Effects of a Self-efficacy Theory–Based Training Program for Peers of Patients with Type 2 Diabetes

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ABSTRACT

Background Training peer leaders to deliver patient education is expected to be a low-cost approach to providing healthcare in urban-poor areas affected by a shortage of healthcare professionals. The purpose of this study was to examine the effects of a training program on the self-efficacy and knowledge of peer leaders with type 2 diabetes.

Methods A single-group longitudinal survey with baseline, intervention, and follow-up periods was conducted at a diabetes clinic in a small municipality in Metro Manila, Philippines. The intervention, a self-efficacy theory–based training program for peer-leaders of diabetic patients conducted in August 2017, comprised hands-on learning, demonstrations, quizzes, role-playing, group sharing, physical exercise, and a buffet lunch. The primary outcome was participants' self-efficacy for management of their diabetes. Secondary outcomes were participants' knowledge of diabetes and levels of emotional distress, motivation, and confidence for guiding their peers, satisfaction with the training program, hemoglobin A1c, and quality of life.

Results At 12 and 18 months after the intervention, participants' knowledge of diabetes was significantly increased compared with baseline (both $P < 0.05$). At earlier time points, an increasing, but not significant, trend was observed. The change in knowledge of diabetes from baseline to 18 months after intervention tended to be positively correlated with the change in self-efficacy ($r = 0.594$, $P = 0.054$). No significant differences were observed for any of the other outcomes, although the descriptive statistics showed an increasing trend for all of the outcomes except motivation.

Conclusion The training program significantly improved participants' knowledge of diabetes at 12 and 18 months after the training programs compared with baseline. A positive correlation between the changes in the levels of knowledge and self-efficacy suggested that the observed improvement of self-efficacy was facilitated by the improvement of knowledge of diabetes.

Key words knowledge; patient education; peer influence; self-efficacy; type 2 diabetes

According to the International Diabetes Federation, 425 million people worldwide were diabetic in 2017.[1] Several studies have shown that the prevalence of type 2 diabetes (T2D) is increasing, particularly in urban areas of developing countries. For example, in an urban area of India, the prevalence of T2D increased by 1.8% in the period 2009 to 2012.[2] And, in the Philippines in 2013, the prevalence of T2D was higher in urban areas (6.3%) than in rural areas (4.5%).[3] It has also been shown that the prevalence of T2D is higher in poor people (as classified by the Wealth Index) than in rich or middle-class people.[3] In Bangladesh, the percentage of urban poor suffering from diabetes estimated through the survey from 2014 to 2015 (19.1%)[4] was more than two times the national average in 2014 (7.7%).[5] Such urban poor areas in developing countries lack the healthcare professionals required for the treatment of T2D. An estimated 4.2 million healthcare workers are reportedly needed to fill the workforce shortage in 57 countries in Africa and Asia.[6] By 2030, the shortfall is expected to reach 18 million, primarily in low- and lower-middle income countries.[7]

To address these issues, education programs for diabetics provided by their peer leaders have been suggested. Previous studies have shown the effectiveness of program through the peer leaders. In China, diabetes-distress scores were improved in T2D adults who received the support from trained peer leaders (education programs with knowledge- and skills-sharing at least once a month), with no significant improvement in those not receiving the peers' support.[8] Another study in China demonstrated significant improvement of metabolic indices and the psychological status of T2D patients with emotional disorders who received a 6-month education from peer leaders.[9] Such programs by peer leaders could provide the same or better effectiveness as programs provided by healthcare professionals. Tang et al.[10] reported the continued effectiveness of education programs by peer leaders on diabetics' glycemic control and systolic blood pressure at 18 months after participating in an education program, with such effectiveness not seen from similar programs offered by community health workers. Such peer-led support programs for diabetics have shown beneficial effects, especially where medical service resources are limited.[10]

The effectiveness of peer-led support programs has been evaluated by examining the improvement of diabetes-related indicators in diabetic patients who took part in such education programs. For example, a study in Iran reported positive effects of a peer-led support program on self-efficacy score and quality of life (QOL) in T2D patients who were offered peer support after receiving diabetic education from health professionals.[11] Similarly, a study in the USA has reported improvements in the motivation of patients to care for their diabetes after 6 weeks of Interactive Voice Response-facilitated telephone-based peer-led support.[12, 13] Also, a study in China has reported positive effects on knowledge of diabetic therapy in T2D patients who were supported by a peer-support program for 4 months.[14] These previous studies measured the effects of these programs in the recipients of support (in terms of change in motivation, knowledge, and self-efficacy), but not in the peer leaders who provided the support. However, the effectiveness of peer-led education programs relies on the peer leaders themselves having sufficient motivation, knowledge, and self-efficacy to provide support for other diabetics. Therefore, examining how to enhance these factors in peer leaders will provide important information for improving peer leader training programs.

