing healthcare providers is to communicate health information in an understandable form, which is appropriate for the literacy skills, culture, and expectations of the target population.

Research has shown that visual aids can increase the patient's understanding. Furthermore, visual cues accompanied by oral instructions have increased the patient's recall more than oral instructions alone (Houts, Doak, Doak, & Loscalzo, 2006). Interactive pictorials are visual tools designed to be used in small, interactive group or individual education, where participants can learn about specific topics (Mansoor & Dowse, 2004). A pictorial is a graphic tool used to create, manage, and exchange information and knowledge. The use of interactive pictorial education may increase the patient's understanding of medication instructions. Especially, the pictorial map represents information and knowledge via the spatial organization of concepts/topics, ideas, words, or other items, linked to and arranged in an ordinal pattern according to the education contents. Visual mapping diagrams of ideas and concepts are widely acknowledged as a very powerful and fun learning tool (Sojourner & Wogalter, 1998).

The pictorial map and cards can incorporate meaningful pictograms to present the flow of ideas. As graphic knowledge representation tools, they provide written, visual, and spatial information and this combination is more likely to be retrievable from memory than written information alone. An interactive pictorial detailing the education contents may be a useful tool to communicate critical medication information to low literate elderly patients and the education provider and the receiver can interact like in a game. Pictorial aids used with verbal education and written materials can further the patients' understanding of safe medication and, therefore, can potentially improve their medication adherence and health outcomes (Hill, 2004).

The concept of self-efficacy, as a major factor in behavioral changes, was proposed by Bandura (1986) and refers to the belief or confidence that one can successfully perform a specific action required to attain a desired outcome, and is an important predictor of medication adherence (Molassiotis et al., 2002). Previous research suggests that self-efficacy is a strong predictor of treatment adherence, and that it serves as a useful basis for interventions (Molassiotis et al.; Scherer & Bruce, 2001).

In addition, knowledge for appropriate medication is an important factor to improve the patients' medication adherence and safe medication. Data from previous studies reported that older adults with inappropriate knowledge of medication are at risk of medication misuse and abuse (Park, 2008).

Therefore, this study examined in older adults living in the community the effectiveness of interactive pictorial education as education strategy to reduce medication misuse and non-adherence, thus improving self-efficacy and knowledge towards safe medication.

1. Purpose of the Study

This study examined how an interactive pictorial education for safe medication was used to increase older adults' self-efficacy and knowledge of safe mediation.

Specific hypotheses related to the outcomes of the interactive pictorial education were tested in this study, as follows:

First, subjects receiving the interactive pictorial education plus information booklet (experimental group) will show greater self-efficacy for safe medication than subjects receiving education only with information booklet (conventional group) or no intervention (control group).

Second, subjects receiving the interactive pictorial education plus information booklet (experimental group) will show greater knowledge of safe medication than subjects receiving education only with information booklet (conventional group) or no intervention (control group).

METHODS

1. Study Design

A quasi-experimental, three-group pre- and post-intervention design was used to examine the effects of interactive pictorial education on community dwelling older adults' self-efficacy and knowledge for safe medication.

2. Setting and Samples

One hundred fifty older adults, from fifteen senior centers in a metropolitan city in Korea, were selected. Ten older adults were selected from each center. Five centers were assigned to three groups respectively. The study was conducted from February 15 to April 8, 2011. Subjects were at least 65 years of age by self-report. Study participants were able to: perform activities of daily living; were cognitively aware; able to understand education; taking one or more prescription or OTC drugs; and were willing to sign the consent form. Subjects were screened for visual acuity, using the pocket vision screener (Rosenbaum, Graham-Field Surgical Co., New York, USA). To be included in the study, subjects had to have a visual acuity of at least 20/100, with corrective lenses, as needed. Those who met the inclusion criteria were assigned to one of three groups, with the goal of retaining 45 subjects per group, to yield sufficient statistical power (.80) to detect medium differences between groups (moderate effect size = .40) at an alpha of .05. Fifty subjects per group were recruited to allow for a 10% attrition rate for the study (Cohen, 1988).

