The Diabetes Educator OnlineFirst, published on November 12, 2014 as doi:10.1177/0145721714558305

Type 2 Diabetes Self-management Education Programs in High and Low Mortality Developing Countries

A Systematic Review

Purpose

Although self-management education is a key factor in the care for diabetes patients, its implementation in developing countries is not well documented. This systematic review considers the published literature on diabetes self-management education in high and low mortality developing countries. The aim is to provide a state of the art of current practices and assess program outcomes, cultural sensitivity, and accessibility to low literate patients.

Methods

The Cochrane Library, PubMed, MEDLINE, PsycInfo, and PsycArticles databases were searched for peer-reviewed articles on type 2 diabetes published in English between 2009 and 2013. The World Bank and WHO burden of disease criteria were applied to distinguish between developing countries with high and low mortality. Information was extracted using a validated checklist.

Results

Three reviews and 23 primary studies were identified, 18 of which were from low mortality developing countries. Studies from high mortality countries were mostly quasi-experimental, those from low mortality countries experimental. Interventions were generally effective on

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Acknowledgments: The authors would like to thank members of the Diabetes Literacy Consortium for a critical review of this paper.

Conflict of interest: None declared.

Funding: Miss Dube was supported by the 2012-2013 doctoral fellowships for development cooperation of the Université catholique de Louvain. The contents of this article are solely the responsibility of the authors and do not necessarily present the official views of the funding organization.

DOI: 10.1177/0145721714558305

behavior change and patients' glycemic control in the short term (≤9 months). While 57% of the studies mentioned cultural tailoring of interventions, only 17% reported on training of providers, and 39% were designed to be accessible for people with low literacy.

Conclusions

The limited studies available suggest that diabetes self-management education programs in developing countries are effective in the short term but must be tailored to conform to the cultural aspects of the target population.

Introduction

Diabetes mellitus (DM) is one of the most common chronic diseases worldwide.[1,2] While until recently it was considered a disease of the affluent, it is increasingly becoming a burden for developing countries. Approximately 80% of people with diabetes live in low- and middle-income countries,[3] and their number is estimated to increase by 170% between 2000 and 2025.[4] This makes the anticipated impact of the condition greater and more damaging in these countries than in more affluent parts of the world.[5]

Developing countries face a significant rise in health care expenditure due to the increasing prevalence of diabetes. In many countries, diabetes consumes 5% to 20% of the health care budget, and more than 50% of that cost is due to complications.[6] Together with pharmacological treatment, lifestyle changes such as increased levels of physical activity, a healthier diet, and smoking cessation have proven useful in altering the course of type 2 diabetes (T2DM) and delaying the development of complications.[7] Consequently, the education of diabetes patients to manage their illness and adopt lifestyle practices to prevent complications is widely recommended, particularly in populations where economic resources are limited.[8-10] As such, diabetes self-management education (DSME) can be considered as a crucial way to address the diabetes problem in developing countries.

Despite the growing body of literature demonstrating positive effects of DSME,[11-15] its implementation in developing countries is a challenging task. Developing countries are often faced with low levels of education in the adult population, resource-poor environments, and a health system designed to address infectious diseases, being less well prepared to tackle chronic conditions like diabetes.[4] As the bulk of the literature documenting the effectiveness of DSME concerns programs that were developed, implemented, and evaluated in developed countries,[11,14,16] their direct importance to developing countries with different sociocultural and economic conditions is uncertain.

Cultural Sensitivity of DSME

The challenge of addressing the diabetes epidemic in developing countries could be partially resolved by using culturally appropriate and context-relevant interventions to delay diabetes and prevent its complications.[4] Culture refers to the behavior patterns, beliefs, arts, and all other products of human work and thought as expressed in a particular community.[17] For diabetes education to be effective in multicultural societies, both the educators and the content of programs should be *culturally sensitive*.[18] This can be achieved through *cultural tailoring*, which is defined as "the process of creating culturally sensitive interventions, often involving the adaptation of existing materials and programs for racial/ethnic groups."[19]

