Public Health Nursing Vol. 26 No. 4, pp. 317–328
0737-1209/
doi: 10.1111/j.1525-1446.2009.00786.x

A Comparison of Diabetes Learning With and Without Interactive Multimedia to Improve Knowledge, Control, and Self-Care Among People With Diabetes in Taiwan

Ju-Ping Huang, Hsing-Hsia Chen, and Mei-Ling Yeh

ABSTRACT ***Objective:*** Given the increased popularity of complementary and alternative medicine (CAM) and traditional Chinese medicine (TCM), this study aimed to evaluate the effects of interactive media on self-directed learning in patients' knowledge of diabetes and related CAM/TCM strategies, the ability to control blood sugar levels, and self-care in people with diabetes. ***Design:*** An experimental study design was used. The experimental group received patient education through interactive multimedia about diabetes for 3 months, while the control group received a routine 3-month patient education. ***Sample:*** On completion, 60 subjects from Taiwan were evaluated—30 in an experimental group and 30 in a control group. ***Measurements:*** Data were collected from both groups at baseline and at the completion of the patient education. The findings were then compared to evaluate the effects of the intervention on the subjects' knowledge of diabetes, blood sugar control, and self-care. ***Results:*** The experimental group showed greater improvement in understanding diabetes than the control ($t = 3.29$, $p < .001$). There was no significant difference in control of blood sugar levels ($t = -1.72$, $p = .10$) and self-care ($F = 1.03$, $p = .32$). ***Conclusions:*** The use of an interactive multimedia device to intervene in diabetes self-care was effective only in raising the subjects' knowledge about the disease. Additionally, the subjects may need more time to implement more effective blood sugar control and self-care activities after receiving instruction.

Key words: complementary and alternative medicine, diabetes, interactive multimedia, self-care, traditional Chinese medicine.

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With the gradual lengthening of the human life expectancy and an increasingly sedentary lifestyle, the number of people with diabetes has been steadily increasing. As much as 5.5% of the U.S. population has been reported with diabetes (Centers for Disease Control and Prevention [CDC], 2007), while in Taiwan, 4.69% of the population currently have a diagnosis of diabetes (Bureau of National Health Insurance, 2005). By 2030 there will be 366 million people with diabetes worldwide (Wild, Roglic, Green, Sicree, & King, 2004). Given this remarkably rapid increase, medical professionals are paying more attention for the associated problems emerging with it. Along with an increase in diabetes comes an increase in morbid-

ity and mortality rates, second only to microvascular and macrovascular complications. For example, diabetes-related disorders of small blood vessels may lead to kidney dysfunction and blindness (American Diabetes Association [ADA], 2008), and the need for the amputation of lower limbs due to ulcers and infection (Unachukwu, Babatunde, & Ihekwaba, 2007). In addition, diabetes-related diseases of the major blood vessels may result in coronary heart disease, cerebrovascular disorders, and peripheral arterial disease (ADA, 2008). Diabetes ranks sixth as a major cause of death in the United States (CDC, 2008), while in Taiwan, it is the fourth leading cause of death, accounting for 42.5 in 100,000 deaths each year (Department of Health, Executive Yuan, Taiwan, 2008).

Since diabetes is a chronic disease, people with diabetes must be equipped with the information necessary to implement adequate self-care, which is routine and complicated (Lee, Kim, Yoo, & Kang, 2007). Self-care behaviors empower diabetics by giving them control over their disease. To achieve optimal blood glucose control, it is important to carefully monitor diet, exercise, and medication. According to the American Association of Diabetes Educators (2005), nursing professionals must educate patients on the following seven self-care aspects of diabetes: the importance of being active, maintenance of a healthy diet, monitoring of blood glucose levels, medication, problem solving, risk reduction, and healthy coping strategies. Compliance with the prescribed medications, including oral medications for reducing blood sugar levels and insulin injections, can rapidly regulate blood sugar levels (Inzucchi, 2002). Increasing physical activity is helpful for controlling blood sugar in type 2 diabetes (Colberg, 2006). It has also been shown that the stimulation of appropriate acupoints may lower blood sugar levels (Chen, Li, Ding, & Ma, 2001); that the regular practice of qigong can control the level of glycosylated hemoglobin A_1C (HbA_1C) (Tsujiuchi et al., 2002); and that Chinese herbal medicines are effective in regulating blood sugar levels (Li et al., 2002).