Data were either anonymous (i.e., self-report instruments and surveys) or confidential (assessment of inclusion criteria) and posed no physical or psychological risk to subjects. Individual subjects were not identified in the analyses or in reporting of data and results. All study participants were asked to sign an informed consent form that was read to them and explained, if needed.

A total number of 136 subjects completed the study: 45 experimental subjects (interactive pictorial education plus information booklet), 45 conventional subjects (education with information booklet), and 46 control subjects (no intervention). Five subjects from the experimental group, five from conventional group, and four from control group were unable to complete the study because of illness of either the subject or the spouse or personal reasons.

3. Measurements

Two instruments to measure outcomes were used: a measure of self-efficacy and an objective test to measure knowledge. Information gathered during the focus groups guided the choice of phrasing (i.e.,, specific drugs mentioned, and the language used with reference to behaviors). Instruments were printed in a large (14-point) Arial font. Instruments were reviewed for content validity by a panel of six expert judges (two nursing faculty members, a pharmacologist, a pharmacist, and two community health nurses), using the standard procedures for item review (Grant & Davis, 1997).

1) Self-efficacy for safe medication

Self-efficacy is the confidence in one's ability to perform a given task and an important determinant of one's behavior (Bandura, 1986). In this study, self-efficacy for safe medication is the confidence in older adult's ability to use medication appropriately. The Self-Efficacy for Appropriate Medication Use Scale (SEAMS) developed by Risser, Jacobson, and Kripalani (2007) was used in this study. Permission to use the instrument was obtained from the authors. The instrument was translated into Korean and back translated by a bilingual speaker who can freely use English and Korean. Both the original and the back translated English versions were assessed by an English native speaker and the Korean versions of the instrument were revised and re-translated when there were semantic differences between the two versions. The 13-item self-efficacy measure consists of two dimensions; first is assessing the self- efficacy for taking medicines under difficult circumstances, such as when patients are busy, away from home, or have multiple medications to take. The second is assessing the self- efficacy for taking medications under uncertain or changing circumstances, such as when the patient is unsure about how to take the medications or changes are made to the therapeutic regimen. Patients were asked to indicate their level of confidence in taking medications correctly, under a number of different circumstances (i.e., 1 = not confident, 2 = somewhat confident, and 3 = very confident). Higher scores indicated higher levels of self-efficacy for safe medication. The instrument was pilot tested on 30 volunteers recruited from senior centers which were not involved in the present study. The Cronbach's alpha coefficient was .890 for the original study (Risser et al., 2007) and .904 for this study.

2) Knowledge for safe medication

Fifteen questions, with possible 'yes/no' answers, were developed by the researcher based on the outline of the education contents and on previously developed instruments (Han, Moon, Park, & Park, 2000; Lee & Park, 2010). Each question was formulated based on examples of actual self-medication behaviors and tested both the knowledge and the application levels of Bloom's taxonomy of the cognitive domain (Bloom, 1956). The total number of correct answers was used in the analysis (i.e., correct = 1, incorrect or don't know = 0). Total scores could range from 0 to 15 with a higher score indicating a greater knowledge of safe medication. The content validity was assessed and the items were pilot tested on the same individuals enrolled for the pilot study of the self-efficacy instrument. Both difficulty and discrimination indices were used to select the most content-valid set of 15 items, which were then revised to improve clarity. Difficulty indices were between .30 and .80 and discrimination indices were all over .20 (Owen, 1993).

4. Procedure

The following guidelines were used to develop the interactive pictorial education, as previously presented by (Sjourner & Wogalter, 1998); Collaborate with the target population and gain insight into their knowledge, beliefs, attitudes and expectations; Use familiar objects and symbols; design simple, realistic pictures, with a limited content; Use the whole body image, as isolated organs may cause confusion; Use multiple-stage pictures with caution; Use abstract symbols, symbols depicting motion and symbols conveying perspective with caution; Use background space appropriately; If used, colors should be as realistic as possible; Use the appropriate size and magnifications; And pre-test new pictograms in the target population.

