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Conventional versus computer-based patient education: Non-randomized controlled trial

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Abstract
Objective: In this paper, we aim to examine the effect of computer-based patient education on patients' knowledge of their health conditions, as well as their satisfaction with this approach compared with the conventional patient education strategy.
Method: We used a non-randomized controlled trial design in this study. We examined the effects of teaching strategies for both computer-based and conventional patient education (independent variables) on the improvement of patients' knowledge about their health conditions, along with their satisfaction (dependent variables). The convenience sample from 120 bariatric patients with appointments for surgery was divided into two groups. The intervention group received computer-based patient education, while the control group received conventional education. A self-administered questionnaire was distributed to the participants and included four parts: demographic data, patient satisfaction section, pre-test for knowledge, and post-test for knowledge.
Results: The lecture format was the study participants' most preferred method of education (49.2%). In the conventional education group, the mean difference in knowledge scores before and after the educational session was 3.4 (SD = 3.5), with a significant improvement in knowledge after the session (t-value = 6.84, df = 47, p-value < 0.001). This result was similar to the mean difference in knowledge scores in the computer-based education group (3.8, SD = 3.4), suggesting a significant improvement in knowledge scores (t-value = 8.2, df = 51, p-value < 0.001). There was no sufficient evidence of a significant difference in the mean change in knowledge scores between the two groups (t-value = -0.63, df = 96.9, p-value = 0.532). The majority of the participants were strongly satisfied with the educational session (83.9% and 86.4% for computer-based and conventional education groups, respectively).
Conclusion: It is an effective option to use multiple teaching methods, including conventional and computer-based patient education delivered by health team members. Both strategies have similar positive effects on patients' knowledge improvement and satisfaction.

Keywords: Conventional versus, computer-based, controlled trial

Introduction
Patient education has been defined as a systematic experience in which a combination or a variety of methods are used. These might include the provision of information and advice and behaviour modification techniques, which influence the way the patient experiences his illness and/or his knowledge and health behaviour, aimed at improving or maintaining or learning to cope with a condition, usually a chronic one (Engers *et al*., 2008) [4].
The benefits derived from patient education include improved quality of care benefits by increasing patient compliance and enhancing health outcomes, as well as financial benefits through the proper use of economic resources, elimination of medical equipment misuse, and low re-admission rates. Patient education is considered pivotal in improving adherence, with various concepts already developed to address this issue.
Patient educational needs vary greatly, depending on a patient's underlying condition; diseases demanding precise medication dosing or modifications in health-related behaviors appear to profit most from educational programs (Suhling *et al*., 2014) [23]. Patients bring varied experiences and learning preferences to the educational environment. To optimally meet their individual learning needs, patients need opportunities to learn in ways that work for them. At various points during the learning processes, patients need opportunities to reflect on what they have learned and what they still need to know. Computer-based

technologies that customize the assessment and education intervention processes should support this important educational concept.

Ongoing changes in healthcare, including legislated reimbursement for educational interventions, are increasing attention to patient education. Patient education has emerged as an important component of many health promotion and disease management programs. In responding to increased pressure to provide more informed and interactive information resources to patients at less cost, patient educators are beginning to realize the benefits of using computer technology to support the healthcare learning process (Lewis, 1999) [12].

Computer-based education (CBE) involves the use of computer technology in teaching patients. This method includes two components: (1) non-interactive, primarily text-based systems, such as computer-generated handouts and written documents, and (2) patient-interactive systems, such as interactive educational software packages (Murphy, 1998) [14].