Most of such peer leader training programs have been organized on the basis of the 'empowerment approach' which stressed the responsibility of diabetic patients for management of their own diseases, and

the 'Kolb's experiential learning theory' to enhance educational effect on the learners through making decisions by themselves, knowing outcome of the decisions, taking next actions according to the outcome.[1, 15, 16] However, these training programs did not focus on the enhancement of the peer-leaders' self-efficacy and motivation for instructing other diabetics.

Here, we hypothesized that a training program for peer leaders to improve their knowledge of diabetes, self-efficacy for the management of their diabetes, and motivation for instructing other diabetics, would increase the corresponding indicators. To examine this hypothesis, we developed a training program for peer leaders in an urban-poor community in the Philippines. The purpose of this study was to identify the effects of a self-efficacy theory–based training program on the self-efficacy, motivation and knowledge of peer leaders with type 2 diabetes. Our findings provide insights for future studies examining the effects of training programs for peer leaders on the QOL of other diabetics in urban-poor communities.

MATERIALS AND METHODS
Study design
The present study was a 2-year (March 2017 to March 2019), single-group, longitudinal survey that comprised a baseline survey (in March 2017), an intervention (in August 2017), and an 18-month follow-up period. The study was conducted at a diabetes clinic in a municipality in Metro Manila, Philippines. According to a census,[17] this municipality is one of the smallest in Metro Manila in terms of area and total population (about 67,000 people). The municipality suffers from low levels of funding for medical services and a shortage of healthcare professionals. A non-governmental organization (Diabetes Association, DA), mostly composed of the diabetics, has been established in this municipality to provide assistance to low-income people with T2D; at the time of the study, the organization had around 800 members. In the present study, this organization provided us with the means to monitor the long-term effects of our study intervention.

Selection of study participants
The study participants were selected from the diabetic residents of the municipality who were aged ≥ 20 years, had attended the diabetes clinic (study site) in the municipality. The criteria for disqualified participants were prepared as follows: any of type 1 diabetes, pregnancy (or possible pregnancy), dementia, cognitive impairment or mental illness making it difficult to answer the questionnaires and/or undergo physical examination, significant

musculoskeletal or incurable diseases making it difficult to undergo physical examination or exercise, cardiovascular disorders requiring hospitalization (e.g., myocardial infarction or stroke), or the need for hospitalization due to complications associated with diabetes (e.g., renal impairment, retinopathy, and gangrene). The participants who fulfilled the requirement were selected through discussion between the president of DA and the physician (diabetologist) assigned by the municipality to the diabetes clinic, who were familiar with health conditions and social backgrounds of the participants. The participants who did not fulfill the requirement in the course of this study were eliminated from the subjects.

Intervention and follow-up activities

The study intervention was a short training program for the study participants (i.e., peer leaders) in August 2017, which comprised 12 modules spanning 10 hours over 2 days, with each module lasting between 45 to 60 minutes. The training program, elaborated through discussions with local medical staff and physicians, was designed to enhance the peer-leaders' self-efficacy to manage their diabetes, knowledge of diabetes, and motivation, confidence, skills, and ability for instructing other diabetics. First, the participants were presented the health conditions and issues of diabetics in the municipality, and the need to control the diabetes. Then, the participants were informed of the necessity for diabetes self-management by the diabetics to achieve their proper glycemic control and increase in their QOL. We stressed the roles expected for the participants (peer leaders) to support actions taken by the other diabetics, so that they could properly improve their own knowledge and self-efficacy on diabetes self-management.

Based on the factors suggested by Bandura to strengthen one's self-efficacy, the program included activities that (1) allowed experience of success and accomplishment; (2) allowed learning through observation from other's success; (3) allowed verbal communication (i.e., provided opportunities for being persuaded by others to believe that one is qualified to accomplish the task); and (4) encouraged positive physiological and emotional states.[18] That is, the training program included activities through which the participants could experience their own successes and learn from others' successes through verbal communication and participation in the program with a positive attitude. The program comprised hands-on learning, demonstrations, quizzes, role-playing, group sharing, physical exercise, and a buffet lunch (arranged to understand the proper amount of food for diabetics) to reduce the social and the psychological distance among the participants, and

thus to encourage their participation. Group quizzes were conducted as a ball game in which the participants prepared and asked each other dual-choice questions related to diabetes. If the correct answer was "Yes", all the balls were moved to the right; if it was "No", the balls were moved to the left (Table 1, Figs. 1 and 2). To our knowledge, such a combination of instructional styles in a single, short-term educational program for diabetes is unique.[19]

To enhance the motivation, confidence, and skills of the participants to instruct other diabetics once the program was complete, we adopted Keller's ARCS model of motivation. This model proposes three factors that promote and sustain motivation during learning, stressing the need to induce feelings of (1) attention (interest), (2) relevance, and (3) confidence in learners; it also stresses the need to induce the feeling of (4) satisfaction after learners take future actions in response to having taken part in a learning program.[20] Therefore, the program modules were designed to encourage the participants to have these feelings. For example, the module titled "Healthy eating" included a buffet lunch to help the participants become interested in their own dietary choices (Table 1, Fig. 1). The quizzes and lectures in the module titled "What is diabetes?", which offered knowledge about diabetes self-management and emphasized actions the participants could take to extend their knowledge after the program, was designed to help the participants recognize the relevance of the information presented during the module. The module titled "Building goals and action plans" encouraged the participants to plan activities after the program so that they were confident in their ability to support other diabetics and would be satisfied with the improvement they were able to foster in other patients.

