*Review Article*

# The Effects of Diabetes Self-Management Education and Support Program in Thailand: A Systematic Review and Meta-Analysis

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***Background***: Diabetes is a growing health problem worldwide. Diabetes self-management education and support (DSMES) program is a crucial component in promoting self-care in all people with diabetes. However, the practice in certain countries, including Thailand, is not yet standardized, thus the effectiveness of such program is unknown.

***Objective***: To evaluate the effectiveness of DSMES in Thailand. The outcomes were glycemic control, lipid levels, body mass index (BMI), quality of life (QoL), and diabetes knowledge.

***Materials and Methods***: The authors searched PubMed, Scopus, and ProQuest databases since their inception until March 2019 for randomized controlled trials conducted in Thailand that evaluated outcomes of DSMES programs. Meta-analyses were performed to pool mean differences (MD) of the outcomes.

***Results***: Seven studies, with 1,523 participants, were included. DSMES programs were conducted in different healthcare settings by health professionals from multiple disciplines. The results revealed that participants receiving DSMES had significantly lower hemoglobin A1c, MD –0.66% (95% CI –0.90 to –0.42), and FBG levels, MD –15.88 mg/dL (95% CI –20.95 to –10.79), than those who did not. Lipid levels, BMI, QoL, and diabetes knowledge, however, did not significantly differ.

***Conclusion***: Meta-analysis results showed that DSEMS is effective in improving glycemic control and should be promoted to combat the burden of this important health problem in Thailand.

***Keywords***: Diabetes self-management education and support; DSMES; Glycemic control; Meta-analysis; Thailand

Received 26 October 2020 | Revised 23 March 2021 | Accepted 26 March 2021

**J Med Assoc Thai 2021;104(6):1050-8**

**Website:** http://www.jmatonline.com

Diabetes is a significant global health problem. The International Diabetes Federation predicted that 700 million people worldwide will be affected by diabetes in 2045, a 51% increase from 2019, with disproportionate increases in developing countries, 74% in South-East Asia, 143% in Africa, and 96% in Middle East & North America[1]. Similarly, in Thailand, the prevalence has increased in recent years from 7.7% in a national survey in 2004 to 9.9% in 2014[2]. Diabetes self-care management is an important cornerstone of diabetes care. Diabetes self-management education and support (DSMES) is a program for all people with diabetes to improve knowledge, skills, and ability for diabetes self-care with confidence. Moreover, DSMES has been shown to be effective in diabetes prevention as well as improving health outcomes such as glycemic control and body weight[3,4], quality of life (QoL)[5], and provide cost savings[6,7].

In the United States, National Standards for DSMES have been suggested by the American Diabetes Association (ADA) and the American Association of Diabetes Educators (AADE)[8] addressing key aspects of DSMES such as program

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**How to cite this article:**

Jerawatana R, Siripitayakunkit A, Anothaisintawee T, Pattanaprateep O, Reutrakul S. The Effects of Diabetes Self-Management Education and Support Program in Thailand: A Systematic Review and Meta-Analysis. J Med Assoc Thai 2021;104:1050-8.

doi.org/10.35755/jmedassocthai.2021.06.12169

structures, curriculum, and personnel. However, such standards are not practiced worldwide. In South East Asia, for example, Singapore has a certification program for diabetes educators[9], Thailand has begun this in the recent years[10,11], and Malaysia currently does not have such certification. Because of this, educators, who are mostly nurse, in countries without formal certifications of diabetes educators, simultaneously have carried other workloads[12]. In Thailand, there is no accreditation of the DSMES programs, therefore, curriculums are not standardized and the cost of DSMES delivery is not currently reimbursed. A recent survey of 470 hospitals in Thailand revealed that most educators (67%) either never evaluated the outcomes of their DSMES programs or were uncertain of the outcomes[12]. Therefore, whether DSMES conducted in Thailand are effective remains uncertain.