As healthcare delivery environments increasingly focus on health promotion and chronic disease management, it appears that CBE will play a greater role in supporting patients in understanding their personal disease management plans. Computer-based patient education has the potential to blend with and strengthen the established healthcare learning environment. Because the broad potential of this new information resource is only beginning to be tapped, it is important that educators understand how these technologies can best support the practice of healthcare education. Computer-based patient education is a tool that provides several advantages, including just-in-time availability, a private learning environment, immediate reinforcement of the learning that has occurred, support for the decision-making process, the potential for individualization of the information presented, and the ability to simulate life experiences (Lewis, 1999) [12]. Moreover, CBE has positive impacts on clinical outcomes, knowledge acquisition, self-care management, and skill development. On the other hand, conventional patient education is time-intensive and requires a trained specialist and a suitable location (Donaghy, 1995) [2].

In this study, our purpose is to examine the effect of CBE on patients' knowledge of their health conditions, as well as their satisfaction with this approach compared with the conventional education strategy.

The majority of research studies present inconclusive findings on the educational effect of computer-based patient education as a teaching strategy in comparison to the conventional method. A review of the available literature reveals two groups of studies: one favoring computer-based patient education over conventional methods, and the other finding no significant difference between the two methods.

Computer-based patient education has a positive effect on patients' knowledge about their health conditions and their satisfaction. Lewis (1999) [12] supported CBE as an effective strategy for transfer of knowledge and skill development of patients, adding that many studies demonstrated an improvement in knowledge scores compared with traditional methods of instruction. Gysels and Higginson (2007) [8] found that patient education using computer technology was as effective as traditional patient education and even superior in many outcomes. Video and computer technology improved knowledge, were accepted well by patients, and increased their satisfaction with information and the decision-making process. Fox (2009) [6] found collective evidence to indicate that interactive CBE programs could add considerable value to the patient education process, although significant inconsistencies were noted. Ryhanen, Siekkinen, Rankinen, Korvenranta, and Leino-Kilpi (2010) [20] found a positive relationship between Internet or computer-based, patient-education interventions and the knowledge of patients with breast cancer. In evaluating the most effective teaching strategies and methods of delivering patient education, Friedman and colleagues (2009) [7] concluded that the use of computers could be an effective strategy, especially when patients are provided information specific to their own situations rather than general information.

Technology has been successfully used to support skill development and patient decision making. Shepperd, Coulter, and Farmer (1995) [22] found that a touch-screen interactive video program was useful in helping patients with hypertension and benign prostatic hypertrophy to make healthcare choices. Nishimoto and colleagues (1994) [15] developed a computer-based patient education program to teach clients the necessary skills to use the Novo-Pen insulin delivery device. In this cited study, CBE supported active participation in the learning process and reduced the time required for learning by as much as 40%, thereby allowing the diabetes care provider more time for individualized instruction.

Similarly, CBE has been shown as effective for persons across the age continuum. Healthcare education for younger children is difficult, partly because of their limited attention spans. School-aged children (from kindergarten to high school) with chronic diseases positively responded to this form of patient education. For the children who participated in these studies, CBE was effective in changing their healthcare behavior and health outcomes, including improving their knowledge and ability to communicate with their parents and care providers and reducing their need for urgent medical care (Brown *et al*., 1997; Engvall, 1994; Evans *et al*., 1998; Krishna, Balas, Spencer, Griffin, & Boren, 1997; Morse, Bartholomew, & Pang, 1997; Petersen, 1996) [1, 3, 5, 11, 18].

Many studies noted that computer-based patient education supported the communication between patients and care providers. Research indicated patient–educator contact as an important factor in ensuring patient motivation and involvement, which would be necessary to facilitate lifestyle changes (Jelovsek, 1993; Juge & Assal, 1992; Patyk, Gaynor, Kelly, & Ott, 1998) [9, 10, 17].

Computer-based patient education methods resulted in improved clinical outcomes when compared with traditional approaches. Reis and Wrestler (1994) [19] found that the use of a computer program to educate patients about interventions for the common cold reduced the duration of healthcare visits. Additionally, patients reported that the computer-assisted instruction program could save time and money, showed the best use of resources, and was a reliable and accurate source of information. Wieland and colleagues (2012) [25] concluded that compared with minimal interventions (pamphlets and usual care) or none at all, interactive computer-based interventions were effective for weight loss and maintenance.