The interactive pictorial education was designed as a pictorial guide map, with pictorial cards for users. The interface design was based on the learning styles of older adults (Houts et al., 2006). Focus groups of older adults evaluated the education components in a formative manner during development of the instrument. Ten older adults were recruited to participate in focus group. The focus group consisted of 4 male and 6 female older adults and 60% were aged 75 old over.

The pictorial map was used to visualize the content of education and to guide the steps of contents. On pictorial cards, the text of instructions was written in a large, bold font (14-point), to accommodate the expected functional health literacy levels and eyesight (Lin, Neafsey, & Strickler, 2009; Wilson, Mood, & Nordstrom, 2010). The navigation arrows on the map were guiding the direction of the education. The card size allowed easy use for individuals with such conditions as arthritis or hand tremors.

The interactive contents were interspersed throughout the map. The education content was developed by the researcher based on the review of related research and programs, and focused on safe medication. The contents are parallel items for the self-efficacy and knowledge tests. Ten experts evaluated the education content. The expert group consisted of five professors from nursing, pharmacology, education, computer technology, and animation and four nurses and one pharmacist. The 40 by 60 cm pictorial map with symbolic images could be used, as the guide to help small groups explored a variety of medication related situations and contained a bundle of quizzes and activities. The participants used drawing pieces to mark their progression through the educational contents. The pictorial map guided interactive discussions, which facilitated the older adults' ability to understand safe medication. The final goal of the map was for the individual older adult to manage safe medication use independently (Figure 1). The map addresses a wide range of topics, from reading the medication label to instructions on how to improve safe medication such as calculating the dosage, keeping the medication log, identifying side effects, avoiding drug interaction, and so on. Each stop point on the map comes with a guide and a set of questions on the cards used as a framework by the facilitator, to lead the discussion. For example, the first question asked when using the map was to explain the information from the medication label, such as medication name, usage, side effects, interactions, warnings, and storage (Figure 2).

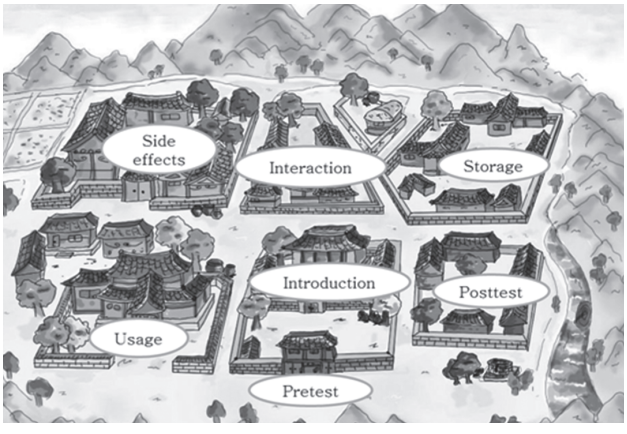

Figure 1. Interactive pictorial map for education.

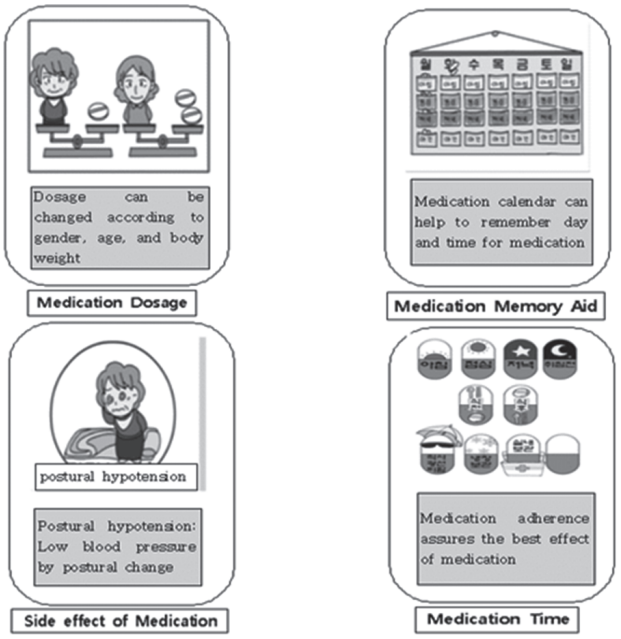

Figure 2. Interactive pictorial cards for education.

