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Effects of a Video-Based Infection Control Education Program Applying the Social Cognitive Theory on Caregivers

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ABSTRACT

This study was conducted with a non-equivalent control group experimental design to investigate the effects of a video-based infection control program through the application of the social cognitive theory on caregivers. Forty-six caregivers were recruited, with 23 pairs being randomly assigned to the control and experimental groups each. While the experimental group took part in the video-based education, the control group was involved in typical lectures. For two weeks, both groups were educated on the principles of infection control, medical and external handwashing, standard precautions, and quarantine. Their knowledge, performance, and self-efficacy were evaluated before and after the program. There was a significant increase in knowledge ($p<.001$ and $p=.005$) and infection control performance ($p<.001$) in the experimental and control groups. Similarly, self-efficacy, self-regulatory efficacy, task-difficulty preference and confidence significantly increased in the experimental group ($p<.001$). In the control group, only task-difficulty preference significantly increased ($p=.005$). Consequently, the online video-based infection control education program applying the social cognitive theory proved effective in improving the caregivers' knowledge and performance in infection control, and their self-efficacy. We suggest the use of this program in effective infection control education for caregivers in the future.

Key words*: Caregivers, Social Cognitive Theory, Infection Control, Self-efficacy.*

1. INTRODUCTION

1.1 Background

Nowadays, where travels between countries is freer than ever, infection prevention can no longer be the concern of a single individual, group, or country. The outbreak of new viruses, such as severe acute respiratory syndrome (SARS), Middle East respiratory syndrome coronavirus (MERS-CoV), and the Zika virus, has become a worldwide issue nearly every year. Accordingly, the World Health Organization (WHO) has implemented an international infection control campaign, Clean Care is Safer Care [1]. The United States, with its leading public health system, has been expanding the scope of infection control by involving social welfare facilities over the last three decades [2] and has been running comprehensive infection control programs in long-term care facilities [3] Similarly, European countries such as Germany, Norway, and the United Kingdom have been conducting research on infection control in social welfare institutions [4]. Although South Korea has promoted infection control efforts, these are entirely centered on medical institutions—there are no strict standards for welfare facilities, including long-term care facilities [5]. As a result, the importance of infection control in such facilities has been emphasized. Indeed, because infection control should not be limited to certain domains or treatments, but must be ensured throughout the entire nursing process [6], infection control within senior care facilities should be treated as an important issue. Infection control in long-term care facilities is especially challenging because of the proportion of in-house health professionals such as nurses in these facilities [6]. Caregivers are trained under the long-term care insurance policies in effect since July 1, 2008, and must possess national certificates [7]. They are the main nursing workforce in long-term care facilities, accounting for 71.4% of the entire workforce. Therefore, the importance and need for infection control education in this population has been increasing [8].

Unfortunately, such education is not provided on a regular basis, and smaller care facilities (which tend to be more vulnerable to infections), tend to be less likely to employ such education [1]. While three hours of theory lessons are given as part of the caregiver training program, there are no other standardized data on the systematic methods of education on infection control for caregivers; indeed, it is often unclear whether infection control education has been implemented or not [9]. Studies have shown that anywhere between 12.8% and 16.3% of caregivers have received no education on infection control [8], [10]. Although some educational institutions provide infection education as part of on-the-job training, increasing caregivers' participation in such education can be a

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challenge. In particular, it can be difficult for caregivers to consistently participate in infection control education because of high job turnover, resulting from the low wages and excessive workloads [10]. Therefore, it would be necessary to introduce educational content on infection control that promotes caregivers' participation and voluntary learning. So far, only a single study, to our knowledge, has implemented an infection control education program for caregivers [11]. The purpose of this study is to design an infectious disease management education program by applying social cognitive theory, considering that it is no longer appropriate for nursing care workers to confine to knowledge-intensive education. Such education is expected to improve their knowledge on infection management to lead to attitude and behavior change. The Social cognitive theory is the theory of psycho-social dynamics that affect individual behavior and how to promote behavior change. The results of this study are as follows. First, it is important to examine the relationship between the behavioral factors and the environmental factors. The social cognitive theory is based on the theory that the nonobvious interaction of behavioral environmental factors as well as individual factors influence an individual's behavior (Bandura, 1986) [12]. It is important to establish infection control habits so that the effectiveness of infection control education can be maintained even upon the completion of the education. Therefore, we developed a program that focused on the possibility of effective behavior change, motivation, knowledge, skill acquisition, and self-efficacy.