There are 2 levels of cultural sensitivity: (1) *Surface structure* involves matching the intervention materials and messages to observable "superficial" (although important) characteristics of a target population, such as familiar people, places, language, music, food, and locations; (2) *deep structure* requires an understanding of the cultural, social, historical, and psychological forces that influence the target population. Whereas surface culture only increases the acceptance of programs, deep cultural factors have more influence on the effectiveness of programs.[19]

Literacy Sensitivity of DSME

Literacy is defined by the United Nations Educational, Scientific and Cultural Organization (UNESCO) as the ability to identify, understand, interpret, create, communicate, and compute using printed and written materials associated with varying contexts.[20] A challenge to DSME in developing countries is that many patients with diabetes have low levels of literacy.[21-23] Health literacy that is linked to literacy entails people's knowledge, motivation, and competences to access, understand, appraise, and apply health information in order to make decisions in everyday life concerning health care, disease prevention, and health promotion to maintain or improve quality of life during the life course.[24] People with low literacy understand little (50%) of what is told to them during

medical consultations and they may be embarrassed by their situation and hide their low level of literacy from people who could possibly help (health care providers, family members, and friends).[21,23] As a result, they have difficulties in managing their medication and lifestyle. Screening for low literacy and tailoring DSME programs to the level of the patients through working with communities to develop more accessible educational materials and interventions can address this problem and enhance program effectiveness.

DSME in Developing Countries

In light of the aforementioned, it appears that addressing the burden of diabetes in developing countries requires DSME programs that are culturally and literacy sensitive.[25] To document the extent to which existing DSME programs in developing countries meet these demands, this systematic review considers the published literature on DSME in developing countries, looking at cultural sensitivity and adaptation for low literacy as potential determinants of effectiveness.

To our knowledge, this is the first systematic literature review of DSME programs in developing countries with a focus on these sociocultural and literacy aspects. A recent paper by Rawal et al[7] reviewed the evidence for the effectiveness of DSME in developing countries but did not consider cultural sensitivity and low literacy. Moreover, the review only included studies that considered blood glucose or glycated hemoglobin A1C (A1C) as a primary outcome, thus limiting the review to 7 studies from 4 countries, all of which are classified as low mortality countries. However, as the primary goal of DSME is to enable patients to integrate self-management into their daily lives and adopt a healthier lifestyle, the core outcomes of DSME are essentially behavioral. Hence, it makes sense to also include studies in the review that evaluate DSME program effectiveness in terms of behavioral outcomes and not only in terms of A1C level changes. In addition, it is possible that DSME programs are implemented differently in countries with a high mortality, where the health system is often less well equipped to address chronic conditions.

Therefore, this systematic review aimed to answer the following review questions: (1) What is the current status of DSME for T2DM in developing countries? and (2) To what extent are cultural specificity, low literacy, and low health literacy addressed in DSME programs in developing countries?

Methods

The process of conducting and reporting this review was underpinned by the PRISMA Statement for Systematic Reviews and Meta-Analyses.[26]

Information Sources and Search Terms

To find existing systematic reviews on DSME programs in developing countries, the Cochrane Library was first consulted, but no reviews were found focusing specifically on developing countries. Consequently, PubMed, MEDLINE, PsycInfo, PsycArticles, and Google Scholar were searched using combinations of the following search terms: *review, diabetes, self-management education, patient education, programmes/programs, developing countries, Africa, Latin America*, and "by country" (only in PubMed). Reference lists from the identified articles were hand searched for additional relevant articles.

Eligibility Criteria

The search was restricted to peer-reviewed articles published in English and with full text available. The initial search was from 1980 but because of time and resource constraints it was limited to the period 2009 until 2013 (November 13). To define developing country status, the World Bank list for developing countries was used. The WHO burden of disease criteria was applied to distinguish between high and low mortality countries.[27,28] Studies with a full description of the DSME intervention, from a developing country, and focusing on T2DM or prediabetes were considered for inclusion. Studies on T1DM, mixed T1DM and T2DM, without a clear indication of the type of DM, gestational DM, and whose subjects were not diabetes patients were excluded. As no primary studies on prediabetes were found during the search, this review focuses on T2DM only. All the articles were selected for inclusion by the first author (LD), and a subsample of the studies was analyzed for inclusion and exclusion by a second assessor (MH). Assessor agreement was 100%.

