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Research Article

The effect of using multimedia education in Women's Breast Cancer Screening Health Education Program

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Abstract:

Breast cancer is an important disease that threatens the lives of women. The majority of breast screening health education is printed promotional material, which is ineffective in enhancing women's knowledge on breast screening in Taiwan, and showed low breast cancer screening rate in women. This provided the impetus for us to carry out this study to understand the major barrier of women on breast cancer and screening procedures. This study used quasi-experimental design and purposive sampling. The study participants were 45–69 year-old women. Data collection was carried out before and after intervention. The health belief model was used as a research framework to examine changes in the study participants after multimedia health education intervention for detecting which factors most affect women's breast cancer screening behavior. Then we could make the policy for enhancing women's breast cancer screening in the future. Our study showed that after multimedia health education intervention, the scores of perceived susceptibility, perceived seriousness, perceived benefits, perceived barriers, cues to action, and self-efficacy in the experimental group were all significantly higher than the control group. We believe that the effectiveness of multimedia health education is better than traditional health education methods, and can enhance women to receive breast cancer screening.

Keywords: breast cancer; multimedia; health education

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Introduction

Breast cancer is an important disease that threatens the lives of modern women. According to the World Health Organization (WHO) [1], breast cancer is the number one cancer in European women. In the US, breast cancer is also ranked first in incidence of cancers in women and its mortality rate is only below that of lung and bronchial cancer. Breast cancer is the most common cancer in Taiwanese women. In Taiwan, the age-standardized incidence rates have risen from 11.69/100,000 population in 1979 to 69.1/100,000 in 2013, and the number of newly diagnosed cases has increased from 701 people in 1979 to 11,281 in 2013. Breast cancer most commonly affects women aged between 45–54 years in Taiwan, which indicates an earlier age of onset than in Western countries[2]. The number of deaths due to breast cancer is also second only to lung cancer, liver cancer, and colorectal cancer [3-4].

Taiwanese women age 45-69 can get free mammograms; nevertheless, earlier data indicated that still fewer women had ever undergone a mammogram. Official statistics released revealed that only 18% of women aged 45–69 years received a mammogram during the past 2 years, and only 30% of breast cancer patients were diagnosed at the early Stages 0 and I. So the Health Promotion Administration in Taiwan wanted to improve mammography-screening rates by providing a mammogram test every 2 years for women aged 45–69 years. In 2013, official statistics released revealed that 36% of women aged 45–69 years received a mammogram during the past 2 years. Despite of intervention, a study showed 50% women never received any type of breast cancer screening during the past 5 years [5]. The mortality rate of breast cancer in Taiwan is also relatively high and this is attributed to insufficient screening. The top three reasons of no regularly breast cancer screening is: 1.no receiving relevant information on breast cancer prevention, 2. breast cancer will not be harmful, 3. they does not have the family history of breast cancer[2]. Hence, a better health education intervention for women's breast cancer screening should be promoted. In medicine, early detection and treatment is the key to decreasing the incidence of breast cancer. Foreign medical care emphasizes disease prevention and indicates that early-diagnosed breast cancer accounts for 70% of all breast cancer. Since the 1990s, when the UK started implementing screening strategies in women aged 50 years and above, the prevalence of breast cancer has declined rapidly[6]. In the US, screening tools are used for early detection of breast cancer and for carrying out early treatment and this has resulted in decreased mortality rates. According to reports from the Health Promotion Administration, Ministry of Health and Welfare, Taiwanese women have a serious lack of awareness of breast cancer prevention and this affects the overall execution of preventive work[3-4].

The majority of existing breast screening health education in Taiwan are printed promotional materials, which are ineffective in enhancing women's knowledge on breast screening, as women remain fearful and anxious about the content of the screening. Multimedia education has been widely used in various fields and has overtaken the classroom education model, resulting in having no spatial and temporal limitations for learning. Text, pictures, animations, sounds, and videos are used to strengthen the overall learning effectiveness. In recent years, there has

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been widespread adoption of multimedia health education for clinical education and the promotion of healthcare policies. This provided the impetus for us to carry out this study to understand the women's knowledge on breast cancer and screening procedures. Women were given multimedia health education films to watch followed by one-on-one health education guidance and assessed to understand whether there are changes in knowledge on breast cancer and breast cancer screening after intervention and whether health education intervention can effectively increase breast-screening awareness.