The factors suggested by Bandura to strengthen self-efficacy, and those proposed by Keller to promote and sustain motivation, were clearly explained in the program modules as the basic principles to increase in the diabetics' motivation and self-efficacy on their diabetes self-management. More specifically, in the modules of "Effective educational strategies" and "Building therapeutic communication" (Table 1), they were introduced as theories and methods applicable for the instruction to other diabetics. Each module was conducted in English by a Japanese staff member (and interpreted into Tagalog when necessary) and in Tagalog by a local staff member. The *Diabetes Textbook* (in Tagalog) and PowerPoint materials (in Tagalog) prepared specifically for the program were used.

Following the training program, the participants were instructed to choose other diabetic patients to

Table 1. Contents and schedule of the training program

	Module name	Instructional approach	Factors that affect self-efficacy (Bandura's source of self-efficacy)[16]†
Day 1	Your health condition and problems	Quizzes	Verbal persuasion
	What is the role of a peer leader? - What is peer support system? - Purpose of facilitation - Requirement for of a good peer leader	Quizzes Group sharing	Performance accomplishments Vicarious experience
	Effective educational strategies - ARCS model - Self-efficacy theory - Building therapeutic communication	Group sharing Quizzes	Verbal persuasion
	Building therapeutic communication - Active listening - Asking open-ended questions - Coaching - Acknowledgment of skills	Quizzes Role-playing Group sharing	Physiological and emotional states Vicarious experience
	What is diabetes?	Quizzes	Verbal persuasion
	Healthy eating	Quizzes	Verbal persuasion
Day 2	What is diabetes?	Quizzes	Verbal persuasion
	Skill training - The skill of blood glucose measurement	Hands-on learning	Performance accomplishments Vicarious experience
	Healthy eating	Buffet lunch (Figure 1)	Physiological and emotional states Vicarious experience
	Oral care	Group sharing Quizzes	Verbal persuasion
	Physical activity	Exercise	Physiological and emotional states Verbal persuasion
	Building goals and action plans	Brainstorming Group sharing	Performance accomplishments
Follow-up seminar	Diabetes quizzes as a group game using balls (Figure 2) Exercise (Tai Chi, Zumba*)	Hands-on learning	Physiological and emotional states

*Zumba, a kind of music arranged for exercise and mainly composed of dance music; Tai Chi, an ancient Chinese mind-body exercise derived from a martial art form that combines breathing with rotational and multi-segmental postures. These were demonstrated in the training program by healthcare professionals in the municipality. †Referred "source of self-efficacy" corresponds to the factors to strengthen self-efficacy indicated in Materials and Methods: Performance accomplishments, (1) experience of success and accomplishment; Vicarious experience, (2) learning through observation from other's success; Verbal persuasion, (3) verbal communication; Physiological and emotional states, (4) encouragement for positive physiological and emotional states.

whom they would offer individualized guidance for the self-management of their diabetes by using the materials and the methods introduced during the training (e.g., active listening, acknowledgment of skills). These other diabetic patients were selected from among the members of DA by the participants themselves. Furthermore, to solidify the participants' understanding of diabetes and improve their guidance skills, follow-up seminars that involved quizzes about diabetes and group physical exercise sessions were held at 6 and 12 months after the intervention. Each of the follow-up seminars lasted 30 to 60 minutes. For the physical exercise, sessions of Zumba (music arranged for exercise and mainly composed of dance music) and Tai Chi (an ancient Chinese mind–body exercise derived from a martial art form that combines breathing with rotational and multi-segmental postures)[21] were led by healthcare professionals in the municipality.

Measurement of outcomes
The primary outcome was the participants' level of self-efficacy for the management of their diabetes. Secondary outcomes were the participants' knowledge of diabetes and levels of emotional distress, satisfaction

Fig. 1. Buffet lunch on day 2 of the intervention. The module titled "Healthy eating" included a buffet lunch to help the participants become interested in their own dietary choices.

Fig. 2. Diabetes quizzes as a group game using balls. Group quizzes were conducted as a ball game in which the participants prepared and asked each other dual-choice questions related to diabetes. If the correct answer was "Yes", all the balls were moved to the right; if it was "No", the balls were moved to the left.

with the training, motivation for guiding other diabetics, confidence for guiding other diabetics, plasma HbA1c, and QOL. Data were collected via questionnaire, quiz, or automated measurement, using Tagalog (translated from English when needed), at baseline survey, immediately before and after the intervention (both in August 2017), and then at 6, 12, and 18 months after the intervention (March 2018, August 2018, and March 2019, respectively) as follows.

