

Self-efficacy-focused education in persons with diabetes: a systematic review and meta-analysis

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Aims: The aims of this study were to assess the effectiveness of self-efficacy-focused education on health outcomes in persons with diabetes and review the strategies employed in the interventions.

Background: The traditional educational interventions for persons with diabetes were insufficient to achieve the desired outcomes. Self-efficacy-focused education has been used to regulate the blood sugar level, behaviors, and psychosocial indicators for persons with diabetes.

Design: This study is a systematic review and meta-analysis.

Methods: Studies on the effectiveness of self-efficacy-focused education in persons with diabetes were searched in six databases from inception until January 2018. The data were extracted and the quality of literature was assessed independently. Review Manager 5.3 was applied for the meta-analysis. Besides, the findings were summarized for narrative synthesis.

Results: Sixteen trials with 1,745 participants were included in the systematic review and ten trials with 1,308 participants in the meta-analysis. The meta-analysis for A1C, self-efficacy, self-management behaviors, knowledge, and quality of life (QOL) were represented in four, six, six, three, and three studies, respectively. The findings indicated that self-efficacy-focused education would probably reduce A1C, enhance self-efficacy, regulate self-management behaviors, increase knowledge, and improve the QOL for patients with diabetes. Weak quality studies, limited participants, and heterogeneity hindered the results pooled of the other secondary outcomes of fasting blood glucose, 2-hour plasma glucose, weight, weight circumference, body mass index, plasma lipid profile, and other psychological indicators. Goal setting, self-management skills practicing and recording, peer models, demonstration, persuasion by health providers, and positive feedback were the most commonly used strategies in the interventions. However, physiological/emotion arousal strategies were relatively less applied and varied significantly.

Conclusion: Individuals with diabetes may benefit a lot from the self-efficacy-focused education. However, insufficient high-quality studies, short-term follow-up period, relatively deficient physiological/emotion strategies, and incomplete outcome assessments were the drawbacks in most studies. Establishing satisfactory self-efficacy-focused education and better evaluating the effects were required in further studies.

Keywords: self-efficacy, self-management behavior, diabetes mellitus, diabetes education, review

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Introduction

Nearly 425 million adults worldwide lived with diabetes in 2017, and it is projected that it will reach 629 million by 2045. Moreover, diabetes may lead to secondary complications, which accounted for 10.7% of the global all-cause mortality among

the individuals aged between 20 and 79 years.¹ Diabetes education is a cornerstone of the diabetes care. Diabetes management is a complex daily work consisting of adjusting diet, performing exercise, conducting self-monitoring, and taking medicine. The traditional diabetes educational interventions, which merely provided the related knowledge, were inadequate to achieve the expected effects.^{2,3} Furthermore, the behavior change theories were applied in few studies on diabetes education.⁴ A variety of research studies manifested that the self-care behaviors of persons with type 2 diabetes (T2DM) were suboptimal.⁵⁻⁹ Besides, poor self-efficacy was considered as an extreme disadvantage of managing diabetes.¹⁰

The notion of self-efficacy originated from the social cognitive theory and developed into its related theory.^{11,12} According to the theory, self-efficacy is the individual's belief that related to specific behavior in a special setting, which can be modified by four sources of information, including performance accomplishments, vicarious experience, verbal persuasion, and physiological/emotion arousal.^{11,12} Satisfactory results may be achieved when an educational intervention properly combined the above information. In addition, self-efficacy can regulate human behaviors based on the theory.

Diabetes educational interventions based on the self-efficacy theory were defined as self-efficacy-focused education.^{13,14} Literature reviews indicated that an educational intervention supported by the related theory may achieve more satisfactory results on reducing blood glucose levels.^{15,16} As far as we know, there was no literature review interpreting the effects of self-efficacy-focused education in patients with diabetes and the strategies used in the interventions. In addition, self-efficacy educational interventions for patients with diabetes on health outcomes were inconsistent.^{14,17-20} As a consequence, the objectives of the review were to evaluate the effectiveness of self-efficacy-focused education on health outcomes in patients with diabetes and review the strategies employed in the self-efficacy educational interventions.

Methods

In this review, combined searching with screening the literature, the reporting was based upon PRISMA.²¹

Eligibility

Types of studies

Studies using experimental designs included randomized controlled trials (RCTs), quasi-experimental approaches,

or mixed method studies that included RCTs or quasi-experimental designs.

Types of participants

The ages of all the participants were ≥ 17 years, and all the participants were diagnosed with T2DM or T1DM unless the participants only included T1DM patients.

Types of interventions

The interventions should be developed and implemented based on the principle sources of information proposed by Bandura with detailed descriptions.^{11,12} Performance accomplishments referred to individuals' direct experience originated from their own personal practices, which would play a crucial role in the establishment of self-efficacy under specific circumstances. Moreover, vicarious experience was defined as individual's learning from observing and absorbing the successful behaviors or achievements from others. In addition, verbal persuasion indicated that individuals were convinced to believe that they can accomplish and succeed in a task by providing knowledge, instructions, and advice. Besides, physiological/emotion arousal was regarded as individuals' psychological state adjustment. The contents of the self-efficacy-focused education for patients with diabetes mainly included education on any of the following aspects: diet adjustment, exercising, foot care, self-monitoring, and medication.

Types of outcome measures

The primary outcomes included A1C, diabetes self-efficacy, and diabetes self-management behaviors. Weight control (weight, body mass index [BMI], and weight circumference [WC]), other indicators of blood sugar level (fasting blood glucose [FBG] and 2-hour plasma glucose [2 h-PG]), plasma lipid profile (total cholesterol [TC], low-density lipoprotein cholesterol [LDL-C], high-density lipoprotein cholesterol [HDL-C], and triglycerides [TG]), and other psychosocial indicators (diabetes knowledge, diabetes distress, depression, and QOL) belonged to the secondary outcomes.