The purpose of the present study systematic review and meta-analysis was to evaluate the outcomes of DSMES in Thailand, which were conducted under randomized controlled design. The outcomes were glycemic control as evaluated by hemoglobin A1c (HbA1c), fasting blood glucose (FBG), QoL, lipid levels, and body mass index (BMI). Changes in diabetes knowledge of the participants were also collected. The results of the present review could support the efficacy of DSME and potentially inform policy change in promoting and standardizing DSMES process in Thailand.

## Materials and Methods

### Data sources and searches

The authors searched studies published in English and Thai from PubMed, Scopus, and ProQuest since their inception until March 2019. The search terms and search strategy were "diabetes education program or diabetes education or diabetes self-management or diabetes support or DSMES or DSME&S" and "hemoglobin A1c or glucose or blood sugar or cholesterol or satisfaction or cost or BMI or self-management or behavior or quality of life or diabetes knowledge" and "randomized controlled trial or RCT" and "Thailand or Thai".

### Study selection

All studies were eligible if they met the following criteria, 1) the study was a randomized controlled trial comparing patients that participated and did not participate in the DSMES program. 2) participants were Thais with diabetes. 3) outcomes included biochemical measurements such as FBG levels, HbA1c, lipid levels, body weight, or BMI, or QoL or diabetes knowledge. The authors excluded studies that included only prediabetes patients. Additionally, clustered randomized control studies were excluded. Study selection was performed by two independent reviewers (Jerawatana R and Siripitayakunkit A). Disagreements were resolved by a consultation with the senior author (Reutrakul S).

### Data extraction

Data were extracted following a standardized data extraction form. Characteristics of the studies extracted included the age group such as children, adolescents, or adults, type of diabetes such as type 2, type 1, or other types, diabetes duration, studies' setting, DSMES intervention program such as length, frequency, delivery methods such as group, individual, or combination, BMI, HbA1c, FBG, lipid levels, QoL measurements, and diabetes knowledge. The data pooled for analyses included number of participants, mean and standard deviation (SD) for continuous data. Additionally, the authors contacted the authors of selected articles for additional information. Two authors responded to the communication[13,14] and their data were included in the final analyses.

### Quality assessment

Quality assessment and bias were performed using the version 2 of the Cochrane risk-of-bias tool for randomized trials (RoB2)[15] that included six domains of bias as randomization process, deviation from intended interventions, missing outcome data, outcome measurement, result reporting, and other bias. The selected studies were judged to have low, high, or some concern risk of bias for each of these criteria. Two reviewers independently assessed quality and bias and then met to compare results and reached the consensus.

### Data synthesis and analysis

The meta-analyses were performed if there were three or more studies with sufficient data for pooling in each planned analysis. If the number of studies was less than three, they were analyzed and presented qualitatively.

Mean differences (MD) of HbA1c, FBG, lipids, and BMI between patients participating in the DSME program as the intervention group and who did not as the control group were pooled using unstandardized MD. Since QoL scores among included studies were measured using different method, mean QoL of intervention and control groups were standardized