Therefore, the present study aimed to implement a video-based infection control education program for caregivers, and compare it to lecture-based teaching. Online video-based education is based on an interactive teaching and learning method, which contrasts with the one-way education often used by teachers currently. Such education methods tend to be advantageous in that they allow for continuous learning, and reduce costs because they are relatively free of time or space constraints [13]. Furthermore, Internet-based learning has the advantage of being highly flexible in terms of the time and place of learning, such as being able to set the learning time by oneself without being attached to a specific place [14], [15]. Web-based education is used in job improvement programs, providing for diversiform of learners' needs. It also has the advantage of making continuous learning possible by increasing "space-time accessibility" to learners who cannot receive education at regular times [16]. Web-based education has shown improvement in knowledge and performance [13], [17], [18]. Self-efficacy was improved after Web-based management training for nursing students and nurses; the higher the self-efficacy of the nursing provider, the better the field adaptability [19], [20].

Caregivers in long-term care facilities tend to spend considerable time with their patients, which means that they should understand and practice infection control principles. However, infection control education for caregivers in these facilities is not legally mandatory, and it has not been confirmed whether or in which cases such education is actually given. It is imperative that infectious disease management education be given in long-term care facilities, and for nursing care staff to recognize the need for such education and participate in it voluntarily. Video content has been employed in regular infection control education for caregivers working in long-term care facilities. By implementing an education program social cognitive theory that maximizes the auditory and visual material, and assessing its effects, we aim to enhance caregivers' performance, as well as improve infection control in public facilities such as long-term care facilities.

1.2 Study Purpose; The purpose of this study is to implement an infection control education program based on video contents for caregivers and to investigate the effects on infection control knowledge, performance ability, and self-efficacy and compare those effects with the effects of lecture-based education.

2. METHODS

2.1 Study Design: Participants were divided into an experimental group (who took part in the video-based infection control education) and a control group (who took part in typical lecture-based education). To prevent diffusion effects between the two groups, we had the control group complete the preliminary assessment and lecture-based education first. The experimental group completed the same assessment, followed by the video-based infection control education. The infection control education program contains a total of 100 minutes of content. The video-based program was delivered over two weeks; all content was released once every two weeks, and participants were not restricted in the number of times they could go through the content. The lecture-based program was conducted by the researcher in weekly 50-minute sessions over two weeks. It contained the same content as the video-based program. When the education program was completed by each group, the post-test assessments were performed. Because the pre- and post-test assessments were separated by an interval of around two weeks, we conducted both during participants' visit to the educational institution to ensure their homogeneity and reliability.

2.2 Data collection and Participants: Participants were caregivers who had been trained at I Caregiver Training Institute in I City, Gyeong-gi Province, were employed at long-term care facilities, and gave written consent to participate in this study. Individuals who did not plan to work as caregivers, or had obtained their caregiver license less than three months prior to the study, were excluded. Study participants were recruited between December 2016 and January 2017. A total of 50 caregivers were eligible for inclusion. From these, 50 persons were randomly assigned to the intervention or control group. During the study period, two participants from each for the control and experimental groups dropped out

The sample size was calculated based on the results of a previous study measuring the effects of a Web-based VRE infection control education program on nursing students [13] using G*power 3.1. With an effect size of .09, a significance level of .005, and a power of .08, the number of participants needed for an independent t-test was 16 each for the control and experimental groups. Thus, considering the dropout rate, 25 participants were assigned to the experimental and control

groups. There were two participants from each for the control and experimental groups dropped out. So data from a total of 46 caregivers were analyzed.

2.2.1 Data collection: Before starting this study, we explained the study purpose and procedure to the director of the caregiver training institute. After obtaining the director's approval, we conducted our study as scheduled. All participants were informed of the education program through phone calls and e-mails, and were asked to submit consent forms prior to participation. The participants visited the educational institution for the pre- and post-experiment assessments, which involved completing a questionnaire. The questionnaire took 10-15 minutes to complete.

2.2.2 Research Ethics: This study was approved by the institutional review board of K University (Approval number: 1040117-201605-HR-019-02). All participants gave written consent after reading an information sheet. Participants were told that they could withdraw participation whenever they wished to. Written consent was given either in person or through e-mail. Participants were not forced to complete their questionnaires. We maintained participants' anonymity by allocating them a personal number and removing all other information. Pre- and post-test questionnaires were matched using the personal numbers. All personal data were kept confidential.

2.2.3 Intervention: The video-based infection control education program was aimed at preventing infection transmission by having caregivers participate in infection control activities. The education contents were created through the stages of analysis, design, development, management, and assessment, as proposed by the Network-Based Instructional System Development Model [21].

In the analysis stage, we analyzed the learners' needs associated with infection control by interviewing nine caregivers who are currently employed in long-term care facilities. We also referred to a previous study involving caregivers [11] to analyze the purpose of the education program, and the depth and scope of its contents. In the design phase, we designed a Web-based education program that considered caregivers' occupational characteristics (i.e., they had to work in shifts and had to have various time and spatial constraints) and was tailored to individual situations that they faced in practice. It was also based on autonomous learning. This infection control education program is based on a social cognitive theory which emphasizes the importance of interaction of personal, environmental, and behavioral factors as a theory related to behavior change (fig. 1).