In addition, questions were provided for all items and presented potential self-medication dilemmas. The answers were selected by choosing cards labeled as O or X. Each "incorrect" choice triggered a feedback message in red explaining why the choice was undesirable, then the user was directed to 'try another answer.' When the correct answer was selected, a feedback in blue stated why the choice was desirable one and directed the user to follow the arrow to continue.

The education was delivered in small groups over three sessions once a week for three weeks. Each session took about 40 minutes. One group consisted of 5-6 older adults. The researcher and the trained research assistants delivered the education to each small group in a room provided by the senior center. The information booklet group received the conventional education of the same contents as the experimental group and received written text information over three 40 minute-sessions. The control group received no intervention.

The study outcomes were measured at pre-test and post-test. The pre-test was measured one week before the first session and the post-test was measured right after the last session. Face to face interview was conducted for about 20 to 30 minutes per subject to complete the questionnaire.

5. Ethical Considerations

Approval for this study was obtained from the Institutional Review Board. During the selection procedure in the local senior center, the purpose and procedures of the study were explained to the director for approval, at each senior center. Once approval had been granted to conduct the study, the subjects gave their written consent during the initial contact.

6. Data Analysis

The SPSS WIN statistical package version 18.0 (SPSS Inc., Chicago, Illinois, USA) was used for data analysis. Both univariate and multivariate outlier screening techniques were used. Descriptive statistics were used for both general and medication-related characteristics. Comparisons were made with the baseline data and the post-test data. Homogeneity of the three groups was verified using the χ^2-test, one-way ANOVA. One way ANOVA were performed on both self-efficacy and knowledge scores. The Tukey's test was used post-hoc to determine the statistical significance of the differences between the means at post intervention.

RESULTS

1. General characteristics and outcomes characteristics of the subjects

Baseline characteristics of the subjects are shown in Table 1. The mean age was 76.0 (SD = 6.0). There were no initial differences between the three groups in gender, age, education, literacy, marital status, economic status, and health and medication-related characteristics. About 75% of the subjects received only elementary education or no formal education. The baseline self-efficacy score was 26.30 ± 3.92 for the interactive pictorial plus information booklet group, 26.70 ± 3.20 for the information booklet group, and 25.33 ± 4.06 for the control group. The baseline knowledge scores were 8.36 ± 1.88, 8.11 ± 2.09, and 8.03 ± 1.81, respectively. At baseline, there were no differences between the groups in self-efficacy and knowledge of safe medication (Table 2).

2. Effects on self efficacy and knowledge towards safe medication

Maximum mean self efficacy was measured with interactive picto-

Table 1. Homogeneity Test for General Characteristics between the Experimental Group and Control Groups (*N* = 136)