Despite the aforementioned supporting evidence of the superiority of computer-based patient education to

conventional health education methods, some research reported conflicting results. Välimäki, Hätönen, Lahti, Kuosmanen, and Adams (2012) [24] found no significant differences in the primary outcomes (patient compliance) between psycho-educational interventions (using information and communication technology [ICT]) and standard care. However, they acknowledged that ICT remained a promising method of delivering psycho-education. Pal and colleagues (2013) [16] concluded that computer-based, diabetes self-management interventions for type-2 diabetes appeared to have a small beneficial effect on blood glucose control, but the effect was larger in the mobile phone subgroup. No evidence showed benefits in other biological outcomes or any cognitive, behavioral, or emotional outcomes. Wofford, Smith, and Miller (2005) [26] concluded that the field of computer-assisted patient education was still in the process of maturing. More evidence of its impact on clinical outcomes would be required before the acceptance of computer-assisted patient education in the healthcare setting. Saksena (2010) [21] concluded that computer-based patient education was not supported as a method of changing health behaviors. However, the author reported that CBE was positively affected knowledge, self-care behaviors, and self-efficacy. In her study that compared tablet-PC education and conventional patient education following lung transplantation, Suhling *et al*. (2014) [23] concluded that CBE (in this case, made available on tablets and PCs) was just as effective as conventional education.

In summary, while the majority of the cited studies drew conclusions about the greater benefits of computer-based patient education compared with conventional teaching methods, others disagreed with these conclusions. To assess the effects of computer-based teaching methods on patient knowledge and satisfaction, we examined the effects of both CBE and conventional education on patients' knowledge of bariatric surgery and their satisfaction with the educational session. Our study had threefold aims. The first aim was to evaluate the change in knowledge before and after the educational session. The second aim was to compare the mean change in knowledge between the group receiving CBE and the group receiving conventional education. The third aim was to evaluate the overall patient satisfaction, following the teaching session in the two groups.

Method

Study Design

A non-randomized controlled trial was conducted at Prince Sultan Military Medical City (PSMMC), Kingdom of Saudi Arabia, comparing CBE and conventional teaching methods among patients receiving bariatric education at the surgical clinic. The primary outcomes included patient knowledge about bariatric surgery, in addition to patient satisfaction about the teaching methods.

Setting, population, and sampling

All bariatric patients with appointments for surgery at PSMMC were selected for this study. Before the scheduled surgeries, specialized and well-trained health educators usually provide these patients with group instructions about all surgery-related details and the necessary postoperative lifestyle adjustments.

Using a sample size calculator to achieve an 80% statistical power and a 95% confidence level, the sample size required for this study was calculated to be 120 patients, who were divided into two groups. The intervention group received CBE, while the control group received conventional education. The patients were not randomized and were conveniently assigned to one of the two groups. We included bariatric patients who were scheduled for surgery in outpatient clinics/PSMMC and had an educational level of grade 9 and above. Individuals younger than 20 years of age were excluded from the study.

Study variables

The method of education (CBE versus conventional education) was treated as the independent variable, while patients' knowledge about their health conditions and their satisfaction were treated as dependent variables.

The CBE session involved using computer technology, including illustrations and videos, to help patients understand the lesson content. This teaching strategy was usually reinforced with soft such as computer assisted instructions and hard educational materials such as pamphlets, according to patient preference. The conventional teaching session involved providing patients only with verbal or written instructions in an individualized or a group setting.

The content of the educational sessions was the same for both groups, which focused on the following topics: definition of morbid obesity, factors associated with weight gain, types of bariatric surgery, follow-up after bariatric surgery, and complications of bariatric surgery. After the teaching session, the patients' knowledge was assessed through a post-test questionnaire, and their feedback about the teaching method was evaluated.