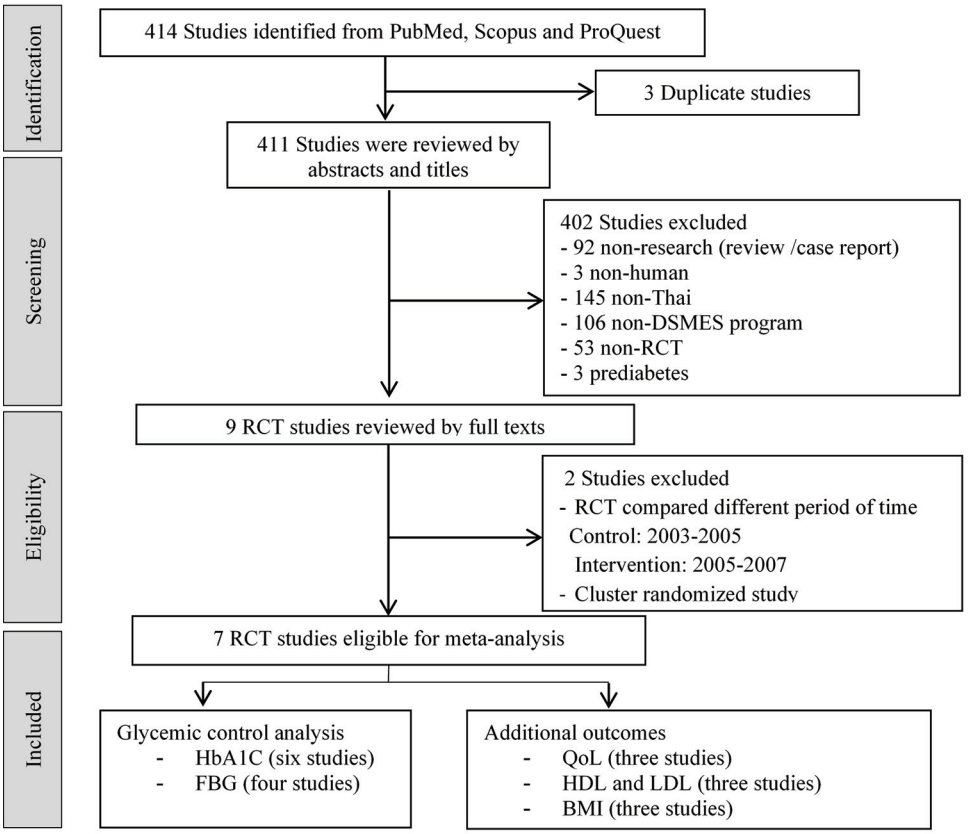


**Figure 1.** Flow chart of study selection.

with standard deviation and standardized MD were pooled by Cohen method.

Heterogeneity was explored using the Q statistic, and a degree of heterogeneity was quantified using the $I^2$ statistic. Heterogeneity was considered to be present if the p-value from the Q statistic was less than 0.1, or the $I^2$ was 25% or more. MD were pooled using random effect model if there was heterogeneity between studies, otherwise fixed effect model was applied. Publication bias was assessed using funnel plots and Egger tests. All analyses were performed using Stata, version 13.1 (StataCorp LP, College Station, TX, USA). A p-value of less than 0.05 was considered as statistically significant.

## Results

### Study selection and data collection

Four hundred fourteen studies were identified from searching PubMed, Scopus, and ProQuest (Figure 1). After removing duplicates, 411 abstracts remained. After reviewing abstracts, nine studies were eligible for full-text review. Ultimately, seven RCT studies involving 1,523 participants were eligible for meta-analysis.

### Characteristics of the included studies

The participants' baseline characteristics, setting, and intervention methods of DSMES programs are listed in Table 1. More than half of the studies setting were studied in central Thailand, the others were in the east[16] and South[17]. Health centers were involved in the studies and included primary[5], secondary[5,13,14,16-18], and tertiary healthcare centers[19]. All studies involved patients with type 2 diabetes with age range of 20 to 80 years, and mean BMI between 24.90 and 27.68 kg/m².

DSMES programs were heterogeneous in regard to the types such as group or individual education, or combination, and length of program. Two study provided group DSMES[5,19], and five combined both individual and group DSMES sessions[13,14,16-18], one of these included family support in DSMES session[17]. Providers of the program consisted of health professionals from multiple disciplines including nurses[13,14,16,18], pharmacist[17,19], dental assistants[14], and other of healthcare staff[5,13]. The