Materials and Methods:

This study used a quasi-experimental design of pre-test and post-test of experimental and control groups (Table 1). The participants were recruited from 1 January 2017 to 31 March 2017. This study was reviewed and approved by the human experimentation committee by the Institutional Review Board II (approval no.: 2-105-05-112).

Table 1. Study design

Group	Pre-test	Intervention	Post-test
Experimental group	O_1	X	O_2
Control group	O_3		O_4

O_1, O_3：Pre-test of experimental and control groups

O_2, O_4：Post-test of experimental and control groups

X: Breast cancer screening health education intervention based on health belief model (HBM)

1. Drafting of preliminary questionnaire

The health belief model (HBM) is a psychological health behavior change model developed to explain and predict health-related behaviors, particularly in regard to the uptake of health services. The health belief model was developed in the 1950s by social psychologists at the U.S. Perceived susceptibility refers to subjective assessment of risk of developing a health problem. Perceived severity refers to the subjective assessment of the severity of a health problem and its potential consequences. Perceived benefits refer to an individual's assessment of the value or efficacy of engaging in a health-promoting behavior to decrease risk of disease. Perceived barriers refer to an individual's assessment of the obstacles to behavior change. Cues to action can be internal or external. The health belief model posits that a cue, or trigger, is necessary for prompting engagement in health-promoting behaviors. The intensity of cues needed to prompt action varies between individuals by perceived susceptibility, seriousness, benefits, and barriers. Self-efficacy refers to an individual's perception of his or her competence to successfully perform a behavior. Self-efficacy was added to the health belief model in an attempt to better explain individual differences in health behaviors.

The health belief model (HBM) has been used widely as a theoretical framework in many studies related to breast cancer screening and evaluations of breast cancer screening behavior. So our study questionnaires applied

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health belief model (HBM), that is, based on the perceived susceptibility, perceived seriousness, perceived benefits from action, and perceived barriers to action, to evaluate the basic profiles and risk factors of women breast cancer screen. The preliminary scale and questionnaire were based on the scales in the article by Wang et al. [7]. The contents of the questionnaire included 7 sections, including sociodemographic and relevant variables, breast cancer, perceived susceptibility (4 items), perceived seriousness (12 items), perceived benefits (12 items), perceived barriers (19 items), cues to action (3 items), and self-efficacy (4 items), with a total of 54 questions. Participants were asked to indicate their answers on a 5-point Likert scale, ranging from strongly disagree (1 point), disagree (2 points), neither agree nor disagree (3 points), agree (4 points), to strongly agree (5 points).

2. Content validity

After the questionnaire was compiled, content validity assessment was carried out by asking a panel of 8 experts to read and determine the appropriateness and comprehensibility of the content. These experts include academic experts, doctors, pharmacists, breast cancer patient case managers, and nurses. These experts reviewed the questionnaire content for relevance, accuracy, appropriateness, necessity, and completeness, and provided suggestions for revision. Various questions were also evaluated and scored. Following that, the researchers consolidated the suggestions and scores by the experts and modified the questionnaire content and selected questions to for the pre-trial questionnaire. The content validity was 0.924, which fulfilled the requirement of the content validity index (CVI) of 0.8 and above [8].

3. Reliability analysis

In order to ensure the reliability of the questionnaire, a pilot study was conducted from 1 December to 31 December 2016 with women aged 45–69 years from the general surgery department. A total of 37 valid questionnaires were collected after the pilot was completed. Data coding of the completed answers was carried out, and SPSS 22.0 for Windows was used for statistical analysis of the completed answers. Reliability analysis of the scale was carried out. The Cronbach's α value for the overall scale was 0.903, showing that the internal consistency of the entire scale was good.

4. Formal samples

Due to manpower and time constraints in this study, we decided to carry out purposive sampling of women aged 45–69 years from the general surgery department from 1 January to 31 March 2017. According to Cohen's [9] estimation of sample size, with $\alpha = 0.05$, power = 0.95, and effect size = 0.50 as an example, a valid sample size of 46 people were needed. According to a sample dropout rate of 10%, it is estimated that 100 participants would have been needed. All participants were randomly selected. Among these participants, 50 were in the experimental group