The patients' knowledge about bariatric surgery was assessed twice (pre- and post-educational session) for both groups, using a self-administered questionnaire. Their knowledge was evaluated through 15 questions related to the same topics covered by the educational session. For each question, we marked 1 point for the correct answer and 0 point for an incorrect answer. Next, the points were summed to produce a final score out of 15 points. This step was performed twice, for pre- and post-knowledge assessment. The knowledge score was treated as a continuous measure in this study. Overall satisfaction was measured based on 15 items related to the lecture (its topic, its format, the presenter's communication skills, illustrations, the venue, whether or not some of the participants' questions were answered in the lecture, provision of practical examples, time of the lecture, encouragement by the presenter, lecture clarity, and attractiveness of the topic). These items were graded on a Likert scale (from 0 = "strongly unsatisfied" to 4 = "strongly satisfied"). The answers to the 15 items were then totaled to provide a final score out of 60 points. The categories were as follows: overall score of 0–8 = "strongly unsatisfied," 9–15 = "unsatisfied," 16–30 = "not sure," 31–45 = "satisfied," and 46–60 = "strongly satisfied." The satisfaction instrument was adopted from the current PSMMC patient satisfaction tool.

Other covariates measured in this study were demographic characteristics and patient weight prior to surgery. The demographic measures included age, gender, marital status, level of education, whether the individual previously received health education, favorite method of health education, interest in attending an educational session, and learning difficulties (in writing or reading).

Data collection

The eligible patients were verbally notified of their inclusion in the study. On the same day of their appointment, the patients first completed a questionnaire, including a pre-test that assessed their knowledge of the various important aspects related to their health conditions. Next, the investigator conveniently assigned each participant to one of the two education groups.

All participants received an explanation about the study's purpose and enrollment and signed the consent form. This study was approved by the Research and Ethics Committee at PSMMC.

Results

Statistical analysis

We calculated frequencies and percentages for categorical baseline characteristics, as well as means and standard deviations (SDs) for continuous measures. We compared the baseline characteristics between the two groups (that received conventional education and CBE methods, respectively) by conducting chi-square analyses for categorical measures and independent sample t-tests for continuous measures.

To assess the change in knowledge, we conducted a paired sample t-test that compared the knowledge scores before and after the education methods applied in both groups. We then conducted an independent sample t-test to compare the change in knowledge scores (before and after the educational session) between the two groups. The alpha level was set at 0.05. All analyses were conducted using SAS 9.2 (SAS Institute Inc., Cary, NC).

Baseline characteristics of the participants

The total number of participants was 121 (39% males and 61% females). Most of the participants in both groups were between 31 and 50 years old (Table 1). Their average baseline weight was 123.5 (SD = 19.3). Over one-third of the participants (36.1%) had a college education or a higher degree, and half of them were married (50.4%). With respect to previous experience with health education lectures, 70.3% had previously attended an education session. Of these, the majority (77.4% and 72.6% of conventional education and CBE groups, respectively) reported that the amount of information they received was minimal. The participants' most preferred method of education was the lecture format (49.2%). The comparison of the baseline characteristics showed no sufficient evidence of significant differences between the two groups (Table 1).