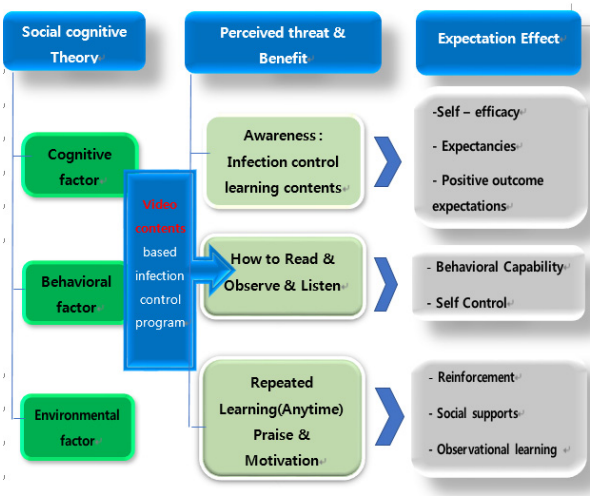

Fig. 1. Development of program based on social cognitive theory

In the development phase, we created various educational materials corresponding to different lecture topics that cater to caregivers of varying learning abilities. In order to induce cognitive change in social cognitive theory, anticipatory effects of continuous infection control activities were applied to anticipated results and an increase in anticipated values due to positive changes such as infection control inhibition, which resulted in improving self-efficacy through participation in management activity checklist. In the behavioral factors, the knowledge required to practice the infection control activity necessary for infection control practice was confirmed through quizzes, and the aim was to improve self-control through reflection notes, wrong picture search, etc. In the environmental factor, the quiz was held at the end of a certain lecture, and a summary of each unit to review the contents of the lesson, the contents were filled in the empty space, respectively. In addition, first we watched infectious management activities of nurses through video, experienced infecting activities indirectly through creating infectious activity log, and tried to promote environmental factors through them. The educational content was presented in a PPT format. Detailed scenes of infection activities were provided in the form of animations and videos. More specifically, we used flash animation and composed several PDF files according to the characteristics of the content, while the quiz took the form of SWF files. The system uses a 3D virtual reality (VR) system, iSTUDIO-S (Jinsung Vision Korea), which integrates the instructor's lectures and multimedia data into a single WMV file. The researchers were in charge of giving the lectures.

After developing the video-based infection control education program, we consulted a nursing home director with a Ph.D. in nursing, two professors in nursing, and a head nurse with 10 years of experience in infection control to confirm the appropriateness and duration of program content, as well as the suitability of the educational content. Fig. 3 shows the organization and content of the video-based infection control education program (Fig. 3). All contents was posted on a study bulletin board for a week so that students could progress through the content at least once; they were free to do so as

many times as they liked. In the second week, the content on infection control method by area and on handwashing was composed. After finishing the lecture, participants completed a 20-question quiz to complete the program. The quiz assessed what participants had learned in parts 1 and 2 of the lecture. Before the program started, participants were given a notice that they were free to leave any questions on the Q&A page at any point during the program. When conducting the post-test, participants also had time to freely discuss the curriculum for around 30 minutes. In the management phase, the video-based infection control education program was uploaded on the Website of the I caregiver training institute, and caregivers were given IDs and passwords to access the content. The participants watched to the lectures uploaded on the Website at a desired time and place. Attendance was not checked. Finally, in the assessment phase, user ratings and the effects of the infection control education program were assessed via a pilot test of five caregivers. All five caregivers rated the program as appropriate in terms of its contents and organization. The efficacy of the infection control education program was evaluated by comparing infectious management knowledge and performance between those who participated and those who did not. The control group were taught the same education content as the experimental group, but via the traditional lecture-based method (not involving videos). They were asked to attend the lecture once per week for two weeks. Each lecture took around two hours.