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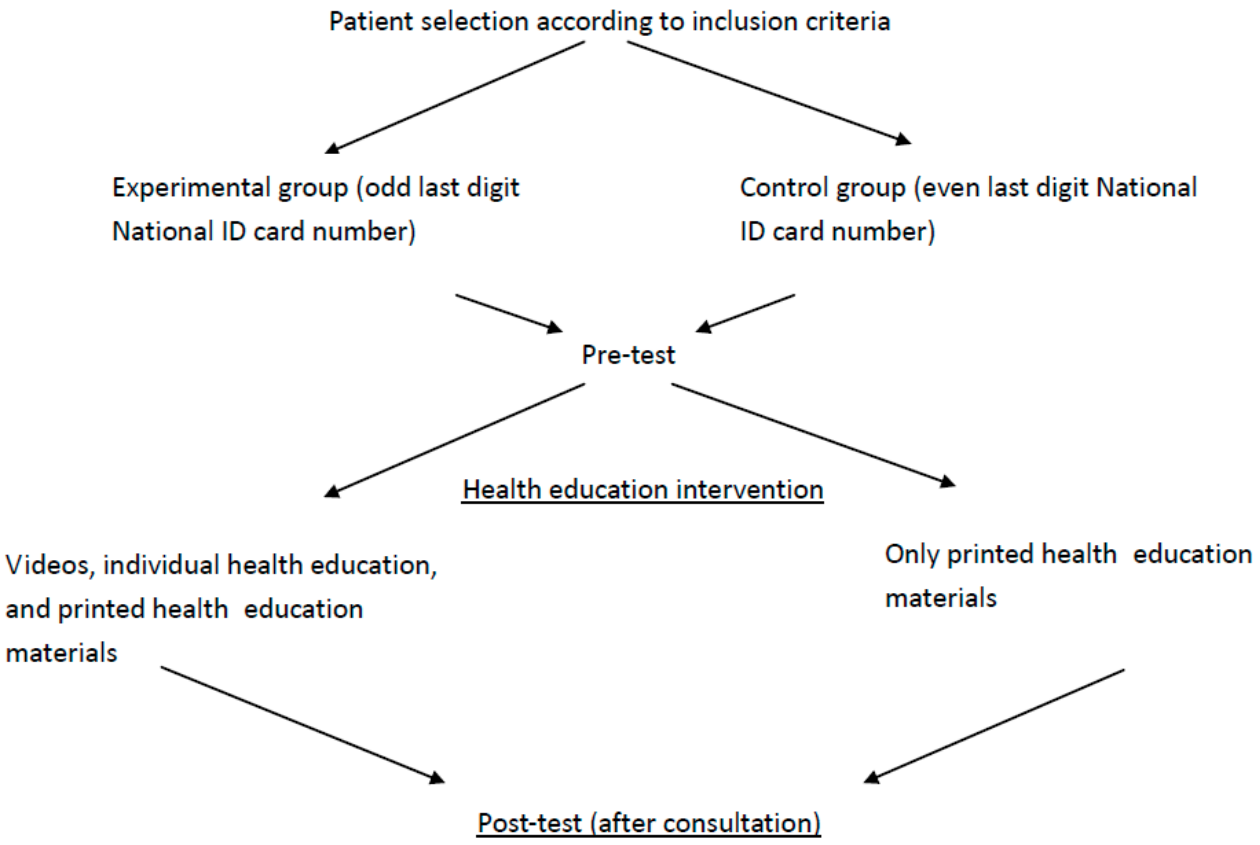
and 50 in the control group. Study participants were selected for the experimental group (n = 50; odd last digit national ID card number) and the control group (n = 50; even last digit national ID card number) based on the inclusion criteria. The aims and methods of the study were explained to participants individually. Participants signed an informed consent form. Pre-test data collection was carried out using structured questionnaires to gain understanding of Taiwanese women's awareness of breast cancer and the current status of breast cancer screening.

After the pre-test questionnaire was completed, the experimental group underwent multimedia health education intervention with HBM as a basis. The participants first viewed health education films and were given breast cancer prevention brochures that were similar to those given to the control group. They were also given a one-on-one special guidance session relating to breast cancer and breast cancer screening measures. The total time taken was 15–20 minutes (contains 6 minutes of film viewing and oral health education). This allowed patients to obtain awareness on breast cancer and breast cancer screening, read through the brochures, and address questions and concerns with their physician. Through this interview method, the likelihood of patients engaging in health behavior is increased. After the session, the patients were reminded of the procedures for making a breast cancer screening appointment and medical treatment. The control group was only given breast cancer prevention brochures. After intervention was carried out in both groups, post-test data collection was carried out for effectiveness analysis of health education guidance on execution of breast cancer screening (Figure 1).