Self-efficacy for the management of diabetes was measured by using the Diabetes Self-efficacy Scale.[22] This scale consists of eight Likert-type items, each scored from 0 (not at all confident) to 10 (totally confident). The mean score for the eight items is the overall score, with a higher score indicating greater confidence. Knowledge of diabetes was measured by using a questionnaire. To prepare the questionnaire, a series of questions were written based on the Diabetes Knowledge Test[23] and the Diabetes Knowledge Questionnaire.[24] Then, prior to the present study, a survey was administered to diabetics residing in the municipality who were not enrolled in the present study ($n = 32$), and the validity of the questions were validated (i.e., face and content validity of the questionnaire) through discussions with diabetologists in the municipality. After modification of the original questions, we finalized the 30 questions used in each of data collection for the current study. Emotional distress was assessed by using the Problem Areas in Diabetes (PAID) instrument, which is a self-administered 20-item questionnaire. Each item is scored from 0 (not a problem) to 4 (a serious problem). The sum of all item scores multiplied by 1.25 gives the total PAID score (range: 0–100), with higher scores reflecting greater emotional distress.[25] In the present study, a score

≥ 40 was considered to indicate that the patient was suffering from emotional distress.[25] The degree of satisfaction with the training, motivation for guiding other diabetics, and confidence in providing guidance to other diabetics were evaluated by using a 10-point numerical rating scale. Plasma HbA1c levels were measured with a Clover A1c Self Analyzer (Infopia Co., Ltd., Gyeonggi-do, South Korea). For all of the participants, a reasonable HbA1c goal was defined as < 7.0%, based on the guidelines of the American Diabetes Association.[26]

The QOL of participants was measured by using the Eight-Item Short Form QOL Survey (SF-8).[27] The SF-8 is composed of eight multiple-choice questions. Each of the eight questions is scored according to reported values allocated for the chosen answers. The eight scores are summed after applying the eight weights allocated for each of the eight questions, and then two summary scores, Physical Component Summary (PCS) and Mental Component Summary (MCS), are calculated. The calculated values of the PCS and MCS are standardized so that the mean and standard deviation for all the subjects is 50 and 10, respectively. Thus, the SF-8 yields two comparable health-QOL profiles.[27] High PCS and MCS scores indicate better QOL. The SF-8 was used with the permission of iHope International Co., Ltd. (Kyoto, Japan), in accordance with their royalty rules.

The presence of complications and other symptoms of diabetes might affect sustainability of the participants' motivation to support other patients. Therefore, they were asked in the questionnaires used for data collection about neuropathic symptoms, resting pain,

intermittent claudication, and other medical issues. To assess the neuropathic symptoms, the neuropathy symptom score of Young et al.[28] was used. In addition, each participant was asked at 6 months after the intervention to fill in a free-response question in English or Tagalog to provide their overall impression, concerns, and any other thoughts regarding the training program. By using a free-response question, we expected to be able to gauge how the participants currently felt about the training, what they had noticed during the training, and what they had learned since the training regarding their activities leading other diabetics.

Data analysis

Values for descriptive statistics were calculated for all of the outcomes. Then, to use repeated ANOVA to examine the change in the outcome measures over time, the following processes were performed. First, the normality of the scales was confirmed. Then, Mauchly's sphericity assumption test was used to test the equality of differences between the values for all the time points. For the outcome which did not satisfied the equality, the degrees of freedom were adjusted using the Greenhouse–Geisser correction. Then, repeated ANOVA was carried out. P values less than 0.05 through multiple comparisons were considered statistically significant for change within each group of outcome values. IBM SPSS Statistics version 22 was used for all of the statistical analyses. All answers to the free-response questions were analyzed qualitatively. Each response was transcribed (or translated from Tagalog into English), summarized into "codes" that described the essential information contained in the responses, and then categorized based on the codes. The results of the analysis were discussed and scrutinized by the study authors to confirm the objectivity and reproducibility of the findings.

Ethical considerations

The study was approved by the ethics committee of the Faculty of Medicine, Tottori University, Tottori, Japan (No. 1608B013). The objectives, potential impact, methods, risks, and benefits of the study were explained in a document provided to all potential participants. All participants provided signed informed consent. The study was conducted after being registered in the national clinical trials registry (UMIN000027073).

RESULTS
Characteristics of the study participants

Fifteen patients were selected as the initial study participants; however, 2 of the female participants withdrew during the study due to illness or old age. Thus, 13 patients (2 male, 11 female; mean age ± SD, 70.31 ± 5.91 years) met the eligibility criteria and were included as the participants of this study (Table 2).