**Table 1.** Characteristics of the studies and their variables included in the meta-analyses

| Study | Setting/hospital level | Intervention; mean (SD) | | | | | Control; mean (SD) | | | | | DSMES program | | Outcomes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | n | Age (year) | BMI (kg/m$^2$) | DM duration (year) | HbA1c (%) | n | Age (year) | BMI (kg/m$^2$) | DM duration (year) | HbA1c (%) | Type of education/ healthcare providers | Length and frequency | |
| Chaveepojnkamjorn et al., 2009[5] | Saraburi Province, Central of Thailand (primary and secondary health centers) | 80 | 48.9 (6.9) | 24.9 (4.2) | | | 84 | 49.1 (7.3) | 25.2 (4.6) | | | Group counseling/ healthcare staff | 16 weeks 5 times (2 hours/time) | - QoL |
| Jaipakdee et al., 2015[13] | Bangkok (secondary health center) | 203 | 61.1 (9.6) | 27.4 (4.8) | Median 7 (4 to 10) | 8.2 (1.5) | 200 | 61.5 (9.7) | 26.7 (4.6) | Median 8 (5 to 13) | 8.5 (1.6) | Combination (group and individual counseling)/ trained nurses and healthcare staff | 24 weeks 6 times (monthly) (3 hours/time) | - HbA1c<br>- FBG<br>- QoL |
| Saengtipbovorn et al., 2015[14] | Bangkok (secondary health center) | 66 | 63.38 (4.51) | 25.30 (3.57) | 6.86 (5.16) | 7.39 (1.18) | 66 | 64.06 (5.53) | 26.63 (4.37) | 8.42 (6.19) | 7.69 (1.47) | Combination (group and individual counseling)/ nurse practitioners and dental assistants | 24 weeks 6 times | - HbA1c<br>- FBG<br>- Lipid<br>- BMI |
| Suppapitiporn et al., 2005[19] | Bangkok (tertiary health center) | 180 | 61.4 (10.6) | | 10 year less than 20 years 41.7% | 8.16 (1.44) | 180 | 59.9 (11.5) | 8.01 (1.51) | 10 year less than 20 years 34.4% | | Group counseling/ pharmacists | 24 weeks 1 time | - HbA1c<br>- FBG |
| Wattana et al., 2007[16] | Eastern of Thailand (secondary health center) | 72 | 58.40 (10.05) | 26.28 (4.31) | 6.52 (4.71) | 8.08 (1.87) | 72 | 55.14 (10.2) | 26.89 (4.45) | 5.82 (5.32) | 8.09 (1.98) | Combination (group and individual counseling)/ trained nurses | 24 weeks 4 times | - HbA1c<br>- FBG<br>- Lipid<br>- BMI<br>- QoL |
| Wichit et al., 2017[18] | Singburi Province, Central of Thailand (secondary health center) | 70 | 61.3 (11.6) | 26.28 (4.31) | 6.52 (4.71) | 7.0 (2.00) | 70 | 55.5 (10.5) | 26.89 (4.45) | 5.82 (5.32) | 6.30 (1.50) | Combination (group and individual counseling)/ trained nurses | 13 weeks 3 times (2 hour/time) | - HbA1c<br>- QoL<br>- Knowledge |
| Withidpanyawonga et al., 2019[17] | South of Thailand (secondary health center) | 88 | 60.53 (10.71) | 27.68 (4.70) | | 9.21 (1.84) | 92 | 58.13 (10.10) | 27.60 (3.87) | | 9.08 (1.47) | Combination (group and individual counseling) and family support/pharmacists | 36 weeks 4 times | - HbA1c<br>- Lipid<br>- BMI<br>- Knowledge |

SD=standard deviation; BMI=body mass index; DM=diabetes mellitus; HbA1c=hemoglobin A1c; DSMES=diabetes self-management education and support; QoL=quality of life; FBG=fasting blood glucose