Table 1: Method of bariatric education

Characteristics	Computer-based education (CBE) group N = 62 Count (%)	Conventional education group N = 59 Count (%)	Total N = 121
Age			
20–30	22 (35.5%)	24 (40.7%)	46 (38.0%)
31–50	34 (54.8%)	28 (47.5%)	62 (51.2%)
51 or older	6 (9.7%)	7 (11.9%)	13 (10.7%)
	p-value = 0.715		
Weight prior to surgery in kg (mean, SD)	125.9 (18.3)	121 (20.1)	123.5 (19.3)
Gender			
Male	23 (38.3%)	23 (39.7%)	46 (39.0%)
Female	37 (61.7%)	35 (60.3%)	72 (61.0%)
	p-value = 0.883		
Level of education			
Lower than high school	11 (17.7%)	8 (19.3%)	19 (16.0%)
High school	22 (35.5%)	17 (29.8%)	39 (32.8%)
Diploma	7 (11.3%)	11 (19.3%)	18 (15.1%)
College or higher degree	22 (35.5%)	21 (39.8%)	43 (36.1%)
	p-value = 0.611		
Marital status			
Married	31 (50.0%)	30 (50.9%)	61 (50.4%)
Single	17 (27.4%)	21 (35.6%)	38 (31.4%)
Divorced	11 (17.7%)	5 (8.5%)	16 (13.2%)
Widowed	3 (4.8%)	3 (5.1%)	6 (5.0%)
	p-value = 0.455		
Previously received education about health			
Yes*	45 (72.6%)	40 (67.8%)	85 (70.3%)
No	17 (27.4%)	19 (32.2%)	36 (29.8%)
	p-value = 0.565		
Favorite method of health education			
Lectures	34 (54.8%)	25 (43.1%)	59 (49.2%)
Videos	6 (9.7%)	10 (17.2%)	16 (13.3%)
Brochures	9 (14.5%)	7 (12.1%)	16 (13.3%)
Computer-based	13 (21.0%)	16 (27.6%)	29 (24.2%)
	p-value = 0.423		
Interest in attending an educational session			
Yes	52 (85.3%)	50 (84.8%)	102 (85.0%)
No	9 (14.8%)	9 (15.3%)	18 (15.0%)

	p-value = 0.939		
Have difficulty in reading			
Yes	6 (9.7%)	5 (8.5%)	11 (9.1%)
No	56 (90.3%)	54 (91.5%)	110 (90.9%)
	p-value = 0.818		
Have difficulty in writing			
Yes	7 (11.5%)	2 (3.4%)	9 (7.5%)
No	54 (88.5%)	57 (96.6%)	111 (92.5%)
	p-value = 0.093		

*The majority of the participants (77.4% of the conventional education group and 72.6% of the CBE group) who reported previously receiving health education stated that the amount of information they received was minimal.

Notes: Almost half of the participants preferred the educational session to last less than one hour (48.3% of the conventional education group and 45.2% of the CBE group). The p-values correspond to the chi-square p-values comparing the two groups' categorical baseline characteristics, as well as the independent samples' t-test p-values comparing the two groups' baseline weights.

Comparing individual knowledge scores, pre- and post-education sessions

At the baseline, the average knowledge scores were 5.7 out of 15 (SD = 2.3) for the group that received conventional education and 5.8 out of 15 (SD = 2.2) for the group that received CBE. Their average knowledge scores after the education session were 9.0 out of 15 (SD = 2.5) and 9.7 out of 15 (SD = 3.1), respectively. The mean difference in knowledge scores before and after the education session for the conventional education group was 3.4 (SD = 3.5), with a significant improvement in knowledge after the education session (t-value = 6.84, df = 47, p-value < 0.001). The CBE group had similar results, with a mean difference of 3.8 (SD = 3.4) and a significant improvement after the education session (t-value = 8.2, df = 51, p-value < 0.001).

Comparing change in knowledge scores between the two groups

The similarity in the mean change in knowledge scores between the two groups (3.4 and 3.8 in the conventional education and the CBE groups, respectively) showed no sufficient evidence of a significant difference between them (t-value = -0.63, df = 96.9, p-value = 0.532).

Overall satisfaction with health education session

The majority of the participants were strongly satisfied with the education session (83.9% and 86.4% for the CBE and the conventional education groups, respectively; see Figure 1).