In recent years, the use of complementary and alternative medicine (CAM) and traditional Chinese medicine (TCM) has become increasingly popular. CAM is a broad domain of resources that involves health systems, modalities, and practices; it refers to a group of diverse medical and health care systems, practices, and products that are not presently considered to be part of modern medicine (National Center of Complementary and Alternative Medicine [NCCAM], 2002). Modern medicine is medicine as practiced by medical doctors and by allied health professionals, such as registered nurses. TCM, an ancient system of health care, has recognized and treated diabetes as a distinct disease for 2,500 years (Yeh, Chen, & Lin, 2004). The ancient Chinese focused on the relationships and patterns that occur in nature, and viewed the world as a harmonious whole. The basic principles of TCM encompass Yin-Yang theory, the Five Elements (wood, fire, earth, metal, and water), Zang-Fu theory, the meridian, and acupoints systems, qi, blood and body fluid, among others. In the view of TCM, diabetes is related to the concept of *Xiao-Ke*, or rather dryness-heat and a deficiency of yin. Therefore, diabetes treatment and care would include nourishing the yin, reinforcing qi, promoting circulation, and removing blood stasis (Yeh et al., 2004). The treatment of diabetes with TCM is authoritative and comprehensive.

TCM encompasses acupuncture and moxibustion, herbal and nutritional therapies, restorative physical exercises, meditation, remedial massage, and so on. Various aspects of TCM are considered CAM in the western world while continuing to be the primary health care system throughout most of Asia. According to recent figures, 58.6% of the people in the United States (Tindle, Davis, Phillips, & Eisenberg, 2005), and 47% of those in England (McDonough, Devine, & Baxter, 2007) make use of these approaches. In Taiwan, the rate of CAM/TCM use ranges from 51% to 82% and is much higher than in English-speaking countries (Chang & Li, 2004). The total cost of these alternatives to modern medicine comes to 13.57 billion dollars in 2006, compared with 0.33 billion dollars in 2000 (Department of Health, Executive Yuan, Taiwan, 2008). These figures indicate that health education for people with diabetes should be more holistic in order to satisfy the needs and preferences of diabetics.

With the rapid progress of information technology, multimedia-based instruction has become more widely used. Multimedia incorporates texts, graphics, sounds, animations, audios, and videos, and is accessed via CD-ROM, videotape, hard disk, or Internet. Interactive multimedia goes even further by allowing users to control what elements are to be delivered. Such advances in computer technology have transformed the traditional model of patient education.

Unlike conventional learning approaches, multimedia resources offer words, animations, sounds, and images to enhance learning effectiveness. This may have an even wider contribution as learners are able to obtain the information they need without the limitations of time and space. In patient education, multimedia technology has been commonly used to enhance patients' understanding of proper self-care related to their disease or symptoms, such as diabetes, asthma, myopia, cancer, chronic diseases, postoperative pain, joint replacement, colonoscopy, and pregnancy (Chen, Huang, Yeh, & Liao, 2007; Flynn, van Schaik, van Wersch, Ahmed, & Chadwick, 2004; Hausenblas et al., 2008; Krishna et al., 2003; Neafsey, Strickler, Shellman, & Chartier, 2002; Shaw, Beebe, Tomshine, Adlis, & Cass, 2001; Yeh, Chen, Chen, & Lin, 2008; Yeh, Chen, & Liu, 2005; Yeh, Yang, Chen, & Tsou, 2007).

Therefore, the purpose of this study was to evaluate the effects of interactive multimedia on self-directed learning in patients' knowledge of diabetes, the ability to control one's blood sugar levels, and self-care in people with diabetes.

Methods

Design and sample

This study used an experimental design with a convenience sample. Subjects were recruited from the endocrinology outpatient department (OPD) at a regional hospital in the south of Taiwan, and randomly assigned to either an experimental or a control group by flipping a coin. The experimental group received 3-month patient education by using the interactive multimedia about diabetes (Chen et al., 2007), while the control group received a routine 3-month patient education program by using the provided booklet and counseling. Inclusion criteria were as follows: adult below the age of 60; diagnosis of type 2 diabetes of <10 years' duration; same prescription of diabetes treatment for 3 months; and without any serious medical complications, including dialysis, retinopathy, and amputation. The power analysis estimated the sample size to be 35 in each group, reaching a power of .80, and with a statistical significance level of .05.