Data source and search strategy

Six databases including PubMed, Web of Science, EBSCO, CNKI, Wanfang, and SinoMed were systematically searched for the articles published from inception until January 2018. The terms of "self efficacy," "self-efficacy," "efficacy, self," "diabet*," and "educat*" were combined for searching. Articles published in English or Chinese language were included. The additional articles were identified through the

references of the included studies. The selection of articles were reviewed by two investigators independently. A discussion or an arbitration was arranged when the two investigators were inconsistent with the inclusion of studies.

Extraction and quality appraisal of studies

The study characteristics including study location, design, sample, strategies of intervention, instruments, outcome measures, and so on were extracted. The Quality Assessment Tool for Quantitative Studies²² was applied to conduct the quality appraisal. The components of the quality tool included six aspects of bias of selection, research design, confounders in studies, blinding issue, methods of data collection, and withdrawals/dropouts of participants. Each criteria was rated in 3, 2, or 1 point, corresponding to the quality of strong, moderate, or weak, respectively. The overall rating in the study was determined by the total of six-component rating points. To be specific, two or more weak ratings in a study were defined as weak quality, less than four strong ratings and one weak rating as moderate quality, and no weak ratings and at least four strong ratings as strong quality.

Data analysis

In terms of participants, interventions, and outcomes, the indicators of FBG, 2 h-PG, weight, WC, BMI, and plasma lipid profile were presented in a format of a textual summary of findings, while indicators of A1C, self-efficacy, behavior,

knowledge, and QOL were pooled for meta-analysis. The mean difference (MD) was calculated when the indicators were measured in the same scale, whereas the standardized mean difference (SMD) was calculated. Chi-squared test was applied to evaluate the heterogeneity, and $P < 0.10$ was considered as heterogeneity. The value I^2 quantified the degree of heterogeneity. If I^2 was above 50%, a random-effect model was employed, otherwise, a fixed-effect model was used. The sensitivity analysis was conducted by deleting the studies of high risk bias. Besides, Review Manager 5.3 was employed for the meta-analysis.

Results

Study selection and study quality evaluation

The selecting criteria of self-efficacy-focused education for adults with diabetes are shown in Figure 1. Two thousand five hundred thirty-three abstracts were obtained via the systematic searches, and four additional articles were got through searching the references lists. To sum up, the total number of searched articles was 2,537. After deleting 1,067 duplicate articles and excluding 1,402 studies through reviewing titles and abstracts, there were 68 articles for full-text reading, and 16 studies were finally selected. The other 52 research studies were excluded because of the study population, review format, study design, the use of other theory, or a lack of detailed description regarding how educational interventions

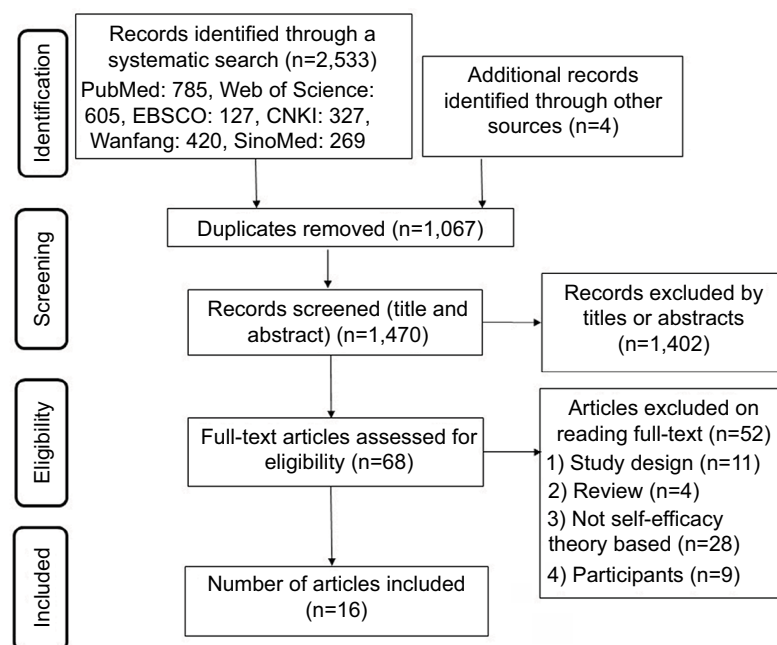


Figure 1 A PRISMA flow diagram describing the study selection criteria.

were developed and implemented based on the self-efficacy theory. Among the selected 16 studies, 6 were of strong quality, 9 of moderate quality, and 1 of weak quality. The blind outcome assessor or study participants were not reported in the above studies.

Characteristics of included studies

Various information including study location, date of publication, sample capacity, and study design is presented in Table 1. Among the 16 included studies, 2 were from Europe, 1 from Turkey, 2 from Thailand, 2 from Malaysia, 3 from Taiwan, and 6 from mainland China. The date of publications ranged from 2006 to 2017 and the sample capacity of studies from 8 to 228. RCT was employed in eight studies and the quasi-experimental design in the others (two pre-post design studies).

