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# Increased knowledge levels of patients with diabetes in resource-limited communities after receiving peer-led education

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## Abstract

**Diabetes self-management education through peer support has been beneficial, especially in regions with limited medical resources. Studying the effects of education offered by trained peers of patients will facilitate tailoring the peer-led education programs to the regions' specific needs. Here, we evaluated changes in diabetes-related indicators in Filipino patients who received a peer-led education. We used data on 23 patients (age, 67.83 ± 6.69 years; 82.6% female) who participated in all five surveys performed every 6 months from March 2017 to March 2019. After the second survey until the end of this study, the participants were educated in diabetes self-management by their 13 peers who previously had received the training in diabetes self-management. Participants' knowledge of diabetes and the related 'cause, risk factors, nature of diabetes and complications' subindicator were greater on all surveys after starting the peer-led education compared with those on the second survey (i.e. before starting the education); these values did not differ between the first two surveys. Because increasing patients' knowledge can enhance their ability to self-manage their disease and thus improve their quality of life, strategies to expand patients' knowledge about diabetes should be included when organizing peer-led education in regions with limited medical resources.**

## Introduction

In 2021, a reported 537 million people worldwide were suffering from diabetes [1]. Maximizing the quality of life (QOL) of patients with type 2 diabetes (T2D) rests on reducing their excessive levels of blood glucose and glycohemoglobin [proportional to hemoglobin A1c (HbA1c)]. Diabetes self-management education (DSME) is one means to improve these disease indicators in patients with T2D. For example, a review of 72 randomized control trials of DSME noted increases in patients' diabetes knowledge, frequency and accuracy of self-monitoring of blood glucose, self-reported dietary habits and self-initiated glycemic control [2]. Another review of 31 randomized control trials reported that HbA1c levels decreased by a value of 0.76% in DSME-recipient groups [3].



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DSME is particularly effective when it is offered by the peers of patients with diabetes. For example, monthly educational programs on diabetes knowledge and skills that were provided by trained peer leaders (in the form of sharing their knowledge and skills) decreased diabetes-distress scores among Chinese adults with T2D, compared with no significant improvement in scores among those who did not receive peer support [4]. Similarly, 6 months of peer-led education significantly improved metabolic indices and the psychological status of Chinese patients with T2D and emotional disorders [5]. In addition, peer-led DSME programs have long-lasting effects. In one study, patients with diabetes still maintained benefits in glycemic control and systolic blood pressure at 18 months after they began a peer-led DSME program; the same program did not achieve this effect when offered by community health workers [6]. Therefore, peer-led DSME programs may be more effective than education provided by health-care professionals.

Peer-led DSME programs for patients with diabetes are particularly beneficial where medical resources are limited because they are relatively inexpensive compared with education provided by health-care professionals [7]. In that regard, the Universal Health Coverage Index of the Philippines in 2019 (55) was below both the average global value (67) and that of the Western Pacific Region (which includes the Philippines) (80) [8]. In 2020, diabetes was the fourth most frequent cause of death among Filipinos [9], and in 2021, the morbidity rate due to diabetes in the Western Pacific Region (11.9%) exceeded the global average (10.5%) [1]. Furthermore, the number of Filipinos with diabetes has increased markedly recently due to increases in obesity accompanied by rapid urbanization and dietary changes, and available health services are insufficient to accommodate these patients [10, 11]. Given the expected increase in disease prevalence [1], the challenges to diabetes control in the Philippines are likely to increase as well.

We previously conducted a 2-year evaluation of training in diabetes self-management that addressed disease-related indicators, which was provided to Filipino patients by health professionals; the patients' diabetes knowledge was significantly increased at 12 and 18 months after they had received the training [12]. These patients in our previous study comprise the peer-led DSME providers for the current study. Assessing the effects of DSME offered by these trained Filipino patients (i.e. peer leaders) in other Filipino patients (i.e. peer-led DSME recipients) will help to demonstrate the benefit of peer-led DSME programs in areas with limited medical services and to tailor these programs to other resource-limited areas. In this study, we evaluated the changes in diabetes-related indicators (i.e. knowledge of diabetes, self-efficacy in management of diabetes, QOL with physical and mental components, HbA1c levels and emotional distress) in the recipient Filipino patients who were educated by their peers (peer leaders) trained in patient education as well as DSME.

## Materials and methods

A 2-year longitudinal study was designed. The interventions and data collection were performed in a diabetes clinic in a municipality of Metro Manila, Philippines. This municipality is one of the smallest in Metro Manila in terms of area and total population (approximately 67 000 people). The municipality suffers from low levels of funding for medical services and a shortage of health-care professionals.