**Table 2.** Quality assessment: the Cochrane risk-of-bias tool for randomized trials (RoB2)[15]

| Studies | Risk-of-bias judgment domains | | | | | |
|---|---|---|---|---|---|---|
| | Randomization process | Deviation from intended interventions | Missing outcome data | Outcome measurement | Result reporting | Other bias |
| Chaveepojnkamjorn et al., 2009[5] | Low | Low | Low | Low | Low | Low |
| Jaipakdee et al., 2015[13] | Low | Low | Low | Low | Low | Low |
| Saengtipbovorn et al., 2015[14] | Low | Low | Low | Low | Low | Low |
| Suppapitiporn et al., 2005[19] | Some concern | Some concern | Low | Low | Low | Low |
| Wattana et al., 2007[16] | Some concern | Some concern | Low | Low | Low | Low |
| Wichit et al., 2017[18] | Low | Low | Low | Low | Low | Low |
| Withidpanyawonga et al., 2019[17] | Some concern | Some concern | Low | Low | Low | Low |
| Percent of low-risk bias | 57.14% | 57.14% | 100% | 100% | 100% | 100% |

Low=low risk of bias; Some concern=Some concern of bias; High=high risk of bias

length of program varied from 12 to 36 weeks. The frequency of contact were 1 to 12 times, which in four studies, the contract hours were not specified[14,16,17,19]. Every study provided DSMES content based on AADE 7 self-care behaviors including overall diabetes knowledge, healthy eating[5,13,14,18,19], being active and exercise[5,13,14,16], monitoring such as self-monitoring blood glucose[5,16,18], taking medications[13,16,17,19], problem solving such as hypoglycemia management[16,18], reducing risks such as foot care[13,16,18], smoking cessation, and dental care[14], and healthy coping such as stress management[13,16,18]. One study set behavioral goals at the end of the session and provided a follow up[13].

## Quality assessment results

Table 2 shows the results of quality assessment. Four studies[5,13,14,18] had low risk of bias in all domains. The other three studies[16,17,19] had some concern in two domains of the randomization process and deviations from intended interventions because the information was not given in detail.

## Meta-analysis results

***Glycemic control***: Results of the meta-analyses comparing glycemic control in intervention and control participants are shown in Figure 2.

Six studies[13,14,16-19] measured HbA1c as an outcome for the 1,359 participants that were included in the analysis. The result revealed that the intervention group had significantly lower HbA1c levels than the control group, with a pooled MD of –0.66% (95% CI –0.90 to –0.42). There was a moderate heterogeneity among studies ($I^2$=55.5%, p=0.047). For FBG, four studies with 1,039 participants were included[13,14,16,19]. This revealed that participants receiving DSMES had significantly lower FBG levels than the control group, with a pooled MD of –15.88 mg/dL (95% CI –20.95 to –10.79). There was low heterogeneity among studies ($I^2$=0.0% to p=0.667).

***Lipid levels and BMI***: low-density lipoprotein (LDL) and high-density lipoprotein (HDL) levels were measured in three studies[14,16,17] (n=456). For HDL levels, there were no significant differences between DSMES compared to control participants, pooled MD 0.43 mg/dL (95% CI –1.33 to 2.19), with low heterogeneity ($I^2$=0.0%, p=0.700). Similarly, for LDL levels, there were no differences between groups, pooled MD –0.52 mg/dL (95% CI –16.86 to 15.82). Heterogeneity among studies was high ($I^2$=81.4%, p=0.005).

BMI was included in meta-analysis from three studies[14,16,17] (n=456). Meta-analysis revealed non-significant reduction in BMI in the DSMES compared to control participants, pooled MD –0.49 kg/m$^2$ (95% CI –1.26 to 0.28). Heterogeneity was moderate ($I^2$=46.7%, p=0.153).

***Quality of life***: Three studies included in the systematic review (n=711) measured QoL by questionnaires including WHOQoL BREF-THAI[5], Thai version of the Patient Health Questionnaire (PHQ-9)[13], and 12-Item Short-Form survey (SF12)[16]. This revealed no significant differences in QoL scores between the intervention and the control groups, with a standardized MD of 1.03% (95% CI –0.06 to 2.13). There was a high heterogeneity among studies ($I^2$=97.5%, p<0.001).