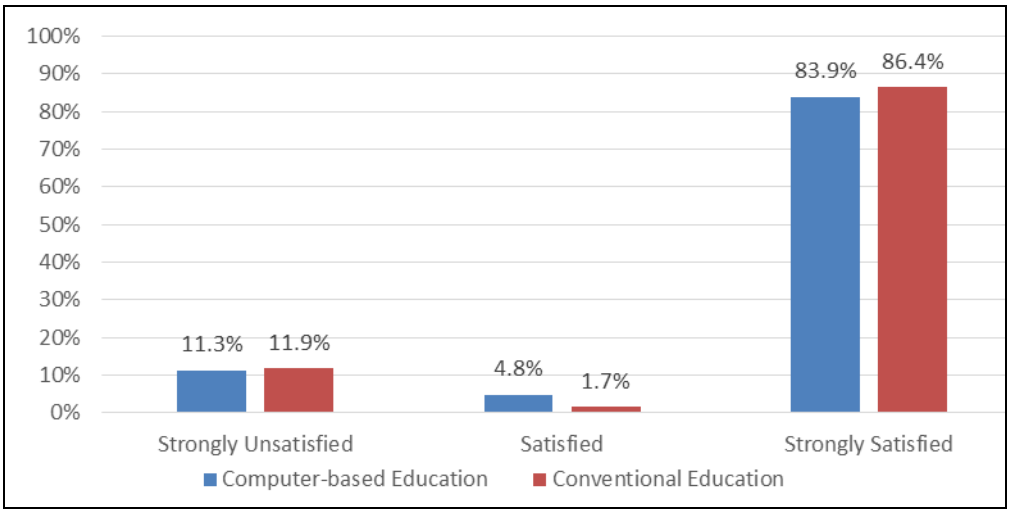

Fig 1: Overall satisfaction with health education session

Discussion

In this non-randomized controlled trial, conventional education and CBE methods were fairly similar in terms of knowledge scores. The analysis of knowledge scores before and after the education session showed significant improvement following the education session in both groups. However, we did not observe a significant difference in the mean change in knowledge scores between the two groups. Additionally, the study participants' most preferred method of education was the lecture format (a conventional teaching method).

In terms of patient satisfaction with the education session, the majority of the participants in both CBE and conventional education groups were strongly satisfied. Although most of the participants reported preferring the CBE method to other health education modalities at the baseline, our study suggests that both conventional education and CBE methods are effective strategies that help improve patients' health knowledge. This finding is congruent with those of many studies, despite their different research settings. For example, Gysels and Higginson (2007) [8] found that technology-based patient education was as effective as traditional patient education and even superior in many outcomes; video and computer technology improved knowledge, were accepted well by patients, and increased their satisfaction with information and the decision-making process. Similarly, Suhling *et al* (2014) [23] concluded that CBE (in this case, made available on tablets

and PCs) was just as effective as conventional patient education. Välimäki and colleagues (2012) [24] found no significant differences in the primary outcomes between psycho-educational interventions using ICT and standard care. However, they acknowledged that ICT remained a promising method of delivering psycho-education. Wofford and colleagues (2005) [26] concluded that the field of computer-assisted patient education was still in the process of maturing. Saksena (2010) [21] reported that CBE was able to affect knowledge, self-care behaviors, and self-efficacy. Friedman and colleagues (2009) [7] concluded that the use of computers could be an effective patient education strategy, especially when patients were given information specific to their own situations rather than general information.

Based on the previous findings, to improve patients' knowledge about their health conditions and ensure their satisfaction, we recommend that health team members use both conventional education and CBE. The final results will be improved clinical outcomes and high-quality care for patients.

This study's main limitations were the small sample size and non-randomization, which neither controlled for confounding variables nor allowed conclusions to be drawn about cause and effect. Thus, we suggest conducting further studies to study the cause–effect relationship with different patient populations.

Conclusion

This study suggests a positive association between patient education, on one hand, and patients' improved knowledge about their health conditions and their satisfaction, on the other hand. The health team members' use of multiple teaching strategies is an effective option for patient education. Conventional education and CBE methods have similar effects in terms of improvement in knowledge scores and patient satisfaction.

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