Changes in outcomes before and after intervention

A significant difference was found in the level of knowledge of diabetes across the six survey time points (P = 0.011; Table 3). Although there were no significant differences observed for the other outcomes, the descriptive statistics showed an improvement at 18 months after intervention for all of the outcomes, except motivation, when compared with baseline values (Table 3). For the participants' level of knowledge of diabetes, a multiple comparison analysis indicated an improvement between baseline and immediately after intervention, but this increase was not significant (Fig. 3). However, significant increases in knowledge were observed between baseline and 12 and 18 months after intervention (both $P < 0.05$). Values for the change of knowledge between baseline and 18 months after intervention tended to be correlated with those for the change of self-efficacy levels ($r = 0.594$, $P = 0.054$) in the same period (Fig. 4).

Analysis of responses to the free-response questions

The "codes" obtained from all the participants' responses to the free-response questions about impressions and thoughts for the training program were categorized and shown in Table 4. Discussion among the authors of this study on the "codes" revealed the 10 categories.

DISCUSSION

The participants' self-efficacy and confidence did not differ significantly at the six survey time points. This may be because the small sample size resulted in the introduction of statistical type-β error, or because the high values at baseline, which we attribute to the optimistic characteristic of Filipinos, resulted in there being only a small margin for increase at the later time points. Otherwise, the short-time intervention (2 days) with many modules affected lack of significant improvement in the self-efficacy and confidence. That is, the intervention might be too short for the participants to apply the obtained knowledge for solidification of their self-efficacy and confidence. Interestingly, self-efficacy decreased immediately after the intervention, which we consider to be a result of the participants obtaining new knowledge about diabetes and realizing how complicated diabetes control is. Such new knowledge might have caused an increase in anxiety regarding their own management of the disease. A similar trend

Table 2. Characteristics of the study participants at baseline (_n_ = 13)

Variables	Number (%)	Mean ± SD (range)
Age (year)		70.31 ± 5.91 (62–78)
Sex		
male	2 (15.4)	
female	11 (84.6)	
Occupation		
Employed	1 (7.7)	
Unemployed	12 (92.3)	
Education		
Primary	1 (7.7)	
Secondary	5 (38.5)	
College	6 (46.1)	
No answer	1 (7.7)	
Marital status		
Married	8 (61.5)	
Single	5 (38.5)	
Complication (Self-declaration)		
Renal disorder	2 (15.4)	
Neuropathy	1 (7.7)	
Eye disorder	5 (38.5)	
Peripheral circulatory disturbance	0 (0.0)	
Classification by neuropathy symptom score		
Normal	1 (7.7)	
Mild	6 (46.1)	
Moderate	6 (46.1)	
Severe	0 (0.0)	
Symptom		
Resting pain	0 (0.0)	
Intermittent claudication	0 (0.0)	

was observed for confidence, which also declined immediately after the intervention. In contrast, although self-efficacy and confidence were lower than baseline at 6 and 12 months after the intervention, at 18 months they were higher than at baseline, indicating a gradual increase in self-efficacy and confidence through the experience of leading their peers (responsible diabetics) (e.g., providing instruction to the diabetic patients, who participated in the present study's follow-up seminars).