Intervention

The Diabetes Mellitus (DM) interactive multimedia we created was a collection of integrated medicine and nursing instructions about diabetes recorded onto a CD in video and audio format. The integrated medicine combines treatments from modern medicine and CAM/TCM for which there is high-quality evidence of safety and effectiveness. As shown in Fig. 1, the contents of the multimedia disk consisted of three parts: an introduction to diabetes according to the views of modern medicine and CAM/TCM; an explanation of nursing interventions in modern medicine and CAM/TCM; and a discussion of preventive health care to lower the risk of complications as well as to promote health (Chen et al., 2007). The coherent and integrated content discusses CAM/TCM in regard to a modern understanding of diabetes. According to Waltz, Strickland, and Lenz (2005), the content validity index (CVI) is calculated by the ratings of two experts for scales; its value provides an estimate of the level of agreement between those experts. The content validity of our DM interactive multimedia disk was verified by two senior physicians who are licensed in both modern medicine and TCM. The CVI achieved was .95.

Each part of the interactive multimedia instruction contained written descriptions, verbal descriptions, photographs, figures, computer animations, audio, etc. (Chen et al., 2007). The graphics files were edited using the Ulead PhotoImpact software. The animation files were created by using Macromedia Flash software. Video images and audio files were edited with Ulead MediaStudio software. All files described above were integrated and converted into an executable file on an interactive multimedia platform of the Macromedia Director software. Finally, the executable file was burned onto VCD to be played on a computer. This version of the multimedia is capable of playing selected segments designed to facilitate practice and review. Therefore, subjects were instructed to watch the multimedia without time limits and select or repeat any part they needed.

The DM routine patient education program involved the same content as the DM interactive multimedia in the booklet, with the exception of CAM/TCM. The views of CAM/TCM were provided while counseling.

The ethical approval for the study was obtained from the ethics committee of the hospital where the subjects were enrolled. All subjects who met the criteria were recruited and randomly assigned to either the experimental or the control groups. All subjects were made aware of the purpose, measures, and procedure of the study, and they were free to withdraw at any time. Informed consent was obtained from all subjects before the start of the study. Additionally, data collected in the study remained confidential.