Characteristic	Categories	Interactive pictorial (n = 45)	Information booklet (n = 45)	Control (n = 46)	χ^2 or F	*p*
		n (%)	n (%)	n (%)		
Gender	Male	21 (46.7)	22 (48.9)	22 (47.8)	10.50	.228
	Female	24 (53.3)	23 (51.1)	24 (52.2)		
Age (yr)	65-69	7 (15.6)	9 (20.0)	7 (15.6)	5.52	.523
	70-74	12 (26.7)	14 (31.1)	11 (24.4)		
	75-79	10 (22.2)	10 (22.2)	13 (28.9)		
	≥ 80	16 (35.6)	12 (26.7)	14 (31.1)		
	M (SD)	76.0 (6.5)	74.6 (5.8)	76.8 (6.0)	76.0 (6.0)	
Education level	None (illiterate)	4 (8.9)	5 (11.1)	5 (10.9)	6.91	.103
	None (literate)	6 (13.3)	6 (13.4)	7 (15.2)		
	Elementary	23 (51.1)	22 (48.9)	22 (47.8)		
	Middle school	10 (22.2)	11 (24.4)	10 (21.7)		
	≥ High school	2 (4.4)	1 (2.2)	2 (4.4)		
Marital status	Married	20 (44.4)	20 (44.4)	19 (41.3)	1.90	.070
	Bereavement	22 (48.9)	23 (51.2)	25 (54.3)		
	Divorced	3 (6.7)	2 (4.4)	2 (4.4)		
Income	Low	15 (33.3)	14 (31.1)	14 (30.4)	6.01	.786
	Medium	17 (37.8)	20 (44.4)	20 (43.5)		
	High	13 (28.9)	11 (24.4)	12 (26.1)		
Health condition	Very good	5 (11.2)	7 (15.6)	5 (10.9)	2.05	.057
	Good	12 (26.7)	9 (20.0)	13 (28.3)		
	Fair	20 (44.4)	21 (46.7)	19 (41.3)		
	Somewhat bad	6 (13.3)	6 (13.3)	8 (17.4)		
	Very bad	2 (4.4)	2 (4.4)	1 (2.1)		
Number of medical diagnosis	0	1 (2.2)	3 (6.7)	2 (4.3)	1.81	.454
	1	20 (44.4)	18 (40.0)	20 (43.6)		
	2	18 (40.0)	12 (26.7)	14 (30.4)		
	3	5 (11.1)	9 (20.0)	8 (17.4)		
	4	1 (2.3)	3 (6.6)	2 (4.3)		
Number of medication	1-2	20 (44.4)	17 (37.8)	18 (39.1)	0.23	.891
	3-4	18 (40.0)	20 (44.4)	19 (41.3)		
	Over 5	7 (15.6)	8 (17.8)	9 (19.6)		

Table 2. Homogeneity Test for the Scores of Self-Efficacy and Knowledge between the Experimental Group and Control Groups (*N* = 136)

Measurement	Interactive pictorial (n = 45)	Information booklet (n = 45)	Control (n = 46)	F	*p*
	Mean ± SD	Mean ± SD	Mean ± SD		
Self-efficacy	26.30 ± 3.92	26.70 ± 3.20	25.33 ± 4.06	5.55	.406
Knowledge	8.36 ± 1.88	8.11 ± 2.09	8.03 ± 1.81	2.60	.267

rial group at post intervention (30.61 ± 3.36), and 28.68 ± 3.18 for information booklet group and 25.36 ± 4.01 for control group at post intervention (Figure 3). One-way ANOVA (Table 3) revealed significant difference among groups for self efficacy (F = 24.32, $p < .001$). Maximum mean knowledge was measured with interactive pictorial group (11.81 ± 2.13) and 10.20 ± 2.50 for information booklet group and 8.30 ± 1.87 for control group at post intervention (Figure 4). Oneway ANOVA (Table 3) revealed significant differences among groups for knowledge (F = 24.26, $p < .001$). Post-hoc analyses indicated that both the interactive pictorial and the information booklet groups had significantly higher self-efficacy and knowledge scores than the control group at the post intervention point ($p < .05$). Furthermore, the interactive pictorial group had higher self-efficacy and knowledge scores than the information booklet group at the post-test point ($p < .05$).

DISCUSSION

This study evaluated the effects of interactive pictorial education

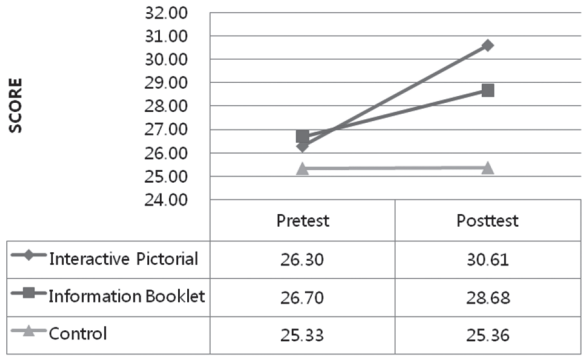

Figure 3. Changes in the scores of self-efficacy for three groups.