Table 1. Structure and composition of infection control program

Division (Time)	Themes	Method	Contents		Activities & Material
Intro (5min)	Greetings & Introduction of the Program		Give friendly greeting comments to the class		Video Clip
			1st week	2st week	
Body (35min)	-Infection -Current infection control -Isolation -Infection Management	-Explain 1 -Inform 1 -Show 1 -Suggest 1 -Compare 1 -Emphasize1 Explain2, & Show 2	-infection control & infection transmission - Disinfection & Sterilization -Important role of infection Disease Occurrence : Especially Caregivers -Currents Data(Infection Disease Occurrence in Hospital and out of hospital, etc) -Benefit of infection control monitoring -Good Case & Bad Case -Important of proper infection control, relationship between infection control activity & rate of infection Occurrence -Type of isolation : Respiratory & Bowel isolation -How to Respiratory management : Oxygen therapy. Aspiration care : Humidifier management -How to Urinary managements : Catheterization care : Perineal administration -How to gastrointestinal management : Gastrointestinal care : Medication & nutrient management	-Type of wound & wound care -Wound management : Prevention & management of bed sore : Management of wound drainage -Drug & disinfection management -Excretion & environmental management -Patient care precautions -Medical & Surgical handwashing -Precautious during patient care as a care giver -Managing infected & vulnerable patients : First aid for infectious substances -How to Excretion management : Hygienic waste treatment -How to Environmental management : Management of dirty & clean area : Disinfection methods : Management of cleaning tools -How to Cleaning & Laundry management : Kitchen management : Pollution laundry control activity : Proper cleaning methods	PPT (whole lecture) B : Knowledge E : Situation C : Expectations values Self -efficacy Quiz 1 B : Knowledge & skills C : Self efficacy E : Surrounding situations Quiz 2 Animation / Video Quiz 3 Animation / Video
End (10min)	Self-written Summary	Suggest Summarize	-Own infection control problems & self-written engagements -The contents of education and emphasize the important points		Discussion Self -written engagements
		: Motivation of Infection control activities	-Acquisition of knowledge in basic concept related infection & infection control -Aware of the situation infection home care area & clinical nursing area -Stimulation of positive outcome expectation & self-efficacy to change behavior -Improvement of one's ability for practices(Knowledge and technique -By activities, application of the concepts for self-efficacy promotion		
1) B : behavioral factor 2) E : Environmental factor 3) C : Cognitive factor					

2.2.4 Infection and Knowledge: Questions assessing participants' knowledge of infection control were extracted from the *Text of Infection Control* 7. A total of 24 items were used, the validity of which was confirmed by experts (a head nurse from an infection control center, a specialist from the department of infectious diseases, and a professor in nursing). A total of 20 items was ultimately selected; 4 were excluded because they were suitable for medical personnel but not caregivers. Of the 20 questions, 10 tested basic knowledge of infection, and 10 tested infection control knowledge. This latter set of questions specifically targeted medical-surgical handwashing (2 items), infection control principles (3 items), standard care instructions (3 items), and isolation methods (2 items). Subjects answered "yes," "no," or "do not know" for each question. The total score was calculated by giving 1 point for correct answer and 0 for wrong or "do not know" answers. The total scores ranged from 0 to 20, with higher scores indicating greater knowledge. The tool had a Cronbach's alpha of .885 in this study.

2.2.5 Infection Control performance: Infection control performance was measured by modifying an assessment tool for caregivers developed by Ryu and Ryu (2010) [11] after receiving approval from its authors. The infection control performance assessment tool comprises 33 items. A professor of nursing, a head nurse with 15 years of experience in long-term care facilities, and a home care nurse with 10 years of experience assisted in modifying and improving the assessment tool for this study. The tool consisted of eight subscales: handwashing and wearing gloves (5 items), respiratory system management (5 items), catheter management (5 items), gastrointestinal tract management (4 items), wound care (3 items), medication management (2 items), fecal management (4 items), and environmental management (5 items). Each item was rated on a Likert-type scale ranging from 0 ("Never") to 5 ("always"). The total score ranges from 0 to 165 points, with higher scores indicating higher infection control performance. In the study by Ryu and Ryu (2010) [11], the tool had a Cronbach's alpha of .762. In this study, the Cronbach's alpha was .902.

2.2.6 Self efficacy: A self-efficacy assessment tool developed by Kim and Park (2001) [22] was used to measure self-efficacy in this study. This tool is very discriminating in measuring learner's academic achievement and comprises three subscales: self-regulatory efficacy, task-difficulty preference, and confidence. Each item was rated on a scale of 1 (not at all) to 5 (very true). Higher scores indicated higher self-efficacy. The Cronbach's alpha of this tool was .770–.900 at the time of its development, and .840–.910 in our study.

2.2.7 Statistical analyses: The collected data were coded and analyzed using SPSS Statistics 21.0. First, we examined the descriptive statistics of demographic characteristics, infection control knowledge and performance, and self-efficacy, expressing them in real numbers, percentages, means, and standard deviations. The χ^2 test and t-test were used to test the homogeneity of characteristics between the experimental and control groups at pre-test. Differences between the control and experimental groups analyzed tested by using an unpaired t-test, and the differences before and after the program were analyzed for each group by using a paired t-test

3. RESULTS

3.1 Self-efficacy Participants characteristics and homogeneity testing: The participants were mostly female (n=42, 91.3%), and their mean age was 61.9 years (range 38–74 years). The mean employment duration was 14.6 months (range 6–18 months). A total of 27 participants (58.6%) had previously received education on infection control. Table 2 summarizes the results of the homogeneity testing of the participant characteristics and main dependent variables between the experimental and control groups at pre-test. We found no significant differences in age, employment duration, infection control knowledge and performance, or self-efficacy between the groups. Thus, they were confirmed to be homogeneous.