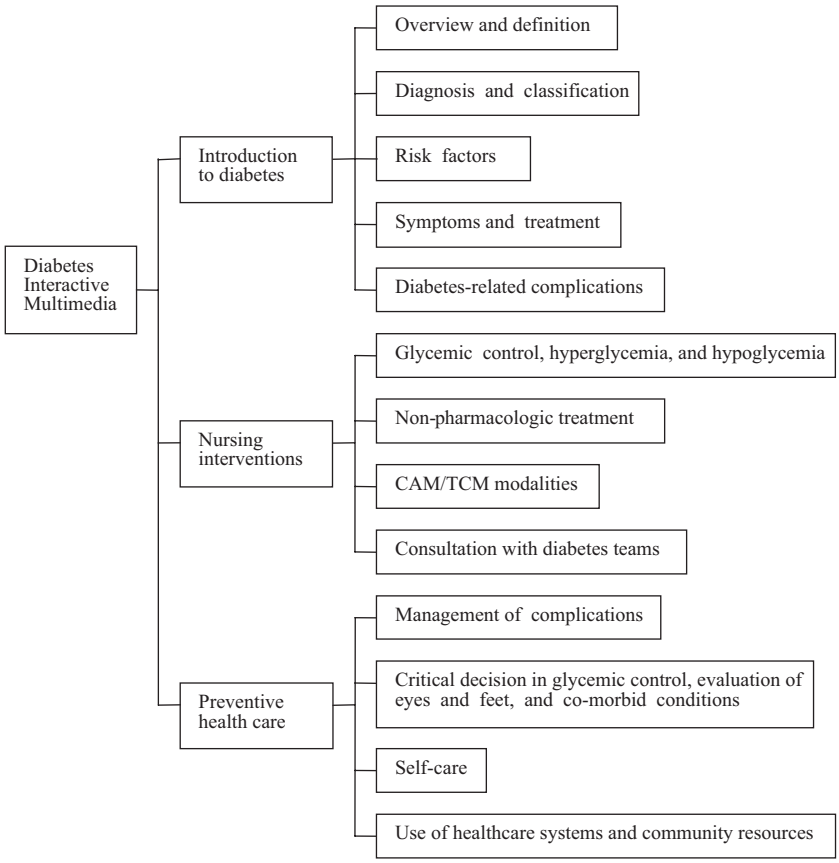

Figure 1. The content of diabetes interactive multimedia

Before starting the intervention, the experimental subjects were instructed on how to operate the DM interactive multimedia on the computer by one of the authors in this paper, and kept the VCD in his or her possession. During the 3-month period of the intervention, the experimental group used the VCD for self-directed learning regarding their knowledge of diabetes, blood sugar control, and self-care. On the other hand, the control subjects received a routine patient education via a conventional approach—receiving the handout DM booklet in an OPD visit, and counseling (in clinic and by phone)—for 3 months. All the required measuring variables were collected within 1 week before and after the intervention. The control subjects received the DM interactive multimedia when their posttests were done.

Measures

The sheet of demographic characteristics and disease conditions included age, gender, educational level, marital status, employment, diabetes, diet control, and exercise. Evaluation of the DM interactive multimedia disk was used and included the utility, satisfaction, and content value of the interactive multimedia on a 5-point scale (Yeh et al., 2005). A Cronbach's α was .89.

The questionnaires used in this study were the Diabetes Knowledge Inventory (DKI) and the Diabetes Self-Care Scale (DSC) (Wang, Wang, & Lin, 1998). The DKI was developed based on a review of specific literature and the textbooks because the body of knowledge utilized in the DM interactive multimedia includes not only modern medicine and nursing but also TCM and nursing. If the existing scales cannot comprehensively reflect the extent of interest, development of a new scale is needed (Waltz et al., 2005). The DKI is composed of 20 true/false items designed in accordance with the content of the DM multimedia disk, and was used to evaluate patients' knowledge and understanding about diabetes. Each question correctly answered scored one point. The higher the sum of scores, the better the knowledge a

patient had. According to Waltz et al. (2005), the validity of the DKI was verified by two senior physicians to be 1, and a Cronbach's α was .75.

Patient self-care behaviors were measured by the DSC in the Chinese vision (Wang et al., 1998). The DSC contains 26 items divided among five subscales: exercise and diet, medication compliance, blood sugar monitoring, foot care, and prevention and treatment of high and low blood sugar reactions. Each item was graded by using a 5-point scale. The higher the sum of scores, the better the self-care a patient had. The DSC obtained a Cronbach's α of .85 in this study.

Hemoglobin A_1C (HbA_1C) in blood samples was used as an indicator of the control of blood sugar levels. Following the protocol, samples were promptly transported to the laboratory in the study hospital. The samples were stored at 4°C, for a maximum of 48 hr between collection and hematological analysis. HbA_1C levels were identified by standard laboratory methods and evaluated in an ion-exchange high-performance liquid chromatography system, the HLC-723 G7 (Tosoh Corporation, Tokyo, Japan). HLC-723 G7, the automated glycohemoglobin analyzer, required no sample preparation and showed a fast analytical time of 1.6 min (Lee & Kim, 2003).

Analytic strategy

Data collected from both groups before and after the intervention were compared in order to evaluate the effect of education on the outcome measures of HbA_1C, level of knowledge of diabetes, and adequacy of self-care. Data were then analyzed with SPSS 15.0 for Windows (SPSS Inc., Chicago, IL). First, descriptive statistical analysis was performed to examine the demographic characteristics of the subjects. Second, inferential statistical analysis (consisting of the chi-square or Fisher exact test, independent *t* test, and one-way ANCOVA) was conducted to compare the data from the outcome measures for both groups.

Results

The demographic characteristics

This study started with 70 subjects and 60 completed, with 30 in each group. Eight subjects left the study: 1 due to irregular OPD visiting, 3 due to computer breakdown, 3 due to incompleteness of the patient education process, and 1 due to rejection. Two subjects who were absent on the day of the posttest were also excluded from further statistical analysis. Table 1 compares the characteristics of subjects who completed and dropped out of the study. In the beginning of the study, both groups had similar demographic and diabetes characteristics. Furthermore, no significant differences in baseline values were found between the subjects who completed the study and those who dropped out.