In Table 1, verbal persuasion was used in all studies, performance accomplishments in 15 studies, vicarious experience in 15 studies, and physiological/emotion arousal in 5 studies. Five studies employed four sources of information when developing and implementing the educational interventions. Strategies such as goal-setting were predominately applied for performance accomplishments, followed by practicing diabetes self-management skills, recording behavior, patients' return-demonstration, making diabetes-related plan, repetition, review and reinforcement, small and realistic steps, behavior contract, evaluation and feedback regarding behavior, and positive attribution. Successful experience provided by a live peer model was primarily applied in vicarious experience, followed by videos, booklets, other elements, such as demonstration and role-play. Verbal persuasion was mainly provided by nurses, followed by researchers, education booklets, group members, and psychologists. Besides, personal health lectures and other healthy knowledge can be obtained through the Internet. Moreover, performance feedback, encouragement, and the identification of barriers and solutions were also employed in the verbal persuasion. For the physiological/emotion arousal aspects, the studies based on the strategy substantially varied and contained psychological consulting, discussion and identification of concerns, encouragement and reward, empathy and caring, reflective listening, mediation techniques, humor, relaxation therapy, and emotional support by nurses and family members.

Group format and face-to-face delivery were used in most of the studies. The durations of the interventions ranged from 4 to 16 weeks, the number of education modules from 3 to 12, the length of each module from 20 to 120 minutes, and the durations of research from 1 to 6 months. Nine studies

measured self-efficacy, 13 studies measured the behavior of participants, 8 studies evaluated both of the above indicators, and 6 studies detected A1C.

Outcomes

The metabolic controls

The improvement of A1C 3 months post intervention was reported in one study.²³ In addition, the changes in A1C between two groups were represented in five studies shown in Table 2, but the follow-up period of one study was only 1 month.^{19,20,24–26} The overall pooled results (3–6 months) of 508 participants suggested that A1C reduced significantly (MD: -0.62% , 95% CI: -0.92% to -0.33% , $P<0.001$), with a heterogeneity of $I^2=21\%$, which favored the intervention group (Figure 2). A study with high risk bias was deleted for the sensitivity analysis. The results of A1C remained effective (MD: -0.78% , 95% CI: -0.87% to -0.35% , $P<0.001$), with a heterogeneity of $I^2=0\%$. Another study conducted in Taiwan was excluded as well. The outcomes of A1C maintained statistically significant (MD: -0.55% , 95% CI: -0.84% to -0.27% , $P<0.001$) with a heterogeneity of $I^2=32\%$.

The positive effects on FBG and 2 h-PG in the intervention group vs the control group were identified in three and two research studies, respectively, and these variables were improved at the end of the studies compared with the baseline.^{27–29} The weight of the patients was assessed in two studies; however, only one of them represented a significant difference between the groups.^{25,26} WC in the intervention group was found to be well-regulated compared with the control group in two studies.^{24,25} Among all the included studies, only one study involved in the positive result of BMI and a non-significant result of TC, TG, HDL-C, and LDL-C (Table 2).²⁴

Self-efficacy

A positive impact on self-efficacy post intervention was reported in two studies.^{13,23} The foot care self-efficacy of the participants was examined and a significant difference was found. Another six studies reported the changes in self-efficacy between the two groups.^{14,17,18,20,24,25} However, the outcomes of self-efficacy were heterogeneous, namely the total self-efficacy of the participants was measured on different scales, including the Diabetes Management Self-Efficacy Scale (DMSES), the Perceived Competence Scales (PCS), and the Perceived Therapeutic Efficacy Scale (PTES) (Table 2). The pooled results (<3 months) of 554 participants revealed that self-efficacy can be improved significantly (SMD: 0.61, 95% CI: 0.23–0.98, $P=0.001$), and the results

Table 1 Characteristics of included studies

Author, year, country	Design	Sample I/C	Self-efficacy educational intervention		Outcome indicators ^a	Quality rating
Sturt et al ²³ 2006 England	Mixed methods, including pre-post design	8	PA: Setting incremental goals to achieve mastery VP: Persuasion by nurses	Format: I–I Duration: 4 months Dose: 20–30 minutes per session per month (4 times)	① ②	Moderate
Wattana et al ¹⁹ 2007 Thailand	RCT	75/72	PA: Realistic goal setting VE: Patient who succeeded in self-management behavior was selected as a model VP: Persuasion by nurses and group members PhA: Mediation techniques for reducing stress	Format: Group and class Duration: Not reported Dose: 120 minutes for a class, 90 minutes per group (4 times), 45 minutes per home visit (2 times)	① ⑥	Moderate
Wangberg ¹⁸ 2008 Norway	RCT	14/15	VE: Videos of overcoming barriers from peers' interviewing (peer modeling) VP: Behavior exercises included monitoring and graphic feedback, quizzes with feedback facilitate interactive learning, and knowledge and personal health lectures by videos through the Internet	Format: Internet Duration: 1 month Dose: Not reported	② ③	Moderate
Shi et al ¹⁷ 2010 China	RCT	77/80	PA: Patients' return-demonstration, and small goal achievement VE: Combining videos of role models with a peer model at the clinic, and researchers' demonstration VP: Persuasion by researchers	Format: Group Duration: 1 month Dose: 60–120 minutes per session per group (4 times)	② ③	Strong
Tan et al ²⁶ 2011 Malaysia	RCT	82/82	PA: Practice VE: Discuss self-care, evidence-based studies with patients, and praise the participants' achievement VP: Explore approaches to overcome self-care deficits based on the patient's past experience, and identify patient's barriers and solutions PhA: Identify emotional problems	Format: I–I Duration: 3 months Dose: Not reported	① ③ ④	Strong
Wu et al ¹⁴ 2011 Taiwan	RCT	72/73	PA: Goal setting by sheets VE: Ten minutes DVD viewing, booklet presented stories of diabetes patients, and experience sharing by the role model as peer support VP: Persuasion by nurses	Format: Group Duration: Not reported Dose: 60 minutes per session per group (4 times), 10 minute DVD viewing, receive booklet, and telephone follow-up	② ③	Strong
Wu et al ²² 2011 Taiwan	Quasi-experimental design	72/73	PA: Goal setting VE: Ten minutes DVD viewing, booklet presented stories of patients, experience sharing, and peer support VP: Persuasion by nurses	Format: Group Duration: 4 months Dose: 60 minutes per session per group (4 times), 10 minute DVD viewing, receive booklet, and telephone follow-up	⑤ ⑥	Strong
Wu et al ²⁵ 2013 Taiwan	Quasi-experimental design	147/81	PA: Self-goal-setting VE: Ten minutes DVD viewing, diabetes self-care handbook, role model, and peer support VP: Persuasion by nurses, and positive feedback	Format: Group Duration: 1 month Dose: 60 minutes per session per group (4 times), 10 minute DVD viewing	① ② ③ ⑤	Strong