Table 2. Homogeneity of variables (N=46)

Category	Group	Mean ± SD	t	p
Age	Exp (23)	60.00±8.42	-1.655	.105
	Cont (23)	63.83±7.22		
Duration of caregiving	Exp (23)	15.13±2.14	1.442	.156
	Cont (23)	14.13±2.55		
Knowledge	Exp (23)	13.30±2.20	-1.145	.259
	Cont (23)	14.00±1.91		
Self-efficacy	Exp (23)	2.72±.58	-.207	.837
	Cont (23)	2.75±.41		
Infection control	Exp (23)	3.01±.25	-1.335	.189
	Cont (23)	3.11±.27		

3.2 Infection control knowledge and self-efficacy: Table 3 summarizes the changes in infection control knowledge and self-efficacy after the intervention. The mean score for infection control knowledge significantly increased from 13.3 to 16.0 in the experimental group ($p<.001$), and from 14.0 to 15.57 in the control group ($p=.005$). And a significant change in self-efficacy was found in either group. The mean score for self-efficacy significantly increased from 2.72 to 3.19 in the experimental group ($p<.001$). We found significant differences in the self-efficacy between the two groups at post-test ($p<.001$). We found significant increases in self-regulatory efficacy, confidence and task difficulty preference ($p<.001$) which were subdomains of self-efficacy in the experimental group. We found significant increases in task difficulty preference ($p=.005$) which were subdomains of self-efficacy in the control group.

3.4 Infection Control performance: Table 4 shows the changes in infection control performance. In both the experimental and control groups, infection control performance significantly improved ($p<.001$). We also observed significant improvements in the subscales of handwashing ($p=.001$), respiratory system management ($p<.001$), catheter management

(p<.001), gastrointestinal system management (p=.001), medication management (p<.001), fecal management (p<.001), wound care (p<.001), and environmental management (p<.001) in the experimental group. The control group similarly showed significant increases in the handwashing (p<.001), respiratory system management (p<.015), catheter management (p<.024), gastrointestinal system management (p<.001), medication management (p=.047), fecal management (p<.022), and environmental management (p<.031) subscales. We found significant differences in the handwashing (p=.004) and environmental management (p=.036) subscales between the two groups at post-test.

Table 3. Effects on Knowledge and Self-Efficacy (N=46)

Category	Group	Pre	post	t	p	Post-pre	t	p
		M±SD	M±SD			M ±SD		
Knowledge	Exp	13.30±2.20	16.00±1.83	-6.432	<.001	2.70±2.01	1.728	.091
	Cont	14.00±1.91	15.57±1.80	-3.116	.005	1.57±2.41		
Self-efficacy	Exp	2.72±.58	3.19±.53	-13.143	<.001	.47±.16	3.952	<.001
	Cont	2.75±.41	2.95±.34	-3.164	.005	.19±.29		
Task difficulty preference	Exp	2.36±.62	2.78±.68	-6.634	<.001	.42±.30	1.632	.110
	Cont	2.40±.68	2.65±.67	-3.124	.005	.25±.39		
Self regulatory efficacy	Exp	2.90±.70	3.38±.60	-10.384	<.001	-.48±.22	-2.476	.017
	Cont	2.90±.51	3.05±.56	-1.217	.237	-.15±.60		
Confidence	Exp	2.91±.82	3.40±.74	-7.524	<.001	-.49±.31	-2.650	.012
	Cont	2.97±.52	3.14±.36	-1.687	.106	-.17±.49		

Table 4. Effects on infection control performance (N=46)

Category	Group	pre	post	t	*p*	Post-pre	t	*p*
		M±SD	M±SD			M ±SD		
Infection control performance	Exp	3.01±.25	3.87±.19	-15.406	<.001	0.86±.27	4.327	<.001
	Cont	3.11±.27	3.52±.51	-7.289	<.001	0.48±.32		
Handwashing /gloving	Exp	3.00±.63	3.70±.47	-3.810	.001	1.04±.77	3.044	.004
	Cont	3.30±.77	3.87±.69	-4.092	<.001	0.30±.88		
Respiratory management	Exp	3.00±.67	3.87±.63	-4.534	<.001	0.87±.92	1.722	.092
	Cont	3.13±.69	3.57±.51	-2.647	.015	0.43±.79		
Urinary tract management	Exp	3.13±.55	3.91±.52	-5.100	<.001	0.78±.74	1.217	.230
	Cont	3.04±.71	3.52±.51	-2.421	.024	0.48±.95		
Gastrointestinal management	Exp	3.00±.67	3.74±.54	-3.872	.001	0.87±.76	1.961	.056
	Cont	3.04±.77	3.83±.58	-4.720	<.001	0.39±.89		
Drug management	Exp	3.04±.56	3.91±.52	-5.509	<.001	0.74±.92	-.172	.864
	Cont	3.13±.69	3.52±.51	-2.105	.047	0.78±.80		
Excretion management	Exp	3.00±.67	3.83±.58	-4.467	<.001	0.83±.89	1.533	.132
	Cont	3.09±.60	3.52±.51	-2.472	.022	0.43±.84		
Wound management	Exp	2.96±.71	4.00±.52	-6.521	<.001	0.70±.88	.570	.572
	Cont	3.04±.71	3.35±.49	-1.667	.110	0.57±.66		
Environment management	Exp	2.96±.71	4.00±.52	-6.521	<.001	1.04±.77	2.159	.036
	Cont	3.13±.69	3.61±.50	-2.307	.031	0.48±.99		