In the 60 subjects who completed the study, the mean age was 46 ($SD = 8.21$) for the experimental group, and 47 ($SD = 5.98$) for the control group, with no significant statistical difference between the two groups ($t = -0.85$, $p = .40$). More than half the subjects were male (66.7%), high school graduates (60%), married (93.3%), employed (78.3%), had diabetes diagnosed <5 years ago (56.7%), were in control of his or her diet (56.7%), and participated in regular exercise (63.3%) as defined by the American College of Sports Medicine (Haskell et al., 2007). As shown in Table 1, no statistically significant difference was detected in the demographics between the two groups. This finding indicates that the demographic data of the experimental and control groups were similar.

Outcomes of diabetes knowledge

As shown in Table 2, there was no significant difference in pretest scores between the two groups ($t = 0.26$, $p = .80$). After the intervention, the experimental group scored an average of 15.13 while the control group had an average score of 12.63. There was a statistically significant difference between the two groups ($t = 3.29$, $p < .001$). In addition, there was a significant difference in the scores of the experimental group before and after the intervention ($t = -5.16$, $p < .001$). The control group, however, showed no significant difference ($t = -0.91$, $p = .37$). As shown in Table 3, the highest increment rate was shown on item 4 in the experimental group and item 2 in the control group. Other items with an increment rate reaching 10% or higher were items 1–3, 5, 8, 11, 14, 16, and 18–20 in the experimental group, and items 4 and 16 in the control group. There were statistically significant increments between two groups in items 1, 3–5, 8, 11, 14, and 18–20 ($p < .05$).

Outcomes of blood sugar control

As shown in Table 4, there was no significant difference in pretest scores between the two groups ($t = -0.39$, $p = .70$). After the intervention, the experimental group obtained an average score of 7.00 while the control group had an average score of 7.49.

TABLE 1. *Comparisons on the Characteristics of Subjects who Completed and Dropped Out of the Intervention*

	Before intervention			After intervention			Compared the completed and dropped subjects		
Characteristic	Experiment	Control	*p* value	Experiment	Control	*p* value	Completed	Dropped out	*p* value
Age (years) (mean ± *SD*)	46.32 ± 8.21	47.68 ± 5.98	.44	45.77 ± 8.73	47.40 ± 5.88	0.40	46.58 ± 7.42	49.22 ± 6.08	.31
Gender (*n*/%)			.91			0.58			.20
Male	24/63.2	20/64.5		21/70.0	19/63.3		40/66.7	4/44.4	
Female	14/36.8	11/35.5		9/30.0	11/36.7		20/33.3	5/55.6	
Educational level (*n*/%)			.39			0.35			.06
Elementary school	2/5.3	0/0.0		2/6.7	0/0.0		2/3.3	0/0.0	
High school	25/65.8	20/64.5		17/56.7	19/63.3		36/60.0	9/100.0	
College and above	11/28.9	11/35.5		11/36.7	11/36.7		22/36.7	0/0.0	
Marital status (*n*/%)			.83			1.00			.43
Married	36/94.7	29/93.5		28/93.3	28/93.3		56/93.3	9/100.0	
Others	2/5.3	2/6.5		2/6.7	2/6.7		4/6.7	0/0.0	
Employment s (*n*/%)			.67			0.75			.970
Employed	29/76.3	25/80.6		23/76.7	24/80.0		47/78.3	7/77.8	
Unemployed	9/23.7	6/19.4		7/23.3	6/20.0		13/21.7	2/22.2	
Duration of diabetes (*n*/%)			.31			0.30			.49
0–4 years	23/60.5	15/48.4		19/63.3	15/50.0		34/56.7	4/44.4	
5–10 years	15/39.5	16/51.6		11/36.7	15/50.0		26/43.3	5/55.6	
Diet control (*n*/%)			.25			0.30			.19
No	20/52.6	12/38.7		15/50.0	11/36.7		26/43.3	6/66.7	
Yes	18/47.4	19/61.3		15/50.0	19/63.3		34/56.7	3/33.3	
Regular exercise (*n*/%)			.10			0.11			.85
No	17/44.7	8/25.8		14/46.7	8/26.6		22/36.7	3/33.3	
Yes	21/55.3	23/74.2		16/53.3	22/73.3		38/63.3	6/66.7	

TABLE 2. *Results of the Independent and Paired t tests in Diabetes Knowledge*

	Experimental group		Control group		
	Mean	*SD*	Mean	*SD*	Independent *t (p)*
Pretest	12.10	.67	12.33	3.37	0.26 (.80)
Posttest	15.13	.19	12.63	3.54	3.29 (<.001)
Paired *t* (*p*)	– 5.16	<.001	– 0.91	0.37	

There was no significant difference in HbA_1C levels between the two groups ($t = -1.72$, $p = .10$). In addition, there were no significant differences in either the experimental group ($t = 1.58$, $p = .13$) or the control group ($t = -0.61$, $p = .55$) before and after the intervention.