(Continued)

Table 1 (Continued)

Author, year, country	Design	Sample I/C	Self-efficacy educational intervention	Outcome indicators ^a	Quality rating
Cai and Hu ²⁴ 2016 China	Quasi-experimental design	29/28	PA: Progressive goal setting, diet plan making, return-demonstration, repetition, review, and reinforcement VE: Peer modeling, successful examples, demonstration, and role-play VP: Persuasion by researchers and performance feedback PhA: Discuss diabetes concerns, encourage and reward, express empathy and caring, reflective listening, and humor	Format: Group Duration: 7 weeks Dose: Not reported	①②③④⑥ Moderate
Bıçer and Enç ³⁰ 2016 Turkey	RCT	45/45	PA: Practice VE: Demonstration VP: Persuasion by researchers and education booklet for patients	Format: 1-1 Duration: Not reported Dose: Not reported	②③④ Moderate
Wichit et al ²⁰ 2017 Thailand	RCT	70/70	PA: Self-goal setting, design personal action plans, and practice specialized skills (meal planning, physical activities, problem solving, and diabetes-related complications) VE: Models of success to other participants VP: Encourage patients to expand their skills and activities when initiating life-style changes	Format: Group Duration: 9 weeks Dose: 120 minutes per session per group (3 times)	①②③④⑥ Strong
Sharoni et al ¹³ 2017 Malaysia	Pre-post design	31	PA: Small and realistic steps VE: Symbolic modeling by pamphlet, and patients as live models VP: Persuasion by researchers and nurses PhA: Weekly visit by local nurse for emotional support	Format: Group Duration: 1 month Dose: 30 minutes per seminar (4 times)	②③④⑥ Moderate
Li et al ²⁹ 2013 China	Quasi-experimental design	50/50	PA: Dietary calorie calculation and recording, and healthy behavior recording VE: Experience sharing, live modeling, and demonstration VP: Persuasion by nurses and simplified diabetes booklet	Format: Group Duration: 6 weeks Dose: 60 minutes per discussion (6 times), 60 minutes per group (6 times)	①③ Weak
Zhang et al ²⁷ 2014 China	Quasi-experimental design	49/55	PA: Dietary calorie calculation and recording, and good behavior recording VE: Discussion and live modeling VP: Persuasion by nurses, CD viewing on diabetes-related knowledge, and simplified diabetes booklet	Format: Group Duration: 6 weeks Dose: 60 minutes per discussion (6 times), 60 minutes per group (6 times)	①③ Moderate
Zhao et al ¹⁸ 2016 China	Quasi-experimental design	49/55	PA: Dietary calorie calculation, dietary, exercise and cessation recording, and healthy behavior recording VE: Discussion, share experience, and live modeling VP: Persuasion by nurses, and simplified diabetes booklet	Format: A class Duration: 6 weeks Dose: 120 minutes per class per week (6 times)	①③ Moderate
Mao and Fang ³¹ 2017 China	RCT	48/48	PA: Goal setting, behavior contract, evaluation, and feedback regarding behavior; diet and exercise diary; and positive attribution VE: Model demonstration, experience sharing, and "Wechat" communication VP: Persuasion by physiologist and nurse (cognitive intervention and health lecture), and healthy knowledge through the Internet PhA: Relaxing therapy, psychological consulting, and family support	Format: A class Duration: 8 weeks Dose: 60 minutes per class per week (4 times), 60 minutes per class per week (8 times)	③⑤ Moderate

Notes: ^aOutcome indicators: ①metabolic controls, ②self-efficacy, ③behavior, ④knowledge, ⑤other psychological indicators, and ⑥quality of life.

Abbreviations: I/C, intervention group/control group; PA, performance accomplishments; PhA, physiological arousal; RCT, randomized controlled trial; VE, vicarious experience; VP, verbal persuasion.