Together, these findings suggest the presence of the Dunning–Kruger effect,[29] which is a recognition bias by individuals that incorrectly appraise their competence as being higher than it really is, and as these individuals gain experience, their confidence in their behavior decreases. In the present study, the participants may have experienced a 'reality shock' immediately after participating in the training as they gained additional knowledge about the disease, and so reported lower self-efficacy and confidence than at baseline. Or, in the short term, they may have felt that they were unable to affect a change in the other diabetics they were supporting, leading to a sense of inadequacy in their own ability. However, it was apparent from the responses to the free-response questions that the participants felt confidence and satisfaction in their activities as peer leaders. It suggests that over the long term, the participants experienced a greater number of successes in their activities as peer leaders, and felt a greater sense of achievement. Then increases in self-efficacy and confidence at 18 months after the intervention were demonstrated.
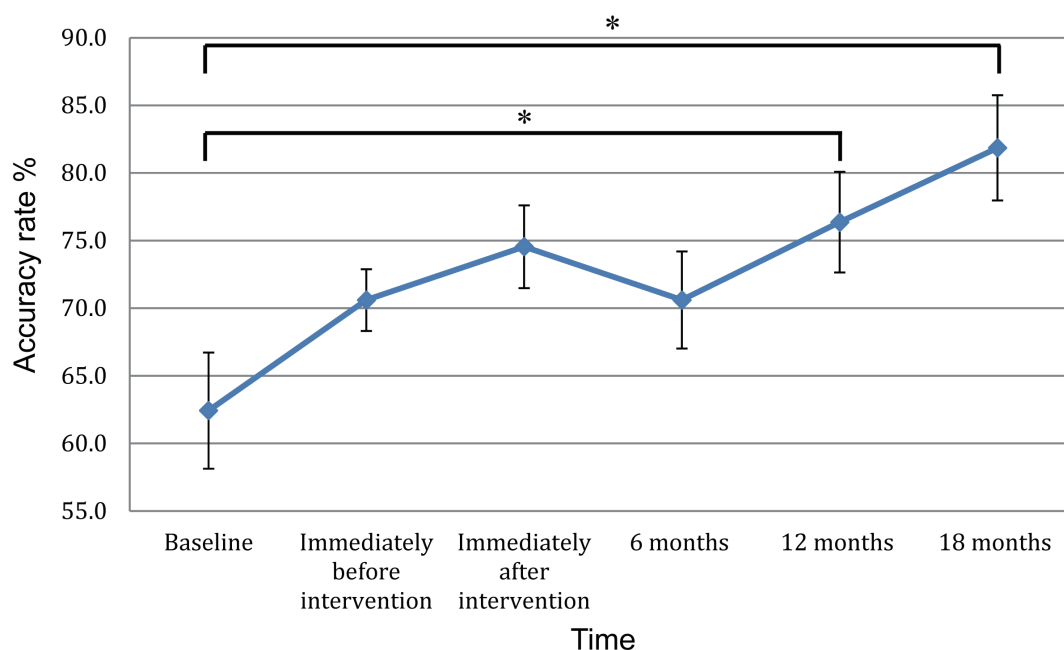
An increase in the participants' knowledge of diabetes was observed at 12 and 18 months after the intervention compared with baseline; whereas no significant difference in knowledge was seen for any other time point. Improvement in the correct-answer rate for diabetes and diabetic management in the ADKnowl questionnaire[30] (from 66.8% to 74.3%; 7.5% change) has been reported at 6 months after a video-education intervention for patients newly diagnosed with T2D.[31] Likewise, a significant improvement in knowledge (19.5% increase in score; $P < 0.05$) compared with baseline was observed at 18 months after the intervention in the present study. This improvement in knowledge might be attributable to the two follow-up seminars held at 6 and 12 months after the intervention (i.e., the seminar and quiz programs about diabetes), which could have solidified the information obtained during the intervention. The responses to the free-response question indicated that the participants felt a sense of satisfaction with their activities as peer leaders and with the knowledge and techniques they acquired, and a sense of achievement that they could provide education to their peers, indicating that the participants obtained sufficient knowledge through the intervention to educate their peers. However, a decrease in knowledge was also observed at 6 months after the intervention, which may have been because of a lack of follow-up seminars in the 6 months immediately after the intervention.

The data obtained at 12 and 18 months after the intervention revealed that the training program had long-term positive effects on the participants' knowledge of diabetes. At 12 months after the intervention, a follow-up seminar was held that included participatory learning

Table 3. Values for each outcome measure at baseline, immediately before and after the intervention, and at 6, 12 and 18 months after the intervention

Outcome measure	Baseline	Immediately before intervention	Immediately after intervention	6 months after intervention	12 months after intervention	18 months after intervention	F value	P value
Self-Efficacy Scale score (scale: 8 to 80)	63.8 (10.9)	63.5 (9.6)	59.5 (12.9)	61.5 (13.4)	62.2 (11.3)	66.9 (10.2)	2.227	0.122
Knowledge (0 to 100)	62.4 (14.2)	70.6 (7.6)	74.5 (10.1)	70.6 (11.9)	76.4 (12.3)	81.9 (12.9)	4.762	0.011*
PAID score (0 to 100)	37.5 (23.9)	32.0 (18.5)	28.0 (13.9)	26.1 (17.0)	25.2 (12.3)	24.4 (12.1)	1.539	0.243
Satisfaction† (1 to 10)	8.6 (2.7)	(not measured)	9.4 (1.2)	7.5 (2.5)	8.1 (2.7)	8.9 (1.6)	1.164	0.341
Motivation (1 to 10)	9.3 (1.0)	8.9 (1.1)	9.1 (1.2)	7.5 (2.7)	8.1 (2.7)	8.5 (2.6)	1.410	0.256
Confidence (1 to 10)	8.5 (2.6)	7.7 (2.7)	7.8 (1.9)	7.5 (2.3)	7.2 (2.9)	8.7 (1.2)	0.839	0.459
HbA1c level (%)	7.41 (0.77)	7.25 (0.58)	(not measured)	7.47 (0.77)	7.31 (0.49)	7.06 (0.55)	0.311	0.661
QOL (Physical Component Summary)	46.1 (6.1)	49.6 (6.4)	46.7 (6.6)	46.5 (5.9)	49.9 (4.1)	47.8 (6.9)	1.188	0.328
QOL (Mental Component Summary)	46.4 (6.2)	44.0 (11.3)	46.2 (8.7)	46.6 (9.1)	45.3 (8.3)	48.0 (8.5)	0.399	0.847

Normally distributed continuous variables are expressed as mean (SD). Changes in outcomes measures were assessed by repeated analysis of variance (ANOVA). *A significant difference was found for knowledge of diabetes at 12 and 18 months after the intervention compared with baseline. †Level of satisfaction in the baseline survey was measured as the participants' satisfaction with the activities prior to the baseline survey (i.e., preliminary survey). PAID, Problem Area in Diabetes; QOL, quality of life. HbA1c refers to glycated hemoglobin.