Figure 1. Study process



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HBM was widely used in the last 40 years to predict and explain health-related behaviors. The health beliefs of breast cancer screening include 6 concepts, namely perceived susceptibility, perceived seriousness, perceived benefits, perceived barriers, cues to action, and self-efficacy [10-13]. The health beliefs of participants and other variables were used to predict whether the participant would develop health-promoting behaviors. Even though the participant may have some awareness on perceived susceptibility and perceived seriousness, and the evaluated perceived benefits is greater than perceived barriers, the cues to action is an indispensable factor, just like a match that can start a raging fire. Therefore, a health education intervention was created using the HBM as a theoretical framework to increase women's awareness of breast cancer and increase their self-efficacy in engaging in breast cancer screening and decrease the barriers toward breast cancer screening to increase breast cancer screening rates and safeguard the health of women (Figure 3).

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Results

With regard to general information, we carried out an analysis of demographic variables in the experimental and control groups including the variables age, career, educational level, marriage status, place of residence, family income, family history, personal medical history, reproductive history, and breast cancer screening experience. Chi-squared tests showed that there were differences in age, menstrual history, childbearing history, family history of breast cancer, and whether or not female hormones were used after menopause between the experimental and control groups, and these were statistically significant ($P < 0.05$) (Table 2).

Table 2. Significant differences in demographic information between the experimental and control groups

General information									
		Experimental group		Control group		Total			
		n	%	*n*	%	*n*		Chi-squared test	*P*
Age	<60	39	82.98	30	65.22	69	74.19	3.83	0.042[a*]
	≥60	8	17.02	16	34.78	24	25.81		
Menstrual history (menopausal)	No	25	53.19	11	23.91	36	38.71	7.70	0.004[a*]
	Yes	22	46.81	35	76.09	57	61.29		
Childbearing history (ever pregnant)	No	10	21.28	3	6.52	13	13.98	3.96	0.040[a*]
	Yes	37	78.72	43	93.48	80	86.02		
Family history of breast cancer	No	42	89.36	46	100.00	88	94.62	5.67	0.023[a*]
	Yes	5	10.64	0	0.00	5	5.38		
Use of female hormones after menopause	No	43	91.49	39	84.78	82	88.17	0.72	0.001[a*]
	Yes	4	8.51	7	15.22	11	11.83		

Note a: Fisher's exact test

Note: * $P < 0.05$

When the pre-test health belief indicators of both groups were compared using an independent sample t-test, it was found that there were no differences in perceived susceptibility, perceived seriousness, perceived benefits, perceived barriers, cues to action, and self-efficacy (Table 3-1).

Table 3-1. Comparison of various effectiveness indicators in the experimental and control groups before breast cancer screening health education intervention

Pre-test								
	Experimental group (*n* = 47)		Control group (*n* = 46)		Total (*n* = 93)			
	mean	SD	mean	SD	mean	SD	t	*P*

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Perceived susceptibility	11.43	3.78	10.43	3.15	10.94	3.50	1.371	0.174
Perceived seriousness	43.23	6.68	42.93	7.43	43.09	7.02	0.204	0.839
Perceived benefits	49.47	5.99	50.04	5.70	49.75	5.82	-0.474	0.636
Perceived barriers	53.72	12.88	55.48	16.24	54.59	14.58	-0.578	0.565
Cues to action	11.55	1.98	11.50	2.17	11.53	2.06	0.124	0.902
Self-efficacy	15.40	2.61	15.15	3.63	15.28	3.14	0.384	0.675

For post-test, it was found that the experimental group had higher scores for four effectiveness markers, namely perceived susceptibility, perceived seriousness, perceived benefits, and self-efficacy, compared with the control group and this was statistically significant. The differences in perceived barriers and cues to action did not reach statistical significance (Table 3-2).