Table 2 Outcomes of included studies

Study	Metabolic controls	Self-efficacy	Behavior	Knowledge	Other psychological indicators	QOL
Sturt et al ²³ 2006	AIC: + (at 3 months)	Scale: DMSES Result: + (at 3 months)	None	None	None	None
Wattana et al ¹⁹ 2007	AIC: + (at 6 months)	None	None	None	None	Scale: SF-36 Result: + (at 6 months)
Wangberg ¹⁸ 2008	None	Scale: PCS Result: + (at 1 month)	Scale: SDSCA Result: + (at 1 month)	None	None	None
Shi et al ¹⁷ 2010	None	Scale: DMSES Result: + (at 1, 4 months)	Scale: SDSCA Result: + (at 1, 4 months)	None	None	None
Tan et al ²⁶ 2011	AIC: + (at 3 months) Weight: – (at 3 months)	None	Scale: RDSA Result: none (at 3 months)	Scale: included in RDSA Result: + (at 3 months)	None	None
Wu et al ¹⁴ 2011	None	Scale: DMSES Result: + (at 3, 6 months)	Scale: SDSCA Result: + (at 3, 6 months)	None	None	None
Wu et al ³² 2011	None	None	None	None	Scale: CES-D Result: – (at 3, 6 months)	Scale: SF-12 Result: – (at 3, 6 months)
Wu et al ²⁵ 2013	AIC: + (at 1 months) Weight: – (at 1 months) WC: – (at 1 months)	Scale: PTES Result: + (at 1 month)	Scale: SDSCA Result: + (at 1 month)	None	Scale: DASS-21 and WHO-5 Result: + (DASS-21), – (WHO-5) (at 1 month)	None
Cai and Hu ²⁴ 2016	AIC: + (at 3 months) BMI: + (at 3 months) WC: + (at 3 months) TC, TG, HDL-C and LDL-C: – (at 3 months)	Scale: DMSES Result: + (at 3 months)	Scale: SDSCA Result: + (at 3 months)	Scale: DKQ-24 Result: + (at 3 months)	None	Scale: SF-36 Result: + (at 3 months)
Bicer and Enç ³⁰ 2016	None	Scale: DFCSSES Result: + (at 1, 3, 6 months)	Scale: FSCBC Result: + (at 1, 3, 6 months)	Scale: DFKQ-5 Result: + (at 1, 3, 6 months)	None	None
Wichit et al ²⁰ 2017	AIC: – (at 13 weeks)	Scale: DMSES Result: + (at 5, 13 weeks)	Scale: SDSCA Result: + (at 5, 13 weeks)	Scale: DKQ-24 Result: + (at 5, 13 weeks)	None	Scale: SF-12 Result: – (at 5, 13 weeks)
Sharoni et al ¹³ 2017	None	Scale: FCC and a self-made questionnaire Result: + (at 3 months)	Scale: DFSBS Result: + (at 3 months)	Scale: Self-made questionnaire Result: + (at 3 months)	None	Scale: NFUS-QOL Result: + (at 3 months)
Li et al ²⁹ 2013	FBG: + (at 3, 6 months) 2 h-PG: + (at 3, 6 months)	None	Scale: Subscale of SDSCA Result: + (at 3, 6 months)	None	None	None
Zhang et al ²⁷ 2014	FBG: + (at 3, 6 months)	None	Scale: Subscale of SDSCA Result: + (at 3, 6 months)	None	None	None

(Continued)

Table 2 (Continued)

Study	Metabolic controls	Self-efficacy	Behavior	Knowledge	Other psychological indicators	QOL
Zhao et al ²⁸ 2016	FBG: + (at 3, 6 months) 2 h-PG: + (at 3, 6 months)	None	Scale: SDSCA Result: + (at 3, 6 months)	None	None	None
Mao and Fang ³¹ 2017	None	None	Scale: SDSCA Result: + (at 2 months)	None	Scale: DDS Result: + (at 2 months)	None

Notes: "+", Significant post intervention vs baseline/intervention group vs control group. "-", not significant post intervention vs baseline/intervention group vs control group. None, cannot extract.

Abbreviations: 2 h-PG, 2-hour plasma glucose; BMI, body mass index; CSF-36, 36-item Short-Form health survey; DASS-21, short form version of the Depression Anxiety and Stress Scale; DDS, Diabetes Distress Scale; DFCSES, Diabetic Foot Care Self-Efficacy Scale; DFKQ-5, Diabetes Foot Knowledge Questionnaire-5; DFSBS, Diabetes Foot Self-care Behavior Scale; DKQ-24, Diabetes-related Knowledge Questions-24; DMSES, Diabetes Management Self-Efficacy Scale; ES-D, Center for Epidemiology studies Short Depression scale; FBG, fasting blood glucose; FCC, Foot Care Confidence scale; FSCBC, Foot Self-Care Behavior Scale; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; NEFUS-QOL, Neuropathy and Foot Ulcer Specific Quality of Life; PCS, Perceived Competence Scales; PTES, Perceived Therapeutic Efficacy Scale; RDSA, Revised Diabetes Self-Care Activity; SDSCA, Summary of Diabetes Self-Care Activities; SED, Self-Efficacy Diabetes Scale; SF-12, Health-related quality of life Short Form-12; TC, total cholesterol; TG, triglycerides; WC, weight circumstances; WHO-5, Five WHO Well-Being Index.

of 3–6 months also represented a positive effect (SMD: 1.17, 95% CI: 0.61–1.73, $P < 0.001$) (Figure 3).

Behaviors

The positive self-management behavior improvements in the intervention group vs the control group were published in eleven studies,^{14,17,18,20,24,25,27–31} and one study identified a prominent improvement 3 months post intervention.¹³ Similar to the results of self-efficacy, behavioral outcomes were heterogeneous, most studies employed the scale of Summary of Diabetes Self-Care Activities (SDSCA) to evaluate the self-management behaviors. The Revised Diabetes Self-Care Activity (RDSA), the Foot Self-Care Behavior Scale (FSCBC), and the Diabetes Foot Self-care Behavior Scale (DFSBS) were employed in one study, respectively. In addition, three studies examined the dietary self-management behaviors using the subscale of SDSCA (Table 2). The pooled results (<3 months) of 707 participants showed that self-management behaviors can be improve greatly (SMD: 1.12, 95% CI: 0.41–1.82, $P < 0.001$), and the results of 3–6 months also revealed a positive effect (SMD: 1.38, 95% CI: 0.73–2.03, $P < 0.001$) (Figure 4).