### Intervention

The patients with diabetes who had attended the diabetes clinic in the municipality were screened for inclusion in the study. Criteria for the participants were as follows: age $\geq$20 years; T2D, no pregnancy, no dementia and no cognitive impairment nor mental illness making it difficult to answer the questionnaires or undergo a physical examination, or both; no substantial musculoskeletal nor incurable disease making it difficult to undergo physical examination or exercise;

no cardiovascular disorders requiring hospitalization (e.g. myocardial infarction or stroke); and nor the need for hospitalization due to complications associated with diabetes (e.g. renal impairment, retinopathy or gangrene).

The intervention of this study (peer leaders' education of patients) started in August 2017 immediately after the peer leaders received the training. The participants in the intervention were provided with education on diabetes self-management by their peers (peer leaders) when they attended weekly checkups at the diabetes clinic. The education was offered by the 13 peer leaders for 18 months [from immediately after the second survey (August 2017) until the end of this current study (March 2019)] after they had received training on diabetes self-management and on the enhancement of self-efficacy to motivate patients with diabetes for their diabetes self-management.

This training for peer leaders was organized on the basis of previously reported DSME [13], the theory of self-efficacy [14, 15] and the attention, relevance, confidence and satisfaction model [16]. The training comprised 12 modules spanning 10 h with each module lasting between 45 and 60 min [12]. It was performed over 2 days in August 2017 by the authors of this study with the support of health-care professionals in the municipality [12]. Owing to the limited time available for support from municipal health-care professionals, the training modules in the reported DSME [17] were modified. Specifically, we omitted 'stress, coping and depression' and 'diabetes medication' in the reported modules [17] and added sessions to enhance the peer leaders' capacity to properly communicate with patients [12], stressing the essence of the DSME (i.e. as a continuous process to facilitate patients' knowledge, skills and abilities in diabetes self-care) [13]. The authors of this study specifically prepared a *Diabetes Textbook* (in the Tagalog language) and self-guided materials on physical exercise and balanced meals (in the Tagalog language) for the training.

Then, each of the 13 peer leaders was responsible for educating 5–10 participants. For the education of participants, instructional styles introduced in the training for peer leaders (i.e. hands-on learning, demonstrations, quizzes, role-playing and group sharing of experiences) were applied; the *Diabetes Textbook* and the self-guided materials on physical exercise and balanced meals were used. Activities given by the peer leaders to the participants were monitored through regular visits of the authors of this study and by the physician (diabetologist) assigned by the municipality to the diabetes clinic. These visits revealed that after peer-led education of patients had begun, the peer leaders prepared posters about diabetic complications on their own initiative, and they frequently used these posters to raise the participants' awareness regarding ways to prevent disease exacerbation.

Because of ethical considerations, we did not include in the current study a no-treatment control group that did not receive peer-led education. It was also because the patients all resided in the same community, it would be difficult to ensure that patients in the treatment group did not share their increased knowledge with their neighbors, who might be in the control group.

## Data collection

We collected data through five surveys performed every 6 months from March 2017 to March 2019 [i.e. March 2017 (6 months before the start of the peer leaders' education of patients); August 2017 (immediately before the start); March 2018 (6 months after the start); August 2018 (12 months after the start); and March 2019 (18 months after the start, at the end of the peer-led education)]. Each of the surveys was performed when a free medical checkup was offered to the patients with diabetes in the municipality.

Population for analysis in this study was the 800 members of a nongovernmental organization (Diabetes Association) established in the municipality. This organization has been established in the municipality and composed of most of the patients with diabetes in the municipality. The collected data from the patients who completed all five surveys were used for analysis. We estimated the minimum sample size ($n = 17$) by using G

Power 3.1.9.7 (Heinrich Heine University, Dusseldorf, Germany), with a statistical significance of 0.05, a power of 0.8 and an effect size (Cohen's $F$) of 0.3. Although the number of sessions or hours offered to each of the participants was not counted, records of weekly medical checkups in the diabetes clinic confirmed that all the participants received the peer-led education at least once a month, when they attended the medical checkups. Therefore, it was estimated that all the participants were offered the peer-led education at least 18 times during this study period.

This study was conducted according to the guidelines of the Declaration of Helsinki and approved by the ethics committee of the Faculty of Medicine, Tottori University, Tottori, Japan (No. 1608B013 on 23 May 2017) after being registered in the national clinical trials registry (UMIN000027073). 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.