Table 3-2. Comparison of various effectiveness indicators in the experimental and control groups after breast cancer screening health education intervention

	Post-test							
	Experimental group (n = 47)		Control group (n = 46)		Total (n = 93)			
	mean	SD	mean	SD	mean	SD	t	P
Perceived susceptibility	12.89	4.95	10.15	3.54	11.54	4.50	3.076	0.003*
Perceived seriousness	45.81	10.65	41.61	7.31	43.73	9.34	2.222	0.029*
Perceived benefits	55.94	6.22	51.61	5.93	53.80	6.42	3.435	0.001*
Perceived barriers	50.68	13.75	53.17	17.16	51.91	15.50	-0.774	0.441
Cues to action	13.47	1.82	12.85	1.67	13.16	1.76	1.712	0.090
Self-efficacy	17.79	2.20	16.37	2.92	17.09	2.66	2.652	0.009*

Note: * $P < 0.05$

Following that, paired t-tests were used for analysis. It was found that participants in the experimental group showed differences before and after health education intervention in various health belief indicators, namely perceived susceptibility, perceived seriousness, perceived benefits, perceived barriers, cues to action, and self-efficacy and these differences were all statistically significant ($P < 0.05$) (Table 4-1).

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Table 4-1. Differences in various effectiveness indicators in the experimental group before and after health education intervention

Experiment group-paired sample testing								
	Paired differences							
	Mean	SD	Mean standard error	95% confidence interval Lower limit	Upper limit	T	df	*p* (two-tailed)
Perceived susceptibility	-0.36702	0.88135	0.12856	-0.62579	-0.10825	-2.855	46	0.006*
Perceived seriousness	-0.21454	0.63101	0.09204	-0.39981	-0.02927	-2.331	46	0.024*
Perceived benefits	-0.53901	0.50536	0.07371	-0.68739	-0.39063	-7.312	46	< 0.001*
Perceived barriers	0.13998	0.30890	0.04506	0.04928	0.23067	3.107	46	0.003*
Cues to action	-0.63768	0.76603	0.11294	-0.86516	-0.41020	-5.646	45	< 0.001*
Self-efficacy	-0.57609	0.62776	0.09256	-0.76251	-0.38967	-6.224	45	< .001*

Note: * $P < 0.05$

Besides perceived susceptibility and perceived seriousness, the participants in the control group showed differences before and after health education intervention in perceived benefits, perceived barriers, cues to action, and self-efficacy and these differences were all statistically significant ($P < 0.05$) (Table 4-2).

Table 4-2. Differences in various effectiveness indicators in the control group before and after health education intervention

Control group-paired sample testing								
	Paired differences							
	Mean	SD	Mean standard error	95% confidence interval Lower limit	Upper limit	T	df	*P* (two-tailed)
Perceived susceptibility	0.07790	0.83359	0.12291	-0.16965	0.32545	0.634	45	0.529
Perceived seriousness	0.11051	0.37435	0.05520	-0.00066	0.22168	2.002	45	0.051
Perceived benefits	-0.13043	0.35165	0.05185	-0.23486	-0.02601	-2.516	45	0.016*
Perceived barriers	0.11728	0.35375	0.05216	0.01223	0.22233	2.249	45	0.029*
Cues to action	-0.44928	0.74773	0.11025	-0.67132	-0.22723	-4.075	45	<0.001*

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Self-efficacy	-0.30435	0.64746	0.09546	-0.49662	-0.11208	-3.188	45	0.003*

Note: *$P < 0.05$

Before carrying out covariate analysis, homogeneity testing of intragroup regression coefficients was carried out. Perceived susceptibility ([F] = 1.88, P >0.05), perceived seriousness ([F] = 0.042, $P > 0.05$), perceived benefits ([F] = 0.225, $P > 0.05$), perceived barriers ([F] = 0.334, $P > 0.05$), cues to action ([F] = 0.015, $P > 0.05$), and self-efficacy ([F] = 0.148, P >0.05) and the covariates of both groups all showed homogeneity with the regression coefficients of the post-test data, and covariate analysis could therefore be carried out (Table 5).

Table 5. Homogeneity testing of post-test intragroup regression coefficients of various effectiveness covariates

Variable	Source of variability	SS	df	MS	*F*	*P*-value
Perceived susceptibility	Pre-test*group	22.819	1	22.819	1.880	0.174
	Error	1,104.794	91	12.141		
Perceived seriousness	Pre-test*group	2.082	1	2.082	0.042	0.839
	Error	4,535.230	91	49.838		
Perceived benefits	Pre-test*group	7.697	1	7.697	0.225	0.636
	Error	3,113.615	91	34.216		
Perceived barriers	Pre-test*group	71.591	1	71.591	0.334	0.565
	Error	19,494.883	91	214.229		
Cues to action	Pre-test*group	0.066	1	0.066	0.015	0.902
	Error	391.117	91	4.298		
Self-efficacy	Pre-test*group	1.477	1	1.477	0.148	0.701
	Error	905.254	91	9.948		

Covariate variables: Age, menstrual history, childbearing history, family history of breast cancer, whether or not there was use of female hormones after menopause

Table 6 shows the results and description of ANCOVA of various effectiveness markers after breast cancer screening health education intervention.