Knowledge and other psychological indicators

The questionnaires employed to assess the outcome of knowledge varied substantially. The RDSA, the Diabetes Foot Knowledge Questionnaire-5 (DFKQ-5), and the Diabetes-related Knowledge Questions-24 (DKQ-24) were used in one, one, and two studies, respectively. While the remaining study employed a self-made questionnaire based on the literatures. Among the included studies, one study indicated the improvement of knowledge post intervention,¹³ and another study assessed the foot care knowledge.³⁰ The other three studies reported changes in knowledge between the two groups (Table 2).^{20,24,26} The pooled results (3–6 months) of diabetes knowledge showed a positive effect (SMD: 2.70, 95% CI: 0.63–4.78, $P = 0.01$) (Figure 5).

For the aspect of other psychological indicators, three studies substantially varied (Table 2). Depression was measured by the Center for Epidemiology studies Short Depression scale (CES-D) in one study, but no remarkable difference between the two groups was found.³² The short form version of the Depression, Anxiety and Stress Scale (DASS-21) was used in one study to evaluate the symptoms of depression, anxiety, and stress. The DASS-21 scores in the intervention group after intervention were much lower than that of the scores in the control group. In addition, the Five

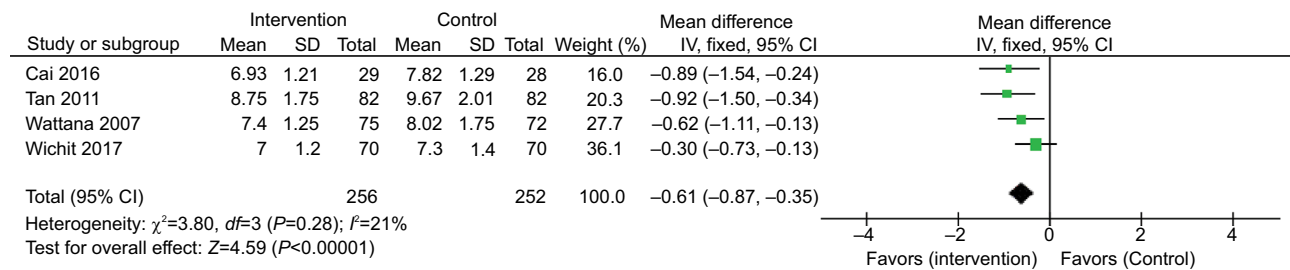


Figure 2 Efficacy of self-efficacy education interventions on AIC.

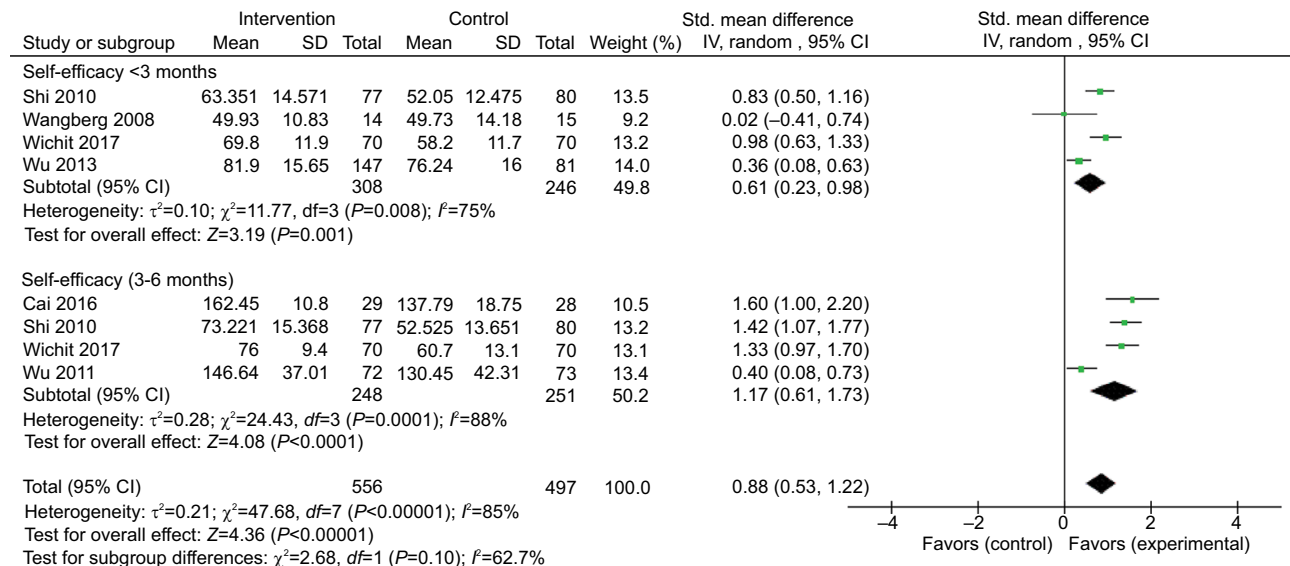


Figure 3 Efficacy of self-efficacy education interventions on self-efficacy.