Fig. 3. Changes in knowledge of diabetes at baseline, immediately before and after the intervention, and at 6, 12, and 18 months after intervention. At 12 and 18 months after the intervention, participants' knowledge of diabetes was significantly increased compared with baseline. *$P < 0.05$
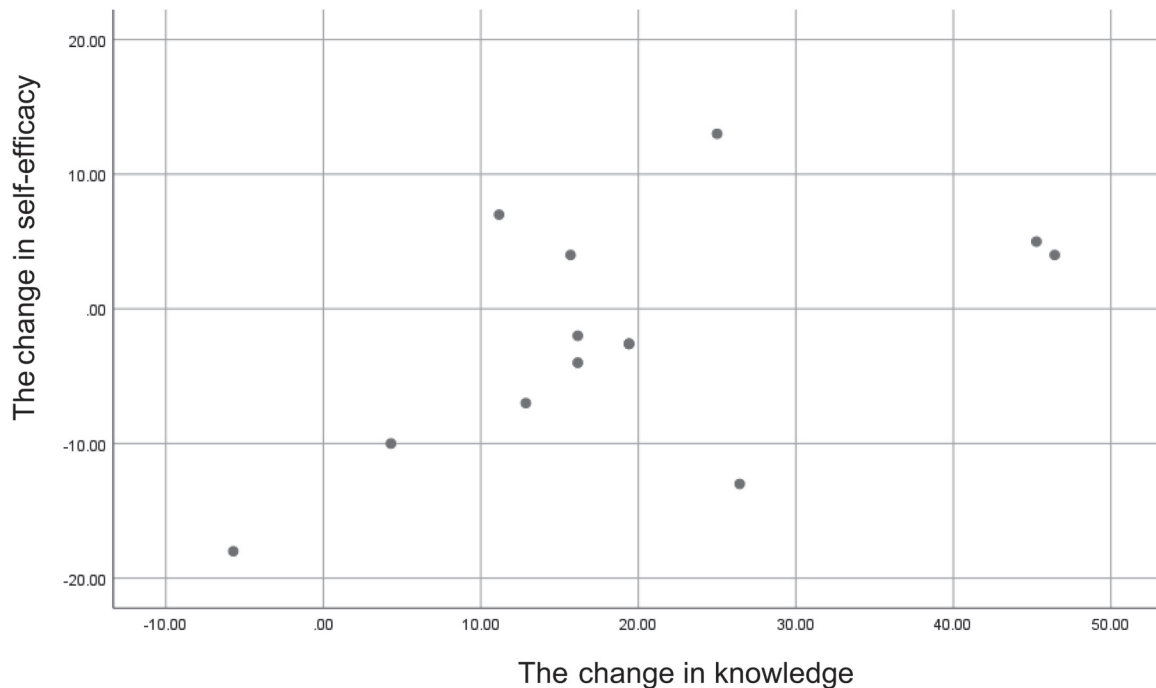
Fig. 4. Correlation between the change in knowledge and the change in self-efficacy between baseline and 18 months after intervention. $r = 0.594$, $P = 0.054$

on how to teach diabetic knowledge through quizzes using balls and physical exercise, and lectures on the use of the ARCS model of motivation to enhance other patients' motivation and educate them on the complications of diabetes. This seminar may have played a role in the improvement of knowledge observed at these two time points. A previous cross-sectional study conducted in diabetics at the site of the present study reported positive relationships between knowledge of diabetes and self-efficacy and between knowledge of diabetes and QOL[32]; therefore, an increase in self-efficacy accompanied by increases in knowledge and QOL was expected in the present study. Indeed, a moderate positive correlation between the changes of knowledge of diabetes and of self-efficacy ($r = 0.594$) was observed and a possible positive correlation between knowledge of diabetes and QOL was also suggested.