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Table 6. ANCOVA of various effectiveness markers after multimedia breast cancer screening health education intervention

Variable	Group	*n*	Mean	SD	Adjusted mean	*F*	*P*-value
Perceived susceptibility	Experimental group	47	12.89	4.95	12.91	9.394	< 0.001***
	Control group	46	10.15	3.54	10.13		
Perceived seriousness	Experimental group	47	45.81	10.65	45.88	4.897	< 0.001***
	Control group	46	41.61	7.31	41.53		
Perceived benefits	Experimental group	47	55.94	6.22	56.00	11.799	< 0.001***
	Control group	46	51.61	5.96	51.55		
Perceived barriers	Experimental group	47	50.68	13.75	50.70	0.599	0.007**
	Control group	46	53.17	17.16	53.15		
Cues to action	Experimental group	47	13.47	1.82	13.52	2.931	<0 .001***
	Control group	46	12.85	1.67	12.79		
Self-efficacy	Experimental group	47	17.79	2.20	17.86	7.032	< 0.001***
	Control group	46	16.37	2.92	13.29		

Note: *** $P < 0.001$, ** $P < 0.01$

1. Perceived susceptibility

Covariate analysis showed that the post-test scores between the experimental and control groups on perceived susceptibility were significantly different ([F] = 9.394, $P < 0.001$). Therefore, the study hypothesis of significantly better post-test scores on perceived susceptibility in the experimental group, compared with the control group, after multimedia breast cancer screening health education intervention was supported.

2. Perceived seriousness

Covariate analysis showed that the post-test scores between the experimental and control groups on perceived seriousness were significantly different ([F] = 4.897, $P < 0.001$). Therefore, the study hypothesis of significantly better post-test scores on perceived seriousness in the experimental group, compared with control group, after multimedia breast cancer screening health education intervention was supported.

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3. Perceived benefits

Covariate analysis showed that the post-test scores between the experimental and control groups on perceived benefits were significantly different ([*F*]=11.799, *P* < 0.001). Therefore, the study hypothesis of significantly better post-test scores on perceived benefits in the experimental group compared with the control group after multimedia breast cancer screening health education intervention was supported. This means that after multimedia breast cancer screening health education intervention, there were statistical differences in post-test perceived benefits scores between the experimental and control groups, i.e. multimedia breast cancer screening health education intervention has effects on perceived benefits.

4. Perceived barriers

Covariate analysis showed that the post-test scores between the experimental and control groups on perceived barriers were significantly different ([*F*] = 0.599, *P* < 0.01). Therefore, the study hypothesis of significantly better post-test scores on perceived barriers in the experimental group, compared with control group, after multimedia breast cancer screening health education intervention was supported.

5. Cues to action

Covariate analysis showed that the post-test scores between the experimental and control groups on cues to action were significantly different ([*F*] = 2.931, *P* < 0.001). Therefore, the study hypothesis of significantly better post-test scores on cues to action in the experimental group compared with control group after multimedia breast cancer screening health education intervention was supported.

6. Self-efficacy

Covariate analysis showed that the post-test scores between the experimental and control groups on self-efficacy were significantly different ([*F*] = 7.032, *P* < 0.001). Therefore, the study hypothesis of significantly better post-test scores on self-efficacy in the experimental group compared with control group, after multimedia breast cancer screening health education intervention, was supported.

In summary, a multimedia breast cancer health education intervention can improve women's awareness and attitudes, increase their risk awareness of breast cancer, deepen the awareness of the seriousness of cancer in women, improve the benefits of participating in screening, overcome the behavioral barriers of participation in breast cancer screening, and strengthen the individual's self-efficacy. If face-to-face health education can be used appropriately, this can promote the self-efficacy of the study participants toward breast cancer screening.