***Other outcomes***: Additional outcomes were measured in different studies, but the information was inadequate for meta-analysis. Diabetes knowledge was measured in two studies[17,18]. Both studies found

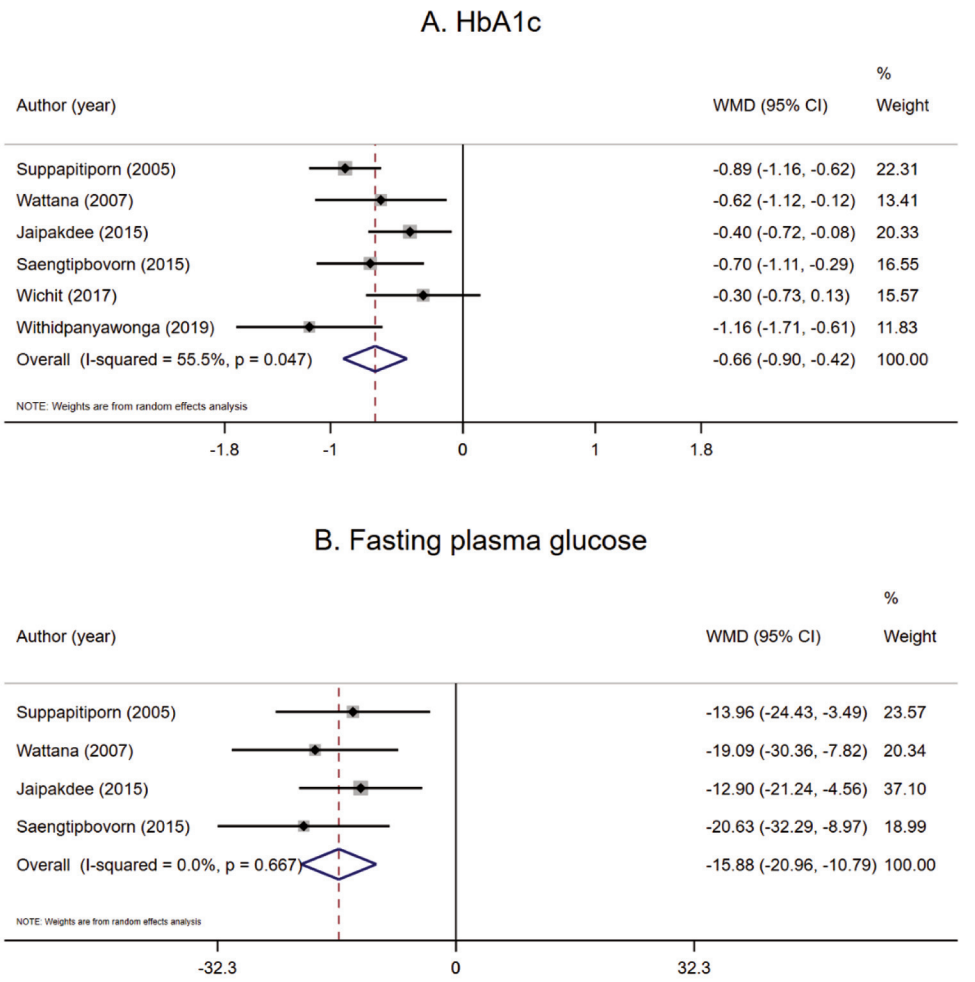


**Figure 2.** Pooled mean differences of A) HbA1c (%), and B) FBG (mg/dL) levels between DSMES and control participants.

that the intervention group had significantly improved diabetes knowledge than the control groups. In addition, one study found improved self-efficacy and self-management skills in the intervention compared to the control group[18]. Health behavior was assessed in one study[13] by using questionnaire that include topics concerning diet, foot care, and general self-care. The result revealed that the intervention group had significantly improved health behavior scores than the control groups.

### Publication bias

Results from Egger's test suggested no publication bias for both HbA1c (coefficient –0.660, p=0.285) and FBG (coefficient 4.856, p=0.608) outcomes. Funnel plots of both HbA1c and FBG were symmetry that indicated no small study effect for both outcomes (Figure 3).