Outcomes of the self-care

There was a significant difference in self-care between the experimental and control groups at pretest ($t = -2.90$, $p = .01$). As shown in Table 5, after controlling for the pretest, there was still no significant difference between the two groups at posttest ($F = 1.025$, $p = .32$). Score distributions for the experimental and control groups are shown in Table 6. There was no significant difference in any single item. Both experimental and control groups obtained the highest scores on the item of preventing/treating high and low blood sugar reactions, and the lowest scores on the item related to exercise.

Evaluation of the Diabetes Mellitus interactive multimedia

The results showed that the highest scoring item was "satisfaction with diabetic interactive multimedia" (mean 4.13, range 3–5), followed by "content value for diabetes care" (mean 4.07, range 3–5). The lowest scoring item was "manipulation of diabetic interactive multimedia" (mean 4.03, range 3–5).

TABLE 3. *Percentage of Correct Response to Diabetes Knowledge*

	Experimental group		Control group		
Items	Pretest (%)	Posttest (%)	Pretest (%)	Posttest (%)	Independent *t (p)*
1. Insulin in diabetes treatment	20	33.3	10	10	2.11 (0.04)
2. TCM for diabetes treatment	76.7	93.3	60	73.3	0.36 (0.72)
3. Classifications of diabetes in the view of modern medicine	50	90	50	56.7	3.27 (0.002)
4. Classifications of diabetes in the view of TCM	53.3	96.7	50	60	3.10 (0.003)
5. Symptoms sign and of diabetes	3.3	16.7	10	3.7	2.55 (0.01)
6. Criteria for diagnosis of diabetes	40	36.7	33.3	30	0.00 (1.00)
7. Knowing modern medicine medications	96.7	100	96.7	96.7	1.00 (0.33)
8. Knowing Chinese herbal medications	23.3	50	36.7	40	2.63 (0.01)
9. Preventing/treating high blood sugar reactions	50	53.3	36.7	33.3	1.41 (0.16)
10. Preventing/treating low blood sugar reactions	93.3	100	90	96.7	0.00 (1.00)
11. Understanding diabetic food exchanges	56.7	76.7	53.3	53.3	2.69 (0.01)
12. Understanding fruit choice	80	76.7	83.3	76.7	0.58 (0.56)
13. Choosing appropriate exercise	53.3	60	50	56.7	0.00 (1.00)
14. Principles of doing exercise	56.7	93.3	73.3	73.3	4.10 (<0.001)
15. Compliance with prescribed medications	90	93.3	86.1	86.7	1.00 (0.33)
16. Emotional management	86.7	96.7	76.7	86.7	0.00 (1.00)
17. Performing diabetes nail care	60	66.7	73.3	76.7	0.58 (0.56)
18. Principles of diabetes outing	80	93.3	93.3	90	2.34 (0.02)
19. Performing diabetes foot care	80	96.7	86.7	86.7	2.41 (0.02)
20. Practicing TCM massage	60	90	83.3	76.7	3.79 (<0.001)

Note. TCM = traditional Chinese medicine.

TABLE 4. *Results of the Independent and Paired t tests in HbA_1C*

	Experimental group		Control group		
	Mean	*SD*	Mean	*SD*	Independent *t* (*p*)
Pretest	7.28	1.43	7.41	1.14	− 0.39 (.70)
Posttest	7.00	1.00	7.49	1.17	− 1.72 (.10)
Paired *t* (*p*)	1.58	0.13	− 0.61	0.55	

Note. HbA_1C = hemoglobin A_1C.