4. DISCUSSION

With the increasing expectations and dependence on long-term care insurance, which was implemented in 2008, the role of caregivers has become increasingly important in Korean society [8]. Caregivers, who are responsible for caring for the elderly residents of long-term care facilities, frequently come into close contact with these elderly patients. As such, they should have sufficient knowledge of infection control and be able to manage infections properly [9]. However, infection control practice is poorer in long-term care facilities than in hospitals [1]. These findings suggest the need to vitalize infection control education programs for caregivers. In the present study, we implemented a video-based education program to boost caregivers' infection control knowledge and performance, as well as their self- efficacy. To examine its efficacy, we compared its effects with those of traditional lecture-based education. Following the completion of the infection education program, the mean score for infection control knowledge significantly increased from 13.3 to 16.0 in the experimental group; the control group also showed a significant increase in mean score (from 14.0 to 15.57). These results were consistent with those of Ryu and Ryu (2010) [11], wherein caregivers' levels of knowledge on infection control significantly increased following the implementation of a Web-based infection control education program. Our results also support those of a study [13] measuring the educational effects of Web-based infection education on nursing students.

The results of this study are furthermore consistent with the results of a four-week Web-based hemodialysis patient education program for nurses [16] and those of 15-week Web-based medical terminology education for nursing students [17]. Therefore, this infection control education program seems to be an effective method of expanding participants' knowledge of infection control. Furthermore, the online video-based version of the program might be a useful alternative to lecture-based education.

We found significant changes in overall self-efficacy, with the mean scores for the subscales of self-regulatory efficacy and confidence, and task difficulty preference increasing in the experimental group. However, the mean score for task difficulty preference subscales of self-efficacy was significantly increased in the control group. These results were in accordance with those of [17] who found that self-efficacy significantly improved only after video-based education. The present results showed that the level of self-efficacy improved after the Web-based artificial respiration management training for nurses, but only partially more than under lecture-based education, consistent with previous studies [20]. All these results suggest that a Web-based infection control education program might be more effective than existing lecture-based education in promoting self-efficacy, an important factor in strategies to educate caregivers of varying ages and academic ability.

Following the intervention, the mean infection control performance score increased from 3.01 to 3.87 in the experimental group, and from 3.11 to 3.52 in the control group. Furthermore, a significant increase was observed for all subscale scores of infection control performance, including handwashing, in the experimental group. This supports the results of a previous study [13] in which a Web-based infection control education improved nursing students' infection control performance. It also supports a Canadian study showing that online education can increase learners' knowledge and performance of infection control [23]. In previous studies that implemented online infection education, students reported being satisfied with Web-based programs because they appear to incorporate more up-to-date information, and students felt relatively less nervous during online lectures.

Notably, the highest scores in both groups were achieved in the handwashing subscale. This result supports previous reports [11], [24], [25] that participants tend to be better at handwashing when compared to the other subdomains of infection control performance. These results might be the result of the national handwashing education program in South Korea, which has been in place for many years now. However, the score was lower than was that found in a previous study involving undergraduate nursing students [13]. This suggests the need for consistent education of caregivers on handwashing. While both the experimental and control groups showed performance improvements in almost all domains of infection control performance in this study, the study by Gong and Kang (2012) [13] observed some differences in the effects of an infection control education program on the various domains of infection control performance [13]. This discrepancy might be attributed to the different subjects studied: Gong and Kang (2012) [13] focused on nursing students, while we focused on currently employed caregivers. It is likely that nursing students have relatively fewer opportunities to come into direct contact with patients compared to caregivers.

The participants were given open-ended questions asking what they liked about the Web-based infection control education program, and what they thought the program lacked. The following responses were received: "It was good to be able to learn at my desired time" (n=5), "The Web-based lectures were more interesting than were typical lectures" (n=4), and "It was nice to have the time to find answers to my questions on my own" (n=3). The same responses were observed in a previous study in which graduate students of public health were provided with a Web-based education program on infection. Particularly, these students pointed out the time flexibility and efficiency of the program as its major strengths [14]. : "It was easy to understand because I could watch a lot of video animation when compared to lecture learning" (n=4), "not boring" (n=5), and "I was excited about the next learning period" (n=4). This reaction supports the results in some studies claiming that Web-based education programs are more flexible due to their utilization of multimedia compared to traditional teaching methods, and that they can promote learning more effectively [11], [15].