## Discussion

The present meta-analysis was conducted focusing on the effects of DSMES on health outcomes in Thailand. Despite not having a national standard in DSMES program, nor widely available certified diabetes educators, the present study demonstrated the effectiveness of DSMES in significantly improving glycemic control, with a reduction in HbA1c of 0.66% and FBG by 15.8 mg/dl. This was achieved from programs conducted throughout the country in various settings such as primary to tertiary health centers, and by health professionals from multiple disciplines, an confirmation of the generalizability of the DSMES concept. In the present analysis, however, other outcomes including QoL, lipids, and BMI did not differ between the DSMES versus control groups, possibly due to relatively small number of studies included. Overall, the data support the benefits of

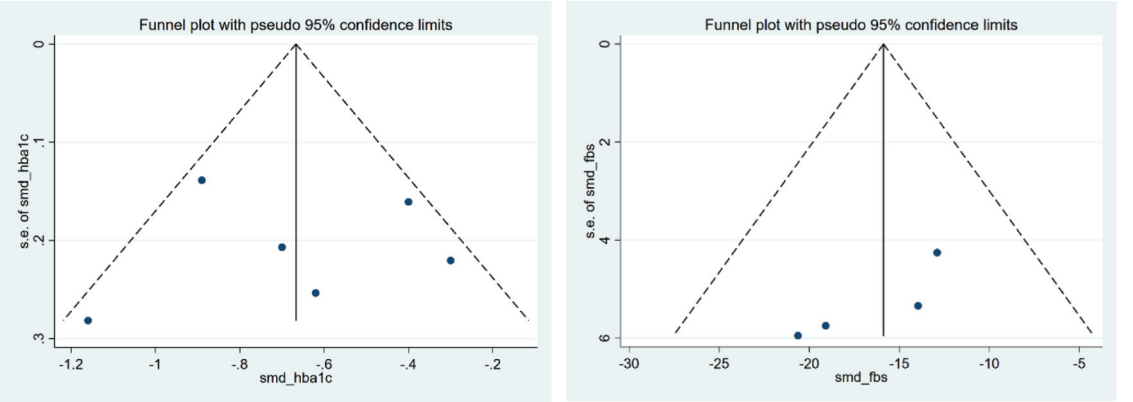


**Figure 3.** Publication bias: the funnel plots of HbA1c and FBG.

DSMES in Thailand.

The magnitude of glycemic improvement in the present analyses is comparable to that achieved worldwide. For examples, five studies[3,4,20-22] presented the effects of DSMES associated with glycemic improvement such as in the previously DSMES meta-analysis and found that HbA1c reduced by 0.44% to 0.76%[4,20], 0.24% in Latinos with T2DM[3], 0.74% in Western people[21], and 0.40% in African-Americans[22]. This finding was similar to the present study. The reduction in HbA1c was significant for all people receiving DSMES. The study by Nicoll et al showed that DSMES improved glycemic control in patients whether they had baseline HbA1c below or above 9%[23]. Further, this HbA1c reduction is approximately equivalent to the potency of one non-insulin antidiabetic medication. This finding is in agreement with the study by Tachanivate et al exploring the effects of DSMES on medication use in a tertiary hospital in Thailand and demonstrated that DSMES was associated with a reduction in medication cost of approximately 90 USD per year[7]. Further, glycemic control is known as a significant predictor of chronic diabetes complications. According to the U.K. Prospective Diabetes Study (UKPDS), 1% of HbA1c reduction is associated a 25% reduction in microvascular complications[24]. Thus, the improvement in HbA1c of 0.66% in the present study is clinically significant. The components of DSMES were likely key factors for this success. All studies had a component of direct contact counseling in individual or group settings, and addressing AADE 7 skills, along with follow up visits in all but one study. Three studies that reported skills and knowledge evaluation after DSMES all found significant improvement in DSMES participants[13,17,18], which likely led to improved glycemic control. These processes are aligned with five steps of the DSMES core concept, which include assessment, behavioral goal setting, planning, implementation, and evaluation or monitoring[25]. The ADA recommends that the time to provide and modify DSMES are the four critical times including at diagnosis, annually or when not meeting treatment target, when complication factors develop, and when transitions in life occur[26]. While a recent nationwide survey of hospitals in Thailand found that 75% of patients with diabetes received education, 70% of the educators were uncertain of the outcomes[12]. This was one of the major weaknesses of the diabetes education process in Thailand. Further, the most perceived obstacle by healthcare professionals in conducting DSMES in this survey was "patient reluctance to change unhealthy behaviors", suggesting that more knowledge regarding educational processes and behavioral changes is needed among educators, as well as education to public at large. Collectively, these data suggest that DSMES is effective in improving glycemia in Thailand in various settings, provided that it is executed from knowledgeable healthcare professionals according to the key concepts of DSMES.