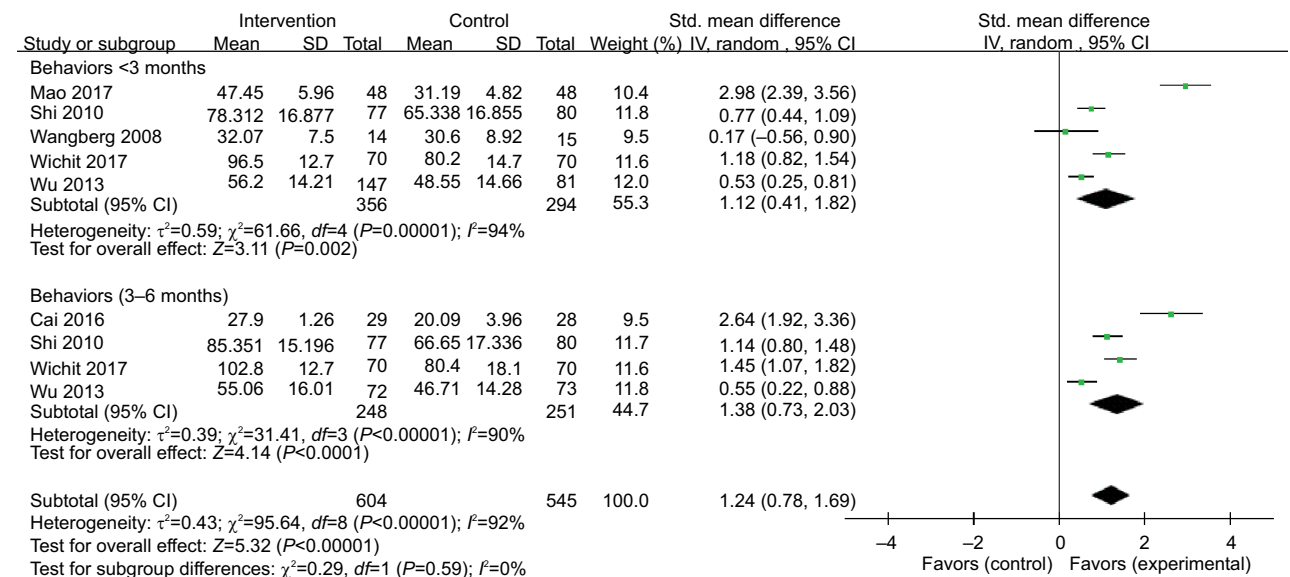


Figure 4 Efficacy of self-efficacy education interventions on self-management behaviors.

WHO Well-Being Index (WHO-5) was applied to inquire about the degree of depression during the past 2 weeks; however, the score of WHO-5 was not significant between the two groups.²⁵ In addition, the diabetes distress was assessed by the Diabetes Distress Scale (DDS) in one study, and the findings indicated that the DDS decreased much more in the intervention group than that in the control group.³¹

QOL

QOL was estimated in five studies using three instruments, including the 36-item Short-Form health survey (SF-36), the Health-related quality of life Short Form-12 (SF-12), and Neuropathy and Foot Ulcer Specific Quality of Life (NFUS-QOL). Among the five studies, one study used the NFUS-QOL to assess the specific QOL of neuropathy and foot ulcer and reported significant improvements in the physical symptoms of the QOL after 3 months.¹³ The others reported the changes in QOL between the two groups (Table 2).^{19,20,24,32} The pooled results (3–6 months) showed a significant improvement in QOL (SMD: 0.29, 95% CI: 0.08–0.50, $P=0.008$) (Figure 6).

Discussion

The present systematic review and meta-analysis were based upon 1,745 and 1,308 cases, respectively, which indicated self-efficacy-focused education was beneficial to the patients with diabetes. The self-efficacy-focused education would probably improve blood sugar level, enhance self-efficacy,

promote self-management behaviors, increase knowledge, and improve the QOL. Learning strategies of self-efficacy theory including goal setting, self-management skills practicing and recording, peer models, demonstration, persuasion by health providers, and positive feedback were frequently applied in the enhancement of self-efficacy.

The effect of self-efficacy-focused education on blood sugar level in patients with diabetes was statistically positive (A1C reduced 0.61%), which approached a clinically significant level (A1C $\geq 0.5\%$ was considered clinically significant).³³ This is superior than the previous meta-analysis of self-management interventions in T2DM patients with suboptimal blood sugar levels conducted by Li et al (A1C reduced 0.49% in 3–6 months),¹⁵ and the other meta-analysis of the self-management education in T2DM patients by Norris et al (A1C decreased nearly 0.26% in 1–3 months and above).³⁴ In addition, the results of A1C by sensitivity analysis were relatively stable. It was mainly because the development and implementation of the interventions were on the basis of self-efficacy theory. Self-efficacy-focused education emphasized on improving self-efficacy of participants with diabetes, and promoting self-management behaviors which were critical for improving blood sugar levels.³⁵ There were predominant promotions of self-efficacy in <3 months and 3–6 months follow-up in the current meta-analysis, and improvements of self-management behaviors were also found. The results were unanimous with the previous reviews of diabetes self-management education^{36,37} and psychological interventions.³⁸

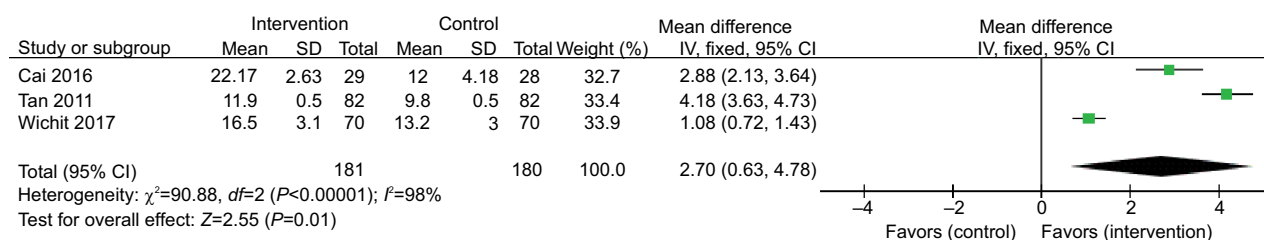


Figure 5 Efficacy of self-efficacy education interventions on knowledge.