Discussion

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Only approximately 30% of breast cancer patients were diagnosed in stage I during 2004-2009 in Taiwan. Since the cure rate for stage I breast cancer with contemporary treatment is as high as 95%, overall survival could be improved markedly if the percentage detection of early breast cancer cases could be increased to more than 50%[14]. Because of low breast cancer screening rate is low in Taiwan; we designed the study to understand the effectiveness of intervention and awareness of breast cancer screening. Our study also used HBM as a foundation to consider the characteristics of the study participants, and to plan and design a multimedia breast cancer screening health education course. This health education intervention strategy was used to establish knowledge of breast cancer preventive screening, health beliefs, and strengthen activity benefits and relevant cues to action in women aged 45–69 years. One-on-one interviews were used to counter anxiety and fear by using explanations to decrease perceived barriers due to a lack of understanding and improve the person's self-efficacy in terms of breast cancer screening. After the health education intervention, it was found that perceived susceptibility, perceived seriousness, perceived benefits, perceived barriers, cues to action, and self-efficacy all showed significant improvements.

With regard to health education intervention, the correlation between various health belief indicators before and after intervention will be examined according in sequence.

Perceived susceptibility

Before the multimedia health education intervention, the experimental group had higher scores for the third question ("I feel that with the status of women in my family, my probability of contracting breast cancer in the future is high") compared with the control group and this was statistically significant. At the same time, we observed that the proportion of women with a family history of breast cancer in the experimental group was higher than in the control group. Therefore, we found that women with a family history of breast cancer had greater awareness of perceived susceptibility, perceived benefits, cues to action, and self-efficacy. This result was consistent with that of other studies [15-18]. In addition, studies by Abbaszadeh [19] and Avci and Kurt [20] also found that if the study participants have a greater perceived susceptibility of breast cancer or if they believe that breast cancer screening can decrease the mortality rate due to breast cancer, they will carry out screening behavior. A study by Hosseini and Hosseini[21] found that in the HBM, the stronger the perceived susceptibility, the more likely the person will be to take action. Therefore, all health education interventions mainly awaken the susceptibility feelings of the person toward certain diseases and the greater the susceptibility, the more likely the person will be to carry out behaviors to prevent the disease.

Perceived seriousness

It was found that the intervention could strengthen the awareness of breast cancer seriousness in participants. The seriousness of breast cancer is especially pertinent in terms of the financial, psychological, and emotional effects

on family members. This section can be used as an area of focus for improving future health education on breast cancer screening. The results of this study were also consistent with the results of other researchers [22]. Rosenstock [23] showed that perceived susceptibility and perceived seriousness are strong awareness variables and will be affected by the level of awareness of the women themselves.

Perceived benefits

Differences in perceived benefits in both experimental and control groups reached statistical significance. There was also significant improvement in the perceived benefits of breast cancer screening in study participants of the control group and we deduced that this might be a result of sampling. This is because the participants were patients who came to the hospital for consultation and these patients themselves have a higher acceptance of health-promoting behaviors. The scores on all questions were significantly higher in study participants from the experimental group after the multimedia health education intervention and this was significantly better than in the control group. We hypothesized that this difference is due to the professional explanations by doctors, which decreased participants' anxiety and their lack of understanding on breast cancer awareness. This cannot be achieved purely by reading printed health education materials. At the same time, our study found that women have a high acceptance of breast cancer screening health education provided by the hospital. Many patients provided good feedback after watching the film. Some patients started to worry whether they might have breast cancer and started showing concern for the health of their relatives and hoped that they could also watch these films. Some women mentioned that their awareness of breast cancer and breast cancer screening became clearer after watching the films and that it also removed their long-standing fear, anxiety, and lack of understanding and they thanked us for our efforts. Some patients even immediately enquired about the examination method and arranged for examination appointments. In addition to graphics and text, the simultaneous use of film, brochures, and educational guidance in this study to repeatedly explain the importance of breast cancer screening, the seriousness of developing breast cancer, and the benefits of screening can be combined with timely education to different participants. For example, explanation through film had greater benefits for participants who have lower educational levels. A study by Miller [24] pointed out that for health education to patients, the education materials are extremely important and the reading level of the participants should be considered. The health education content can be matched with various forms of health education so that patients have the opportunity for repeated learning, which will strengthen their memory and promote the development of healthy behaviors. Visual experiences account for around 90% of sensory acceptance during health education, while the remainder is hearing, touch, smell, and taste. The combined used of graphics, audiovisual materials, and printed information can stimulate the use of patients' eyes and ears [25]. In addition, multiple studies have found that multimedia health education can improve learning outcomes [26-27]. Gaskey [28]

found that health education videos can significantly improve the knowledge and attitudes of patients compared to verbal health education.