Regarding the drawbacks of the program, the following responses were received: "Real lectures are better because online lectures do not produce the atmosphere of a real classroom" (n=3), "I could not get my questions answered immediately" (n=3), and "Iterative learning was not easy" (n=2). These findings support that Web-based education must involve lecture contents and objectives, and its contents must be organized and presented in a concrete manner. Thus, while Web-based education programs have many strengths, they can put academic pressure associated with the need for self-motivation on learners. Web-based education might also have limited effects on learners who prefer to listen to lectures in a "real," face-to-face learning environment. In other words, it might be difficult to expect significant learning effects from a Web-based education program if the learner lacks strong motivation to learn.

In this study, the infection control education program was delivered to caregivers as either video-based education (for the experimental group) or traditional lectures (for the control group). The results of this study showed that on the level of knowledge, performance and self-efficacy the training was significant in experimental groups. Based on these results, we can conclude that video-based education is a useful teaching method that can substitute for lecture education. Based on its unique improvement of self-regulatory efficacy, it might be utilized in certain cases according to the professional conditions and learning characteristics of the caregivers in question. However, according to Ward's [9] literature review of 39 studies revealed that infection education does not have long-term positive effects on infection control. Takahashi (2009) [27] reported that infection education might be more effective if implemented before residents are admitted to care facilities. These findings suggest the need for further contemplation on the timing and duration of infection control education before implementing it.

5. CONCLUSION

The infection control education program was accessible through the caregiver training institute's Website, and its contents included videos and animations. The Web-based infection control education program significantly improved caregivers' knowledge and performance of infection control. This study confirmed the positive evaluation of how to provide Web-based education to caregivers working in long-term care facilities at convenient times regardless of working hours and location.

This study is meaningful because it is the first to implement and compare a video-based infection control education program for caregivers, who are the main workforce in long-term care facilities, with a lecture-based education method. However, because our study included caregivers from one region only and our program was implemented only over two weeks, a short period of time for the learners to fully experience it, our results should be generalized only with caution. Moreover, repeated research involving other regions and a larger group of participants is needed to confirm the effects of this video-based infection control education program. To ensure that caregivers effectively perform infection control, it is necessary to standardize their education content and methods, and consistently assure the quality of education through additional assessments. Educational programs that utilize various teaching methods and learning media, and that consider caregivers' work characteristics, should be repeatedly implemented. It is our hope that this study has helped give non-physician caregivers the important opportunity to play the crucial role of infection managers within the public healthcare system, and that it will help foster regular education in infection control through various methods, including both lectures and video-based instruction. Future research on effective management of online systems for infection control education for caregivers will be needed, and it is suggested that operational guidelines and legal institutional devices should be developed to maximize the educational effect of this kind of education using the Web.

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REFERENCES

[1] J. H. Kang and H. C. Lee, "The analysis of effects on infection management and education in social welfare facilities: Comparing to hospital infection management," Public Policy Review, vol. 29, no. 1, 2015, pp. 107-135.

[2] P. W. Smith and P. G. Rusnak, "Infection prevention and control in the long-term care facility. SHEA Long-Term-Care Committee and APIC Guidelines Committee," American Journal of Infection Control, vol. 25, 1997, pp, 488-512. doi : 10.1086/592416

[3] A. T. Makris, L. Morgan , D. J. Gaber, A. Richter, and J. R. Rubino, "Effect of a comprehensive I nfection control program on the incidence of infections in long-term care facilities," American Journal of Infection Control, vol. 28, no. 1, 2000, pp. 3-7. doi: 10.1016/S0196-6553(00)90004-X

[4] H. M. Erikson, A, M. Koch, P. Elstrom, R. M. Nilsen, S. Harthug, and P. Aavitsland, "Healthcare-associated infection among residents of long-term care facilities: A cohort and nested case-control study," Journal of Hospital Infection, vol. 65, no. 4, 2007, pp. 334-340. doi: 10.1016/j.jhin.2006.11.011

[5] N. Abela and M. A. Borg, "Impact on hand hygiene compliance following migration to a new hospital with improved resources and the sequential introduction of World Health Organization recommendations," American Journal of Infection Control, vol. 40, no. 8, 2012, pp. 737-741. doi: 10.1016/j.ajic.2011.09.012

[6] C. L. Richards, "Infections in residents of long-term care facilities: An agenda for research. Report of an expert panel," Journal of American Geriatric Society, vol.50, no. 3, 2002, pp. 570-576. doi: 10.1046/j.1532-5415.2002.50128.

[7] Korean Association of Infection Control Nurses, *Text of Infection Control,* Hyunmoonsa: Seoul, 2012.

[8] K. J. Kim and S. W. Park, "The influencing factors on infection management behavior of health worker in long term care facilities," Journal of Korean Academic Society Home Care Nursing, vol. 23, no. 2, 2016, pp. 155-165.