Discussion

Effects on diabetes knowledge

Subjects in the experimental and control groups were similar in age and disease conditions. In addition, both groups had comparable levels of knowledge about diabetes. The DM interactive multimedia disk raised the knowledge level in the experimental group, compared with the control group, at posttest. Knowledge level was also compared within the experimental group between pretest to posttest. This finding agrees with other, studies that have shown that a multimedia approach to patient education improves the knowledge of hip replacement patients' self-care for operative preparation and functional activity in postoperative rehabilitation (Yeh et al., 2005); newly diagnosed prostate cancer patients' disease cognition (Flynn et al., 2004); pregnant and postpartum women's exercising (Hausenblas et al., 2008); children's and caregivers' asthma control and tracking (Krishna et al., 2003); older adults' potential drug interactions (Neafsey et al., 2002); the colonoscopy procedure (Shaw et al., 2001); school children's visual health care (Yeh et al., 2008); and of surgical patients' manipulation of patient-controlled analgesia and pain control (Yeh et al., 2007).

Even though subjects were familiar with CAM/TCM because of their cultural society, they entered the study with less correct diabetes-related knowledge at baseline, especially regarding CAM/TCM. It is possible that, since most of the subjects informally access to CAM/TCM health information concerning diabetes, they did not have a thorough understanding of it. This was also demonstrated in the study by Kumar, Bajaj, and Mehrotra (2006). After the patient education process, in the experimental group the highest increment rate was shown regarding the questions of diabetes classification in TCM, and followed by practicing TCM massage, knowing Chinese herbal medications, and TCM for diabetes treatment. In addition, the DM interactive multimedia intervention demonstrated more learning effectiveness in patients than conventional patient education on seven questions, including: (#1) insulin in diabetes treatment, (#3) classifications of diabetes in the view of modern medicine, (#5) sign and symptoms of diabetes, (#11) understanding diabetic food exchanges, (#14) principles of doing exercise, (#18) principles of diabetes outing, and (#19) performing diabetes foot care.

CAM/TCM has emerged as an additional alternative and complementary treatment system alongside modern medicine. These findings indicate that a holistic integration of CAM/TM and modern medicine could truly help patients manage their diabetes. In fact, most subjects in this study were highly appreciative of the DM interactive multimedia instruction as well as knowledge of CAM/TM.

TABLE 5. *Result of ANCOVA in Diabetes Self-Care*

Source	*SS*	*df*	*MS*	*F*	*p*
Pretest	6.81	1	6.81	40.612	< .001
Between group	0.17	1	0.17	1.03	.32
Error	9.56	57	0.17		
Total	784.00	60			

Effects on blood sugar control

The intervention did not incite subjects to change their HbA_1C levels efficiently. This result is similar to that of Adolfsson, Walker-Engstrom, Smide, and Wikblad (2006) in that the diabetes knowledge gained was found at a 1-year follow-up, but HbA_1C was not. Although patients' short-term knowledge and attitudes were greatly improved due to the education intervention, no apparent effect in actual control of blood sugar levels was proven. Norris, Engelgau, and Narayan (2001) performed a systematic review of 72 papers on the effectiveness of self-management training in type 2 diabetes and found that, while the intervention effectively increased the patients' knowledge

TABLE 6. *Results of the Self-Care Behaviors*

	Experimental group				Control group				
	Pretest		Posttest		Pretest		Posttest		
Subscales	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Independent *t* (*p*)
Preventing/treating high and low blood sugar reactions	3.47	0.78	3.77	0.68	4.03	0.96	3.94	0.80	1.93 (.06)
Medication-taking and blood sugar monitoring	3.35	0.62	3.45	0.61	3.79	0.85	3.96	0.68	− 0.42 (.67)
Diet	3.33	0.77	3.43	0.72	3.59	0.76	3.64	0.67	0.34 (.74)
Foot care	3.30	0.77	3.51	0.74	3.77	0.87	3.90	0.78	− 0.49 (.63)
Exercise	2.83	1.18	2.75	1.13	3.31	0.93	3.19	0.85	0.24 (.81)
Overall self-care	3.26	0.50	3.39	0.51	3.67	0.59	3.76	0.55	0.34 (.74)

of diabetes, it was not directly correlated with effective control of blood sugar levels. It is possible that changing patients' attitudes toward self-care and strengthening their motivation would lead to more effective control of blood sugar. Norris, Lau, Smith, Schmid, and Engelgau (2002) pointed out that although self-management could improve HbA_1C, the control effect of HbA_1C may be reduced after termination of the influence of the intervener.