Study Selection

Using the aforementioned procedure, 2289 articles were identified (2171 from electronic databases and 118 from hand search). After applying the inclusion and

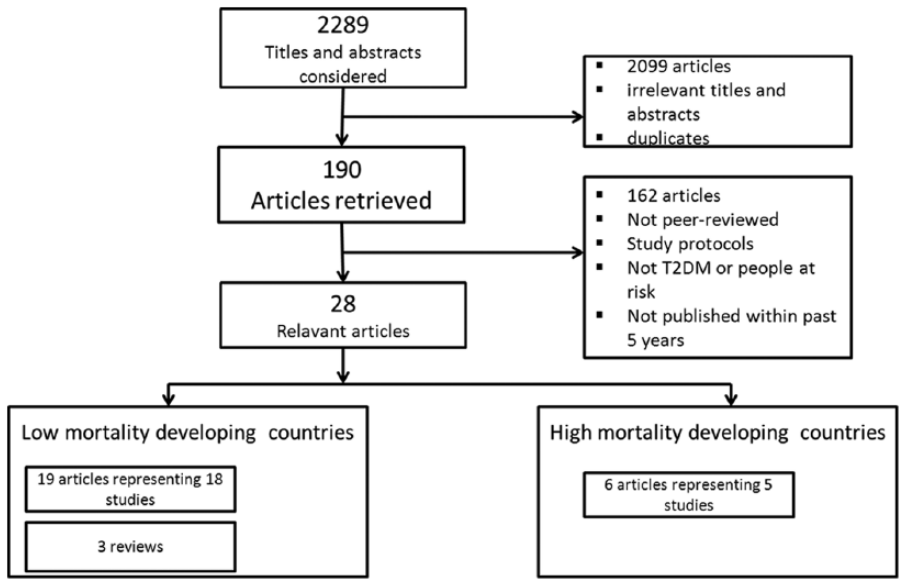

Figure 1. Flowchart of the selection process.

exclusion criteria, 28 publications remained, 25 of which were primary articles (representing 23 studies) and 3 were reviews (Figure 1).

Study Quality

Using a validated checklist for measuring study quality[29] (question 1-10), 22 articles were rated as having good quality, 1 article as fair quality, and no articles as poor quality. Good quality was said to have a score of 8 and above. All articles gave sufficient information about: study aims, outcomes measures, patient selection, description of intervention, results, and statistical details. The main limitations observed in study quality were lack of reporting of adverse events and no report on characteristics of patients lost to follow-up.

Data Extraction

An analysis of the existing reviews was performed separately. For the analysis of the DSME programs presented in the primary articles, the authors used a description tool developed and validated by an international consortium.[30] This tool was developed via a multiple Delphi process for the Global Diabetes Survey (GDS), which is a global initiative to collect data on diabetes care quality on a yearly basis.[31] It consists of an online wiki-like survey with questions describing existing educational programs for diabetes and prediabetes prevention. The items used for the purpose of this review include program content, intervention, strategy, duration, program providers, training of the providers, and accessibility of the program to patients with low literacy. Although the primary interest for this systematic review was on health literacy, the primary studies found do not give information on health literacy but literacy levels. Due to the fact that there was only 1 paper on health literacy, the overall literacy levels of the patients will be discussed in this paper. In addition, program effectiveness on outcomes and tailoring of the program to the culture (surface and deep cultural aspects) were assessed. An intervention was said to be culturally sensitive (surface structure) if it was delivered in the local language; if local foods, symbols, objects were used; and if local guidelines or country guidelines were incorporated in the design of the intervention. Deep structure was assessed as needs assessment; an understanding of cultural history, values, and norms; and incorporating this knowledge in the design of the program.[19] Data were summarized in tables and missing data according to the description tool were reported as "not reported" (NR).

Data extraction from the selected articles was done by the first author. A subsample of the articles was also evaluated by a second assessor, yielding an assessor agreement of 95%. The assessors then discussed the differences and consensus was reached (100%).