Perceived barriers

With regard to perceived barriers, although study participants showed a decrease in scores for perceived barriers after multimedia health education intervention, this did not reach statistical significance when compared with the control group. We hypothesize two possible reasons: 1) Poor design of the set of questions as some questions are negative questions and the participants may have misunderstood the intent of the questions and answer incorrectly. During reliability analysis of questions, the Cronbach's α value of perceived barriers was 0.801, which was the lowest among all coefficients for effectiveness indicators and is far below the overall reliability value of 0.903. 2) Over-emphasis on perceived benefits of breast cancer screening during course design and simplified content on perceived barriers of breast cancer screening. The questionnaire also cannot change certain behaviors of perceived barriers such as lack of time, inconvenience of consultation, requirement for another appointment, long consultation times, and the fact that breast examination cannot be carried out by males, and so on. These factors require cooperation with the system and the environment, such as social health policies and hospital environment. In addition, the health education interviews with patients also verified this hypothesis as the reason for study participants for not accepting breast cancer were similar to the top 10 reasons for not agreeing to breast cancer screening that were obtained from a large database on the Internet. This shows that these reasons are the greatest perceived barriers affecting whether patients will undergo breast cancer screening.

Cues to action

There were significant differences in breast cancer screening cues to action indicators during pre-test and post-test between both groups. An intergroup comparison showed that the experimental group had better scores than the control group and, even though this difference did not reach statistical significance, it was close to statistical significance. We hypothesize that the effectiveness is mainly due to the multimedia breast cancer health education intervention and that our study uses brochures and multimedia breast cancer screening videos together. Regardless of breast cancer prevention brochures or multimedia breast cancer screening, the presentation methods have more graphics than text and the information was clear and concise. The education materials used in our study used six minutes of animation and subsequent verbal health education. The results showed that, although the video education times were short, when this was combined with oral health education it can repeatedly strengthen the impression of the study participants and increase the intention of the study participants to participate in breast cancer screening. A study by Adelson et al., [29] also found that using posters, pamphlets, and interactive computer programs for various forms of promotion could improve women’s awareness of breast cancer screening and increase self-efficacy.

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Self-efficacy

There were significant differences in breast cancer screening self-efficacy indicators during the pre-test and post-test between both groups. An intergroup comparison showed that the experimental group had better scores than the control group and this reached statistical significance. We deduced that the effectiveness is mainly due to the multimedia breast cancer screening health education intervention. According to Bandura's social-cognitive theory [30], the concept of self-efficacy is produced from an understanding of the self and is composed of four determining factors. These four factors are enactive mastery experiences, vicarious experiences, verbal persuasion, and physiological and affective states. These four aspects were used for health education intervention to strengthen the individual's mastery in carrying out health-promoting behaviors. A European study on the effectiveness of breast cancer screening health education activities found that the majority of active invitation methods for breast cancer screening activities performed better than not carrying out any intervention at all [31]. In addition, face-to-face communication on the content between the doctor and the woman can strengthen the level of sensibility and psychological contact, so that the woman can have deeper communication.

Conclusions

In conclusion, the rate of breast cancer screening is low in Taiwanese aged 45-69 women. Our study is the first to adopt multimedia for health education courses on breast cancer screening and uses the HBM to verify that multimedia health education courses show effectiveness for breast cancer screening in women. Despite of one-to-one interview is unlikely to be cost-effective for a population-based education programme but we still recommend that the government should strengthen health education throughout the community and use multimedia to highlight the importance of mammography. Future more studies can further examine the impact of demographics and the reinforcing and inhibiting factors which may impact women's awareness of breast cancer and their screening uptake.

Practice implications

This study shows that by employing multimedia health education intervention enhances the effects in the participants in the experimental group, increase the women's awareness on breast cancer screening and achieve the aim of breast cancer prevention.

A limitation of this study was the scope of the intervention. Expanding the intervention to other modules or other courses, where appropriate, may provide additional evidence. Another limitation of the study was the modest although significant improvements in patient performance.

Conflicts of interest: None of the authors have any competing interests in the manuscript.

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Informed consent: All authors confirm all participants identifiers have been removed or disguised so the participants described are not identifiable and cannot be identified through the details of the story.

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