## Indicators used for data analysis

Knowledge of diabetes was measured by using the scores of test with the 30 questions prepared on the basis of the Diabetes Knowledge Test [18] and the Diabetes Knowledge Questionnaire [19]. Before the start of this study, the face validity and content validity of these questions were confirmed through discussions with diabetologists in the municipality. Then, the questions were administered to patients with diabetes residing in the municipality who were not enrolled in the study ($n = 32$). The value of Cronbach's coefficient of the questions ($\alpha = 0.772$) demonstrated the reliability (i.e. internal consistency) of the original questions. We finalized this set of 30 questions for use in each of the five data collection surveys. These 30 questions on knowledge of diabetes were categorized into the following subindicators for analysis: (i) cause, risk factors, nature of diabetes and complications; (ii) importance of self-management of their own disease; (iii) diet and nutrition and (iv) exercise. The questions categorized in the subindicator (i) were designed to determine the participants' understanding of diabetes in terms of cause, exacerbating factors and complications. The questions in the subindicator (ii) accounted for the participants' attitudes toward their diabetes and toward the importance of disease self-management, as well as their establishment of partnerships with health professionals.

Self-efficacy in the management of diabetes was measured by using the Diabetes Self-efficacy Scale [20]. This scale consists of eight Likert-type items, each scored from 1 (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.

The QOL of participants was measured by using the Eight-Item Short Form QOL Survey (SF-8) [21]. The SF-8 is composed of eight multiple-choice questions. Each of the eight questions is scored according to reported values allocated to the chosen answers. The eight scores are summed after applying the weights allocated to all eight questions, and then two summary scores [i.e. the physical component summary (PCS) and mental component summary (MCS)] are calculated. High PCS and MCS scores indicate better QOL [21]. Because neither values applied to the chosen answers nor weights for the eight questions used in the calculation have been reported in the Philippines, we used the values and weights for PCS and MCS applied in the United States [22]. The SF-8 was used with the permission of iHope International Co., Ltd (Kyoto, Japan), in accordance with their royalty rules.

Plasma HbA1c levels were measured with a Clover A1c Self Analyzer (Infopia Co., Ltd, Gyeonggi-do, South Korea). Emotional distress was assessed by using the Problem Areas in Diabetes (PAID) instrument, which is a self-administered 20-item questionnaire [23]. Each item is scored from 1 (not a problem) to 5 (a serious problem). The sum of all item scores gives the total PAID score (range: 20–100), with higher scores reflecting greater emotional distress [23].

### Data analysis

To minimize bias that might result from the lack of a control group for analysis, we confirmed with paired *t*-tests that—as expected—values for diabetes-related indicators did not differ significantly between the first two time points (i.e. March 2017 and August 2017), which occurred before the peer-led education began. Then, we assessed differences between the indicator values immediately before the start of peer-led education (August 2017) and those at the three later time points (March 2018, August 2018 and March 2019), by using repeated-measure analysis of variance and Bonferroni's multiple comparisons. *P*-values less than 0.05 through multiple comparisons were considered statistically significant. SPSS Statistics version 22 (IBM, Armonk, NY, USA) was used for all of the statistical analyses.

## Results

The number of patients who completed each survey ranged from 95 to 145, out of which 23 patients completed all five surveys; this number of patients was more than our estimated minimum sample size for analysis ($n = 17$). Data of these patients (participants) were used for further analysis. The average age of the participants was $67.8 \pm 6.7$ (range, 57–84) years. Of the 23 patients, 82.6% were female, 91.4% were not working and 47.8% were married (Table I).

None of the indicators or subindicators of the 23 participants showed significant differences between the first two time points (i.e. before the start of the peer-led education) (Tables II and III, Supplementary Appendix A and B). The two significant increases were found in levels of the participants' knowledge of diabetes at 12 and 18 months after the start (both $P < 0.05$), compared with those immediately before the start (August 2017) (Table II). Furthermore, a significant increase ($P < 0.05$) was observed in the category of 'cause, risk factors, nature of diabetes and complications' under the subindicator of 'knowledge of diabetes' at 6 months after the start (Table III).