Effects on self-care

Since the between-group difference in self-care was found at pretest, ANCOVA was used with the pretest as a covariance. The results indicate that in terms of statistics, provision of interactive multimedia does not bring about substantial improvement in self-care behaviors. On the other hand, the self-management of irregular blood sugar levels in the experimental group was superior to that of the control group. This finding indicates that intervention might improve self-care. Furthermore, both groups performed well in terms of preventing/treating high and low blood sugar reactions via self-care. The scope of the above performance encompasses: preventing the response of the hypoglycemia according to medical treatment, immediately taking the correct ways to deal with abnormal blood sugar, and visiting the doctor to deal with uncontrolled blood sugar. This result is the same as that of Lou, Li, Yeh, and Chang (2004) but different from that of Wang et al. (1998). This difference may be related to the duration of the disease. Actually, the postdiagnosis duration of this study and Lou et al. (2004) was >5 years, while Wang et al. (1998) was <2 years. It seems that in the early stages of diabetes, people lack the knowledge, experience, and self-awareness needed to prevent and treat high and low blood sugar reactions. Therefore, we wish to point out that offering patient education about diabetes should be seen as a whole in order to satisfy patients' real needs.

In addition, this study shows that the two groups performed the lowest in the area of exercise. The scope of exercise involves participating in routine sports, doing exercises designed specifically for diabetes, continuing one's exercise routine on the weekends or on vacation, and finding time to exercise amidst a busy schedule. This result is the same as that of Lou et al. (2004), but different from that of Wang et al. (1998). Lou et al. (2004), which pointed out that in terms of diabetic patients' self-care behaviors, the issue of exercise had been rated the lowest because patients did not understand its importance and were more often than not limited by their physical conditions, local weather, suitable locations for physical exercise, and exercise companions. It was also pointed out that the major obstacles to regular exercise are the demands of employment, fatigue, and changes in daily schedule (Nies & Kershaw, 2002). Since the subjects in this study are mostly employed, these factors indeed impeded their opportunities for regular exercise.

In conclusion, using an interactive multimedia device in patient education of diabetes self-care was effective in raising subjects' knowledge about their disease, but not in changing behaviors or controlling blood sugar. Perhaps this study may not have followed subjects long enough to observe changes in blood sugar control and self-care activities. Or, more time may be needed in learning to change one's behaviors than in obtaining knowledge.

This study has some limitations. This study was conducted in one hospital, hence representation and generalization were restricted. Potential threats to external validity include the selection bias of the sample. Even though a random assignment was used in this study, a random selection was not. In addition, the statistical power may be too low to detect the educational effect since the sample size did not achieve the estimated sample sizes. In order to achieve the purpose of this study and to meet sample criteria, subjects who could not complete the education program were excluded from data analysis, and no further evaluation was conducted. Additionally, threats to external validity include the Hawthorne effect because the subjects knew that she or he was being measured. Note that the DKI is in a true-false format, hence the extent of information and knowledge of diabetes may be limited as the subject has a 50/50 chance of guessing correctly even when he or she does not know the answer. This study provides no evidence-based proof of its effectiveness beyond the short-time period.

Diabetes is a lifelong condition, and patients must be equipped to take better care of themselves. Given these circumstances, health care professionals in clinical practices should provide patients with appropriate and readily implemented information about diabetes self-care. In doing so, health care practitioners can help modify patients' behavior patterns and enhance the effects of medical treatment. Most of the subjects in the experimental group recognized the value of the interactive multimedia intervention in providing necessary and helpful instruction for their understanding of diabetes, and recommended a wider application of such multimedia-based instruction for other patients.

Since most of the subjects in the experimental group greatly appreciated the interactive multimedia on diabetes, an approach to patient education based on interactive multimedia may serve as a choice for people with diabetes to raise their disease-related knowledge in order to care for themselves. However, further research is required to support the preliminary results described in the present study. In addition, the present study found that people with diabetes do not have an adequate understanding of insulin use if they have never been treated with it, but they should be provided with enough information in order to handle possible instances in the future. Moreover, in terms of patient education, and in addition to offering knowledge, strengthening motivation, and making preparations, medical and nursing professionals should assist patients in building the habit of regular exercise into their daily lives so that they can maintain an adequate level of physical activity. This is a subject meriting further study.

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