A decline in HbA1c level by 0.35% (from 7.41% to 7.06%) compared with baseline at 18 months after the intervention indicated improved glycemic control in the participants. Improvement in HbA1c level during short-term follow-up ($\leq$ 6 months) has been reported by a previous study reviewing the effects of self-management training in people with T2D; whereas a longer follow-up period (>1 year) was reported to show mixed effects on glycemic control.[33] The slight improvement in HbA1c level observed in the present study at 18 months after

the intervention suggested that a longer follow-up period would be required to affect glycemic control in the participants. A meta-analysis of studies examining diabetic education found a 0.76% improvement in HbA1c level after 1 month or less of education intervention.[34, 35] The improvement in HbA1c in the present study is lower than that reported from the meta-analysis; however, it has been reported that improvement of a patient's average HbA1c value can be difficult in patients who are well controlled at the start of intervention.[22] Another study reported that no improvement was observed in patients with HbA1c less than 8.0% at baseline.[35] Likewise, in the present study, improvement in HbA1c level was difficult to achieve because the participants already had relatively good HbA1c levels at baseline. Furthermore, van der Wulp et al.[36] reported that there was limited margin for improvement of HbA1c levels in patients who received treatment and lifestyle guidance and had good psychological condition at baseline (based on the five-item WHO Well-being Index[37]). In the present study, the average PAID score at each time point was less than 40 (cut-off value indicating emotional distress), indicating that the participants were not suffering from emotional distress. Accordingly, no significant improvement of PAID score was observed in the present study.

For motivation, the values were less than baseline

Table 4. Categorized responses to the free-response question regarding participants' impressions of the training program

Category	Code
Sense of responsibility as a peer leader	I need to fulfill my duty and responsibility with all my effort
	I will fulfill my responsibility without any reward or regret for my activities
Active behavior arising from self-awareness as a peer leader	I encourage patients to attend meetings
	I actively review what I have learned
	I do my best as a peer leader to tackle issues
Sense of difficulty to continue activities as a peer leader	Sense of dissatisfaction as some patients cannot take part in my meetings
	Loss of confidence as some patients cannot take part in my meetings
	Worry about directing patients to the appropriate care and providing adequate education
Confidence in the activities as peer leaders	Confidence that I can manage my own disease
	Confidence that I could provide instructions to patients in similar circumstances
	Confidence arising from active communication with patients
	Confidence that patients participated in my meetings
Sense of significance for learning and activities as a peer leader	Sense of significance regarding contents covered in training
	Sense of significance that I contributed to patients and their quality of life
Sense of satisfaction that peer leader activities made some contributions	Sense of satisfaction that I helped patients as a peer leader
	Sense of satisfaction arising from team unity
Sense of satisfaction for the acquisition of knowledge and techniques	Sense of satisfaction regarding contents covered in training
	Sense of satisfaction for gaining new knowledge and experience
	Sense of satisfaction for learning about how to interact with others
Sense of achievement that they could provide patients with education	Sense of achievement that I was able to provide patient education
Increased motivation by patients' positive attitude	Increased motivation by patients' positive attitude
Sense of positive outcome as a result of peer leader activities	I noticed an improvement in the patients' knowledge and blood glucose levels
	I experienced the positive outcome of peer leader activities through patients' attitude

All the responses from the participants (in English or Tagalog) were summarized into the "codes", which were then categorized.

at all observation time points. Since the baseline value (9.3/10) was high, further improvement was not expected. We conclude that motivation was well maintained throughout the study period. For QOL (PCS and MCS), no clear trend was observed. A previous study has reported that a group education intervention had no effect on QOL at 1 year after the intervention but did have an effect at 2 and 4 years after the intervention.[38, 39, 40] Lack of apparent increases in the values for QOL could be due to the short study period (2 years), which was insufficient to detect an improvement.

This study was conducted in a small municipality, which limited the sample size and possibly resulted in the introduction of type-β error into the analysis results. Moreover, because the participants were selected on the basis of recommendation by the president of DA and the physician (diabetologist) in the municipality, the participants might have been high in the levels of confidence and motivation even at the commencement of this study. This may have caused small margin for increase in the outcomes other than the knowledge. For further improvements in these outcomes, acquisition of practical knowledge is expected by applying the theoretical knowledge improved in this study. More practical modules, such as role-playing to simulate the instruction for the other diabetics, could be effective. The major limitation of the present study was the inability to include a control group in the study. As the alternative, the indicators for outcomes were measured two times before the intervention (baseline, immediately before intervention; Table 3). Therefore, lack of significant improvement in the knowledge between these two times,

and significant increases in the knowledge at 12 and 18 months after the intervention compared with baseline, would indicate effects of the intervention in this study. Because it is difficult in the real world to conduct randomized, controlled trials, especially in vulnerable populations, the most effective way to enhance external validity would be via replication studies or studies not involving a vulnerable population.

Here, we developed a 2-day training program based on self-efficacy theory to educate peer leaders in an urban poor diabetic community. In conclusion, the training program and accompanying follow-up activities significantly improved participants' knowledge of diabetes at 12 and 18 months after the intervention. Despite there being no significant effect of the training on self-efficacy, a positive correlation between knowledge of diabetes and self-efficacy suggested that the improvement in self-efficacy was facilitated by the improvement in knowledge of diabetes. The improvement in self-efficacy and effects of the program would be more clarified by the change in other diabetics (recipients of support). Further studies are needed to investigate the long-term effects of peer-led training programs and of diabetes self-management education offered by peer leaders on self-efficacy and knowledge of diabetes in urban poor communities.

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