**Table I.** *The characteristics of survey participants at 6 months before the start of peer education ($n = 23$)*

| Variable | Number (%) | Mean ± 1 SD (range) |
|---|---|---|
| Age (years) | | 67.8 ± 6.7 (57–84) |
| Sex | | |
| Male | 4 (17.4) | |
| Female | 19 (82.6) | |
| Occupation | | |
| Employed | 2 (8.7) | |
| Not working | 21 (91.3) | |
| Highest level of education | | |
| Primary | 3 (13.0) | |
| Secondary | 14 (60.9) | |
| College | 4 (17.4) | |
| No answer | 2 (8.7) | |
| Marital status | | |
| Married | 11 (47.8) | |
| Single | 12 (52.2) | |
| Complications (self-declared) | | |
| Renal disorder | 3 (13.0) | |
| Neuropathy | 4 (17.4) | |
| Eye disorder | 11 (47.8) | |
| Peripheral circulatory disturbance | 0 (0.0) | |
| Classification by neuropathy symptom (self-declared) | | |
| Normal | 3 (13.0) | |
| Mild | 7 (30.4) | |
| Moderate | 13 (56.5) | |
| Severe | 0 (0.0) | |

## Discussion

The participants' levels of knowledge were significantly higher at 12 and 18 months after the initiation of peer-led education than immediately before it began (Table II), with the lack of a significant difference between the two time points before the peer-led education began. The scores in the subindicator 'cause, risk factors, nature of diabetes and complications' were significantly higher

**Table II.** *Values of indicators before and after the start of peer education of participants with T2D*

| Indicator | 6 months before | Immediately before | 6 months after | 12 months after | 18 months after | *F* | *P* | Bonferroni's multiple comparison test |
|---|---|---|---|---|---|---|---|---|
| Knowledge (score: 0–100) | 63.6 (12.9) | 65.5 (8.0)[†] | 69.6 (8.5) | 73.8 (12.4)[‡] | 75.3 (13.2)[§] | 6.474 | 0.001 | † < ‡ ($P < 0.05$), † < § ($P < 0.05$) |
| Self-efficacy (score: 8–80) | 62.0 (14.4) | 55.2 (16.6) | 60.5 (11.1) | 60.4 (12.1) | 62.0 (10.7) | 1.901 | 0.166 | |
| QOL (PCS) | 46.5 (7.0) | 46.3 (7.5) | 47.7 (5.9) | 46.6 (6.7) | 48.6 (7.5) | 0.829 | 0.477 | |
| QOL (MCS) | 47.9 (5.2) | 47.3 (6.4) | 44.3 (8.4) | 48.5 (7.4) | 49.8 (6.7) | 2.845 | 0.051 | |
| HbA1c (%) | 7.43 (2.03) | 7.40 (1.72) | 7.70 (1.74) | 7.58 (1.98) | 7.29 (1.89) | 1.369 | 0.264 | |
| PAID (score: 20–100) | 39.6 (15.0) | 48.7 (14.2) | 46.1 (15.8) | 46.2 (13.2) | 47.1 (15.9) | 0.167 | 0.879 | |

[†] Normally distributed continuous variables are expressed as mean (1 SD).
[‡]Paired *t*-tests confirmed the lack of significant difference ($P > 0.05$) between indicators at 6 months prior to and immediately before the start of peer education.
[§]Repeated-measures analysis of variance and Bonferroni's multiple comparison tests were used to assess changes in indicators values among the four later time points (i.e. excluding '6 months before')—*F*- and *P*-values therefore refer to those four time points.

**Table III.** *Values of subindicators categorized under 'knowledge of diabetes' before and after the start of peer education of participants with T2D*

| Subindicator | 6 months before | Immediately before | 6 months after | 12 months after | 18 months after | *F* | *P* | Bonferroni's multiple comparison test |
|---|---|---|---|---|---|---|---|---|
| Cause, risk factors, nature of diabetes, and complications | 69.2 (11.6) | 67.6 (11.6)[†] | 76.9 (11.6)[‡] | 76.9 (15.7) | 75.3 (16.7) | 3.834 | 0.016 | † < ‡ ($P < 0.05$) |
| Importance of self-management of their own disease | 63.0 (16.6) | 57.6 (17.6) | 67.4 (15.9) | 64.1 (25.9) | 68.1 (21.3) | 1.728 | 0.176 | |
| Diet and nutrition | 59.6 (13.4) | 62.1 (15.9) | 50.9 (13.5)[§] | 63.4 (18.7) | 63.8 (13.9)[¶] | 3.798 | 0.025 | § < ¶ ($P < 0.01$) |
| Exercise | 73.9 (17.3) | 75.4 (18.0) | 75.4 (23.0) | 71.0 (25.2) | 73.9 (17.3) | 0.232 | 0.852 | |

[†]Values are the percentages of questions in the category under 'knowledge of diabetes' that the participants answered correctly (Table II).
[‡]Normally distributed continuous variables are expressed as mean (1 SD).
[§]Paired *t*-tests confirmed the lack of significant difference ($P > 0.05$) between indicators at 6 months prior to and immediately before the start of peer education.
[¶]Repeated-measures analysis of variance and Bonferroni's multiple comparison tests were used to assess changes in indicators values among the four later time points (i.e. excluding '6 months before')—*F*- and *P*-values therefore refer to those four time points.