Results

Existing Reviews

Three reviews evaluated the published literature on DSME programs in low mortality developing countries. The first review included 7 articles on DSME programs from 4 countries. Of these 7 studies, 4 were concerned with prevention of complications in T2DM, and 3 were focused on prevention of the development of T2DM. While considering lifestyle and other nonpharmacological interventions to prevent T2DM and its complications, this review only included studies with blood glucose measure or A1C as a primary outcome.[7] The main conclusion was that the reasonably consistent and positive results are significantly limited by the small number of studies. The second was a systematic review of 18 reports on DSME in Iran, published between 2002 and 2008.[32] Of these 18 studies, 11 were studies on T2DM, 4 were T1DM, 1 was mixed T1DM and T2DM, and in 2 studies, the type of DM was not mentioned. Whereas the interventions seemed to have a positive effect on knowledge, self-monitoring of blood glucose, and glycemic control, the review concluded that the findings were insufficient and too conflicting to draw firm conclusions. The third review gave a summary of the literature on DSME in mainland China, involving 34 studies published between 1989 and 2008.[33] Of these 34 studies, 18 were on T2DM, 6 were on mixed T1DM and T2DM, 1 was on gestational DM, and in 9 studies, the type of diabetes was not mentioned. Only interventions with a duration of at least 3 months and involving A1C and/or behavior change as outcome measures were included. This led to the conclusion that DSME programs in China have positive effects on the patient's knowledge and glycemic control but that the effects on behavior change and on cardiovascular risks were variable. Long-term effects of the programs on quality of life and on medical complications were not assessed.

Study Characteristics of Identified Studies

Of the 23 original studies that were identified in the 25 publications, 18 (78%) were from low mortality developing countries (Iran,[23,34-41] Argentina,[42,43] Turkey,[44,45] South Korea,[46] China,[47,48] Malaysia,[49] and a combination of 27 selected developing countries[50,51]); 5 were from 2 high mortality developing countries (South Africa[52-54] and India[55-57]) (Tables 1 and 2). Most studies from low mortality developing countries were experimental, and except for 1, those from high mortality developing countries were quasi experimental (Tables 1 and 2). A third of the studies (35%), only 1 being from high mortality developing countries, referred to theories of behavior change as a theoretical basis for the interventions. Sample sizes ranged from 62 to 11 384 participants.

The professional background of the educators who provided the interventions varied across studies (reported in only 18 studies) with nurses in 8 of 18 as the most common providers, followed by physicians/doctors 7 of 18, dietitians/nutritionists 5 of 18, and community support workers or health promoters 2 of 18. Only 4 of 18 studies reported using trained diabetes educators. The content of the educational interventions was comprehensive in most interventions, covering almost all the topics of diabetes education including basic knowledge of diabetes, diet, exercise, self-monitoring blood glucose, medication taking, reducing risks, problem solving, and living with diabetes.

Intervention Characteristics

In low mortality developing countries, the reported interventions were mostly delivered in groups (12 of 18 studies). Three studies used a telephone follow-up. Four interventions used face-to-face individual sessions, and 1 of these included a telephone follow-up while 2 interventions used both group and individual delivery strategy (Table 3). Sixteen of the studies in low mortality countries were 12 months or less in duration, and only 2 studies had a duration of 42 months and 6 years (Table 1). Eight studies provided written literature to the intervention group to supplement the educational sessions. Forms of teaching differed across the interventions and included lectures, group discussions, and question and answer sessions. A few interventions used film demonstrations, illustrative materials, and role plays.

In high mortality developing countries, 2 interventions were delivered in groups, 2 individually, and 1 using a combination of group and individual sessions. Education formats included discussions, individual counseling, and providing written literature to supplement the sessions. Only 2 studies had a duration of more than 1 year (Tables 2 and 4).