[9] E. J. Park, Y. J. Lim, B. H. Cho, I. J. Sin, and S. O. Kim, "A survey on performance of infection control by workers in Nursing hoomes for the elderly," Journal of Korean Gerontological Nursing, vol. 13, no. 2, 2011, pp. 79-90.

[10] H. J. Lee and S. H. Kwon, "The effects of work environment characteristics and job stress on the job satisfaction among caregivers," Journal of Welfare for the aged institute, vol. 51, 2011, pp. 125-144.

[11] B. M. Ryu and S. M. Ryu, "The effects of infection prevention education program on infection prevention knowledge and attitude to nursing caregiver students," JKIIS, vol. 15, no. 5, 2010, pp. 167-177.

[12] A. Bandura and National Inst of Mental Health, *Prentice-Hall series in social learning theory. Social foundations of thought and action: Asocial cognitive theory,* Englewood Cliffs, NJ, US: Prentice-Hall, Inc, 1986.

[13] J. Gong and J. Kang, "Development and evaluation of a Web-based education program for nursing students on control of vancomycin-resistant enterococcus infection," Journal of Korean Academy of Fundamentals of Nursing, vol.19, no. 1, 2012, pp.122-133.

[14] R. M. Agius and G. Bagnall, "Development and evaluation of the use Internet as an educational tool in occupational and environmental health and medicine," ccupational medicine (Oxford, England), vol. 48, 1998, pp. 337-343.

[15] J. Koch, S. Andrew, Y. Salamonson, B. Everett, and P. Davidson, "Nursing students' perception of a Web-based intervention to support learning," Nurse Education Today, vol. 30, 2010, pp. 584-590.

[16] H. C. Jung, "Development and effectiveness of hemodialysis nursing education program using Web-based

learning system," Journal of Nursing Query, vol. 9, no.1, 2009, pp.146-166.
[17] Y. M. Kown, "The development and evaluation of Web-based nursing educational program: Focused on the medical terminology," Journal of Korean Nursing Administration Academic Society, vol. 12, no.1, 2006, pp. 41-51.
[18] C. Kaveevivitchai, B. Chuengkriankrai, Y. Luecha, R. Thanooruk, B. Panijpan, and P. Ruenwongsa, "Enhancing nursing students' skills in vital signs assessment by using multimedia computer-assisted learning with integrated content of anatomy and physiology," Nurse Education Today, vol. 29, 2009, pp. 65-72.
[19] K. B. Chai, "Effects of the education of using structured video-audio media on self-efficacy, stress and performance confidence in future nursing professionals," JKEIA, vol. 11, no. 2, 2017, pp. 193-203. doi : 10.21184/jkeia.2017.02.11.2.193
[20] Y. S. Choi, "The development of Web-based ventilator management education program," JKAIS, vol. 13, no. 11, 2012, pp. 5284-5291. doi : 10.5762/kais.2012.13.11.5284
[21] I. J. Na, *Web-based education,* Kyoyookbook Company, Seoul, South Korea, 1999. ISBN: 8982-8730-0793-370.
[22] A. Y. Kim and I. Y. Park, "Development and validation of academic performance self-efficacy scale," Korean Journal of Education Research, vol. 39, no. 1, 2001, pp. 95-123.
[23] L. Atack and R. Luke, "Impact of an online course on infection control and prevention competencies," Journal of Advanced Nursing, vol. 63, no. 2, 2008, pp.175-180. doi:10.1111/j.1365-2648.2008.04660.x
[24] J. Kang, J. Cho, Y. Kim, D. Kim, J. Lee, H. Park, S. H. Jung, and E. N. Lee, "Hospital nurses' knowledge and compliance with multidrug-resistant organism infection control guidelines," JKAN, vol. 3, 2009, pp. 186-197. doi : 10.4040/jkan.2009.39.2.186
[25] Y. M. Park and K. Y. Park, "Influence of VRE knowledge and awareness with VRE infection control in compliance with VRE infection control among nurses in intensive care units," JKBNS, vol. 11, no.1, 2009, pp. 42-50.
[26] E. S. Park, J. S. Jeong, K. M. Kim, O. S. Kim, H. Y. Jin, S. Y. Jung , S. Y. Yoo, J. Y. lee, J. H. Choi, and S. Y. Jang, "A study on the costs of hospital infection control and prevention," Korean Journal of Nosocomial Infection Control, vol. 12, 2007, pp. 50-57.
[27] I. Takahashi, Y. Osaki, M. Okamoto, A. Tahara, and T. Kishimoto, "The current status of hand washing and glove use among care staff in Japan: Its association with the education, knowledge, and attitudes of staff, and infection control by facilities," Environmental Health and Preventive Medicine, vol. 14, 2009, pp. 336-344. doi : 10.1007/s12199-009-0103-z

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