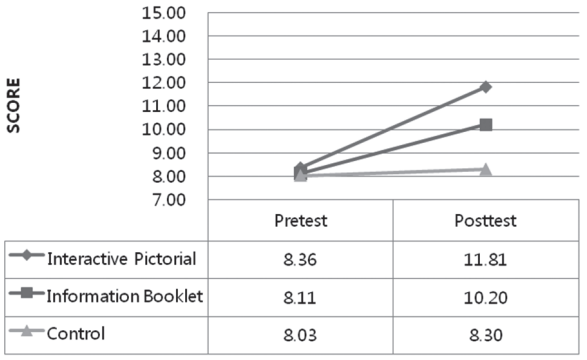

Figure 4. Changes in the scores of knowledge for three groups.

Table 3. Result of Oneway ANOVA for Self Efficacy and Knowledge (*N*=134)

Source	SS	df	Mean Square	F	*p*
Self Efficacy*					
Between groups	734.01	2	367.01	24.32	<.001
Within groups	2,671.10	133	15.09		
Total	3,405.11	135			
Knowledge†					
Between groups	214.21	2	107.11	24.26	<.001
Within groups	781.45	133	4.42		
Total	995.66	135			

*post-hoc Tukey's test: The interactive pictorial education plus information booklet group >education only with information booklet group >no intervention group; †post-hoc Tukey's test: The interactive pictorial education plus information booklet group >education only with information booklet group >no intervention group.

on self-efficacy and knowledge towards safe medication of community dwelling older adults in Korea. Data from this study support all study hypotheses. The recipients of the interactive pictorial education plus information booklet showed greater self-efficacy and knowledge of safe medication than both the group receiving the conventional education only with the information booklet and the control subjects who received no information. The improvement in self-efficacy and knowledge with the intervention suggests that older adults benefit from visual aids tailored to their learning style and aging characteristics. This study tested an innovative approach that is different from the previous studies using the pictorial map and cards to facilitate older adults' participation and comprehension of education.

At baseline, the overall initial self-efficacy score was medium and knowledge towards safe medication score was relatively low, indicating that Korean older adults in the community need an educational intervention to improve their medication self-efficacy and knowledge. Data from previous studies reported that older adults typically take multiple medications and are at high risk of adverse drug interactions (Fialova et al., 2005). In addition, their knowledge concerning potential interactions arising from self medication and the self-efficacy to avoid such incidents was low (Kripalani et al., 2007; Neafsey, Strickler, Shellman, & Padula, 2001).

The experimental group showed significant increase of self-efficacy and knowledge compared to those of the information booklet group and the control group. Mild to moderate improvement in self-efficacy was reported in previous studies using pictorial aids with interaction (Kripalani et al., 2007; Neafsey et al., 2009). This demonstrated that the use of an educational aid, such as visual materials with active interaction, allowed older adults to use medication appropriately and increased their confidence. Research in psychology and education indicates that human subjects have a cognitive preference for picture-based, rather than text-based, information (Katz, Kripalani, & Weiss, 2006). In this way, medication-related pictorial aids, that describe appropriate medication-taking behaviors, can help patients to reduce their medication misuse and overuse behavior. In this study, pictorial aids with written information booklet were used in the experimental group. The findings of this study supported previous studies. Several studies emphasized the importance of using pictures in conjunction with either written or oral instructions to avoid misinterpretation of picture only instructions. Dowse and Ehlers (2005) assessed both comprehension and adherence to treatment using either text-only (control) or text-plus-pictogram (experimental) information for prescribed antibiotics in a mostly female population with low literacy level. The text-plus-pictogram group showed higher comprehension and medication adherence (95% and 90%, respectively) than those in the text only group (70% and 72%, respectively). Sojourner and Wogalter (1998) assessed the effect of pictures on patients' comprehen-

sion of simulated medication schedules. Participants recalled significantly more medication information when presented with the redundant text and pictures than with text alone, pictures alone, and text with only some pictures. Patients found pictures most helpful for obtaining information about medication name, daily dose, and times to take the medication, but found them less useful for showing drug interactions.