The present study should inform the policy change in Thailand. Currently, DSMES is not a reimbursable service. Further, training for educators has not been standardized and certification process has just begun[10,11]. As a result, current educators listed lack of time due to the need to perform other duties, inadequate number of educators, and lack of skills to assist with behavioral change as leading obstacles in performing DSMES[12]. As the cost of care for patients with diabetic complications was

shown to be significantly higher than those without[27], DSMES should be recognized as one pivotal process in improving glycemia and preventing complications, hence reducing health care cost. This will require a national standardization of education process with objectively measured behavioral, biological, and process outcomes, along with a strong support to increase knowledge and career promotion among diabetes educators.

The current meta-analysis found no significant impact of DSMES on QoL. This is in contrast to a meta-analysis of DSMES in African-Americans[28], which found significantly improved QoL. However, another meta-analysis focusing on group-based DSMES only could not conclude the effects on QoL due to high heterogeneity of the studies[4]. This is similar to the present analysis, which revealed very high heterogeneity among the three studies, therefore, the results should be interpret with caution. Further larger research should explore the effects of DSMES on QoL in Thailand to calculate economic benefits using an incremental cost effectiveness ratio. This will further strengthen the advocate for standardized DSMES programs in Thailand. However, limitations included the small number, the participant of all studies were type 2 diabetes, and the high heterogeneity of studies particularly in the analyses of non-glycemic outcomes.

## Conclusion

DSMES in Thailand is effective in improving glycemic control. Thus, policy advocacy is needed to establish DSMES in Thailand to improve health and reduce disease burden and complications in the country.

## What is already known on this topic?

DSMES program is known to be the standard of care not only to prompt self-management but also to improve glycemic control in people with diabetes that have been recommended by the ADA. However, DSMES in Thailand is not yet standardized and nowadays a meta-analysis study of the effectiveness of DSMES program in Thailand have not been reported.

## What this study adds?

The authors study has strengths of being the first systematic review and meta-analysis of DSMES outcomes in Thailand. The result demonstrated the effectiveness of DSMES in significantly improving glycemic control, with a reduction in HbA1c and FBG. The studies were performed in various settings from regions in Thailand by healthcare professionals in different disciplines, suggesting that the results are generalizable. Overall, the results suggest that DSMES program should be standardized and applied to people with diabetes in Thailand.


## Acknowledgement

The authors would like to thank Dr. Saruta Saengtipbovorn, Dentist, Public Health Center 54, Bangkok, and Chodchoi Wattana PhD (Nursing) for providing additional data for analyses.


## Authors' contributions

Jerawatana R contributed to the study design, researched and interpreted the data, wrote, reviewed, and edited the manuscript. Siripitayakunkit A contributed to the study design, researched and interpreted the data, and reviewed and edited the manuscript. Anothaisintawee T contributed to the study design, analyzed and interpreted the data, and reviewed and edited the manuscript. Pattanaprateep O reviewed and edited the manuscript. Reutrakul S contributed to the study design, researched the data, wrote, reviewed and edited the manuscript.

## Conflicts of interest

Reutrakul S received honoraria from Becton, Dickinson and Company, outside of the submitted work. Other authors declare that they have no conflict of interest.

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