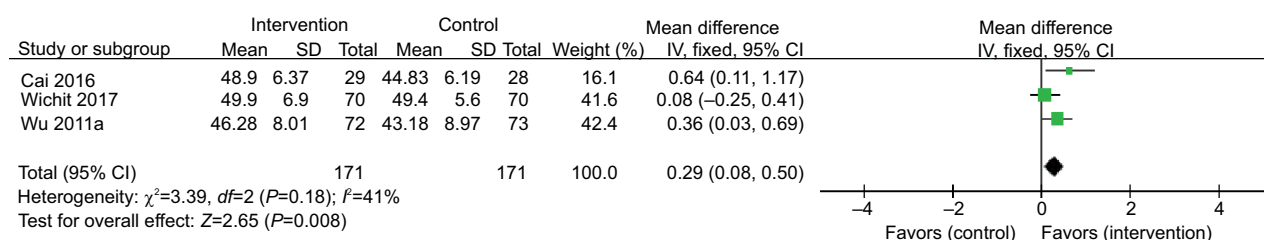


Figure 6 Efficacy of self-efficacy education interventions on quality of life.

However, the follow-up durations of the studies were relatively short and high-quality RCT was insufficient; thus, high-quality RCT design with long-term follow-up period should be taken into consideration for the further study. Although all studies were based on self-efficacy theory, only eight studies evaluated both self-efficacy and behaviors. It would be better to measure both self-efficacy and behavioral outcomes and to assess the linkage between them using causal modeling to help explain that self-efficacy was a crux mechanism in achieving behavioral and metabolic improvements.

Knowledge and QOL improved significantly in the current study. Nevertheless, the generalization of the findings should be careful because of the limited studies included. Knowledge provided by traditional education was necessary; however, other factors, for instance, self-efficacy, may be more effective to promote the establishment and maintenance of self-management behaviors. As a consequence, the interventions based on cognitive reframing techniques, which can preferably motivate patients, would produce better results.^{36,39} QOL was measured by SF-36 and SF-12 which were not specially designed for measuring QOL of persons with diabetes. In general, patients with diabetes often accompanied with other diseases (hypertension, hyperlipidemia, etc); hence, the scores of QOL could be easily affected and disturbed.⁴⁰ Consequently, a QOL instrument that is specific for patients with diabetes were urgently designed to accurately assess the effects of intervention on QOL.

The outcomes of FBG, 2 h-PG, weight, WC, BMI, plasma lipid profile, and other psychological indicators were expected to be well-analyzed by the meta-analysis, but were failed due to the lack of high-quality studies, limited studies, or heterogeneity. A positive change on the secondary outcomes of FBG and 2 h-PG through comparing the two groups was reported in several studies; however, the quality of one study was considered weak and the number of participants was limited. A meta-analysis manifested that group based self-management education can reduce the level of FBG,³⁷ but there was no strong proof supporting the effect of 2 h-PG. For other secondary outcomes, it was difficult to draw a conclusion on weight, WC, BMI, and plasma lipid profile because of the limited evidence. Likewise, it was quite difficult to determine the effects of self-efficacy-focused education on the other psychological indicators for the huge heterogeneity.

All the included studies were based on the self-efficacy theory, and almost all of them employed the performance accomplishments, vicarious experience, and verbal persuasion when developing and implementing diabetes educational interventions. The researchers of most studies were nurses

rather than psychologists, which might be the main reason for the limited usage of physiological/emotion arousal and varied strategies to improve emotion state. Therefore, a multidisciplinary research group that comprised both nursing and psychology disciplines may be much better for developing and delivering the interventions based on self-efficacy theory. Strategies, such as goal setting, directly aroused and affected the motivation of behavior change.¹² Moreover, progressive and realistic goal setting step by step would provide a sense of successful experience for the patients. The self-management skills practicing and recording by patients may directly influence their behaviors and strengthened their experiences. The live peer models with mutual characteristics would promote the learning of patients by observing the success of others enhancing self-efficacy. What's more, peer models may also combine with other media, such as videos and booklets, and it was noted that the experiences and characteristics of the models should be similar to the patients.⁴¹ Self-management skills could be mastered through observing the demonstration from educators or group members. Verbal persuasion provided by health providers, mainly by nurses, might be related to the workforce nature of diabetes education, and a review indicated that diabetes education led by nurses could improve the blood glucose levels of patients.⁴² Positive feedback was the critical means to guide the patients to conduct and persist the self-management behavior.

Limitations

The outcomes may be affected by several limitations. First, most included studies did not employ the RCT designs, which may influence the evidence level of pooled results. Secondly, the sample capacities of most studies were quite limited, and a number of trials had the following biases: blinding, withdrawal, or dropping out. Finally, the duration of the interventions varied greatly, and it was insufficient to determine the long-term effects of the interventions due to short durations of studies.

Conclusion

In this review, relevant data regarding self-efficacy-focused education effects were provided and mutual strategies in the self-efficacy-focused education to enhance self-efficacy, promote behavior change, and achieve optimal blood sugar level were summarized, which facilitated the studies on self-efficacy-focused education for patients with diabetes. In addition, individuals with diabetes mellitus would probably benefit from the self-efficacy-focused education. However, this review indicated that the research designs with high

quality were insufficient and there existed several limitations, including short follow-up periods, deficient physiological/emotion arousal strategies, and incomplete outcome assessments. Future studies should emphasize on self-efficacy and employ the frequently used strategies including goal setting, self-management skills practicing and recording, peer models, demonstration, persuasion by health providers, positive feedback, and so on. It is high time to develop and deliver an educational intervention for patients with DM, as well as assess the outcome indicators with a high-quality study design.

Disclosure

The authors report no conflicts of interest in this work.

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