Research indicates that visual aids have been an effective aid to both comprehension and recall of information, if combined with text and verbal interaction in small group education (Andrus & Roth, 2002; Lee & Park, 2007). In this study, we delivered the small group based education, allowing active interaction between the instructor and the participants. This small group approach allowed enough time for the older adults with different literacy levels to understand the education contents and facilitate the interaction. The problem in older adults with low literacy level is their inability to read the text. Therefore, we consider that in this population, pictorial aids should always be used in conjunction with verbal instructions. Older adults with low literacy level comprise a population with special needs, who are at higher risk of experiencing poor health. Compared to traditional education methods, interactive pictorial education focuses on participant-directed discussions and on shared problem-solving with self medication (Sawhney & Reicherter, 2005).

This study has also shown that the pictorial education can be successful in communicating medication information, particularly if they are developed in collaboration with the target population. Previous studies recommended that pictorial aids needed to be developed based on the target user's culture level and learning style. In this study, the researcher developed the pictorial aids while working with the focus group of older adults in a formative manner, during the development phase (Neafsey et al., 2001). The revision of the contents and designs was made based on the opinions from the focus group such as use of easy terminology, big size of text, use of simple graphics and familiar subjects and so on.

The findings from the studies of pictorial memory suggested a large storage capacity for visual information and good retention of pictures over time (Dowse & Ehlers, 2005; Mansoor & Dowse, 2004). They also reinforced the importance of incorporating a follow-up phase in the testing process and demonstrated that the pictorial aids were easily learned and subsequently recalled over a prolonged time. This study tested only the difference between the pre- and post-test effects; therefore future study is needed to test the long term effects.

This study had several limitations and these limitations can be addressed through future research. First, the education contents used in this study involved simulated usage instructions, usually for a single treatment, rather than one or more real drugs prescribed in the study participants. Because older adults with chronic disease usually take multiple medications, we need to explore the effects of individualized education, according to the older adults' health state and medication-related characteristics. Second, the outcome variables in this study were self-efficacy and knowledge of medication. Additional research is needed to measure other clinical outcome data, such as medication adherence behavior, biological markers, and health related quality of life.

CONCLUSION

The interactive pictorial education is an innovative approach that provides a mean for older adults to learn the appropriate medication use for improving their own health. It empowers older adults with different literacy levels to enhance their self-efficacy and knowledge for the safe use of medication. The results from this study demonstrate that the study sample of older adults benefited significantly from this innovative approach of health education. Moreover, augmentation of conventional (written) health education via an interactive visual concept map provided participants with the significant overall advantage of increased knowledge and self-efficacy.

Future studies, using subjects with lower education levels, are needed to confirm whether the interactive pictorial approach can help remove the barriers of advanced age and limited education in health literacy efforts.

The sample used for this study was recruited from senior centers in a single metropolitan city. Consequently, the results of this study cannot be generalized to the entire population of older adults in Korea. Data from future studies will help to determine if the interactive pictorial education is equally effective with the older adults in both rural and urban areas. Moreover, future research will include study of a sample population in home care settings or clinical settings, to support the efficacy of the approach across various settings, as well.

In this study, the effectiveness of the intervention was measured at pre- and post-test points. Prospective long term studies may ultimately reveal that health education presented in this manner benefits older

adults in the assimilation of knowledge and self-efficacy necessary to avoid costly medication interactions and their consequent adverse health effects.

The implications for future practice are related to the delivery of various health information to older adults via interactive visual aids. In the community setting, interactive pictorial education can be adapted to cover broader topics, related to both health promotion and disease management. In addition, the computer assisted pictorial education has the potential to revolutionize health education for older adults. Computer assisted interactive pictorial education can be provided to older adults as a self-education method. Additionally, computer assisted interactive pictorial education may provide both timely and appropriate individualized interventions and evaluations for older adults with various diseases and health information needs. Personalized health education for older adults, based on this innovative approach, could promote meaningful continuity of care and could amend any potential gaps between the clinical and the home care settings.

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