at 6 months after the peer-led education began than immediately after the education ($P = 0.04$); later scores remained similar to the 6-month value (Table III). These findings suggest that the peer-led education of participants increased their knowledge levels. A previous study reported a significant increase in patients' levels of knowledge of diabetes at 12 and 18 months after they had received training on diabetes self-management, compared with their level 6 months before the training [12]; it was expected that this increased knowledge obtained by the patients could be extended to other patients with diabetes. Indeed, in this study, absorbed knowledge of the patients (i.e. peer leaders) was extended to the other patients (i.e. participants). The use of the posters prepared by the peer leaders after starting the education of participants might have contributed to increasing the participants' levels of knowledge on diabetes and on its 'cause, risk factors, nature of diabetes and complications'. The lack of significant differences between the scores of subindicator 'cause, risk factors, nature of diabetes and complications' immediately before the start of education and those at 12 and 18 months after the education started ($P = 0.09$ and 0.23, respectively) was attributable to increases in the standard deviations of the scores at both of these two time points. By contrast, the lack of improvement in the scores of subindicator 'importance of self-management of their own disease' ($P = 0.176$) emphasized the need to enhance knowledge around this subindicator when facilitating peer-led education of patients.

The self-efficacy levels did not differ significantly among all the surveys (Table II). A previous report suggested the Dunning–Kruger effect as a cause of the lack of increase in self-efficacy levels of the peers who educated the participants in this current study [12]. In other words, among individuals who incorrectly appraise their competence as being higher than it really is, their confidence in their behavior decreases as they gain experience [24]. This effect could have counteracted the expected increase in our participants' self-efficacy levels in response to the peer-led education and thus caused the lack of increase in the participants' self-efficacy levels.

The values of QOL were slightly (albeit not significantly) higher 18 months after the start of the peer-led education (PCS, 48.6; MCS, 49.8) than immediately before the education (PCS, 46.3; MCS, 47.3), although no significant differences were observed in the participants' QOL (both PCS and MCS) among all the surveys. They were higher than those reported using the SF-8 in the United States (PCS, 47.2; MCS, 48.2) [21]. Positive influences of Filipino patients' levels of diabetes knowledge on their self-efficacy regarding the management of diabetes and on their QOL (both PCS and MCS) have previously been reported in patients with T2D at this same study site [11]. In addition, another study at the same site reported a positive correlation between diabetes knowledge levels with self-efficacy for the management of diabetes among the peer leaders who educated the participants in the current study [12]. Improving patients' knowledge of diabetes may promote increases in their self-efficacy and QOL; additional long-term studies to explore the effects of enhancing patients' diabetes knowledge on these two indicators are warranted.

No significant improvements were observed in plasma HbA1c levels. In a previous report, there was an improvement in HbA1c levels in the patients with T2D and HbA1c >8.0% who received individual education on metabolic control, diabetes knowledge and psychosocial outcomes, whereas there was no significant change in HbA1c levels in those with HbA1c <8.0%; this suggested that benefits from the program would appear in patients with high HbA1c levels [25]. Likewise, the lack of a significant improvement in the participants' HbA1c levels through the peer-led education in our current study may have been attributable to their fairly well-controlled HbA1c levels before the intervention (7.43% and 7.40% at 6 months and immediately before the start of peer-led education).

The PAID scores did not differ significantly among all the surveys. A lack of significant change over 3 years in the PAID values of patients who

had attended a single 6-h group education program (baseline PAID values were not mentioned) has been reported before [26, 27]. Another study performed at this same site demonstrated no significant differences in the patients' PAID values over a 2-year period ($P = 0.24$) [12], which is the same duration of follow-up as in our current study. The lack of a significant change in the participants' PAID values in our current study suggests either that the effect of the intervention in mitigating the patients' emotional distress appears after more than 2 years or that there is no effect.

## Conclusion

The knowledge levels of Filipino patients with diabetes regarding the disease and its related subindicator 'cause, risk factors, nature of diabetes and complications' increased after they started receiving peer-led education. These findings—together with a previously reported positive correlation of patients' knowledge levels with their self-efficacy and QOL—support the incorporation of strategies to enhance patients' knowledge about diabetes into peer-led education programs targeted to communities and regions with limited medical resources. Increasing patients' knowledge could improve their self-management of their disease and enhance their QOL. Additional long-term studies are needed to verify the effects of enhancing patients' knowledge on the indicators of self-efficacy and QOL.

## Supplementary data

Supplementary data are available at *HEAL* online.

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## Conflict of interest statement

None declared.

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