Table 1

Study Characteristics for T2DM in Low Mortality Developing Countries (n = 18)

Reference	Country	Study Objective	Design	Inclusion Criteria	Sample	Duration
Negarandeh et al[23]	Iran	Explore the impact of pictorial image and teach back educational strategies on knowledge, adherence to medication and diet among patients with T2DM and low health literacy	RCT	• >6 months duration of diabetes • Low health literacy (59 or lower on TOFHLA) • 18 years or older • Absence of mental, visual, or learning abilities • No former participation in diabetes education research projects	135	9 weeks
Aliha et al[34]	Iran	Evaluate the effects of diabetes self-care group education and nurse-telephone follow-up on glycemic control and compliance with treatment orders in patients with T2DM attending to diabetes clinic	RCT	• Informed consent, access to telephone • Lack of difficulty in speech, hearing, and vision • Absence of disease associated with physical and mental illness, excluded if admitted during study, changing treatment protocol, or developing complications	62	3 months
Samadi et al[39]	Iran	Determine the effect of quality of life education on self-concept of patients with T2DM	RCT	• >30 years old • Cognitive ability to answer questions and consent given • Excluded if with prior DSME within 1 year or having complications	123	3 months
Bayat et al[35]	Iran	Assess the effectiveness of educational intervention based on extended health belief model on T2DM patients	RCT	• Being able to read and write • T2DM diagnosis by specialist	120	6 months
Farsaei et al[36]	Iran	Evaluate the effect of a clinical pharmacist-led patient education program for T2DM patients	RCT	• With uncontrolled T2DM A1C >7% • Able to read and write • Were in suitable therapeutic condition • Excluded if confused, unable to communicate verbally, or reached A1C <7% during first month	172	3 months
Sharifirad et al[40]	Iran	Determine the effectiveness of the HBM on nutrition education in T2DM patients	Semi-experimental study	• 30-60 years, not to be illiterate • At least 1 year attendance in Iranian Diabetes Association seminars, regular follow-ups • No severe and chronic complication of diabetes	88	NR (only 1 month follow-up)

(continued)

Table 1 (continued)

Reference	Country	Study Objective	Design	Inclusion Criteria	Sample	Duration
Hazavehei et al[37]	Iran	Determine the effects of educational program based on the Belief, Attitude, Subjective Norm, and Enabling Factors (BASNEF) Model on eye care among patients with insulin independent diabetes mellitus	Experimental study	• 40-60 years, 5 year duration of diabetes • Exposed to danger of ocular complications • Excluded if diagnosed with ocular or cardiac complications	100	4 months
Kashfi et al[38]	Iran	Evaluate the effect of educational program and jogging based on HBM on sugar control in type 2 patients	Prospective quasi-experimental interventional study	• Without diabetes foot and cardiovascular side effects	100	3 months
Vatankhah et al[41]	Iran	Evaluate the impact of a simple educational program on the knowledge and practice of people with T2DM in relation to the foot at risk	NR	• Excluded if unable to answer questionnaire due to dementia, psychosis, or profound deafness	148	9 months (6 months follow-up)
Gagliardino et al[42]	Argentina	Implement an educational program in 10 Latin American countries and evaluate its effect on the clinical, biochemical, and therapeutic aspects as well as the economic cost of diabetes	Randomized 2 × 2 design	• At least 2 years duration of diabetes, between 25 and75 years old, excluded if T1DM, with severe complications, alcohol or drug addiction, or inability to self-care	468	42 months
Perman et al[43]	Argentina	Compare the all-cause mortality rate in elderly T2DM patients who attended self-management educational workshops with those who did not	Retrospective cohort study	• Diagnosis of T2DM before Dec 31, 2003 • ≥65 at Jan 1 2001 • Remain an affiliate of the health plan at least for 1 year after recruitment	1730	6 years
Atak et al[44]	Turkey	Evaluate the effect of patient education on knowledge, self-management behaviors, and self-efficacy in patients with T2DM	RCT	• Had attended at least 1 follow-up visit • Able to give informed consent	80	1 month
Karakurt et al[45]	Turkey	Determine the effect of education given to patients with T2DM mellitus on self-care	Pre/posttest experimental design	• At least 6 months of DM duration, being literate, no serious complications • No psychiatric history, volunteer to participate	100	9 months
Song et al[46]	South Korea	Investigate the effects of a diabetes outpatient intensive management program (DOIMP) on A1C levels and adherence to control recommendations	Randomized 2 group pre/posttest experimental design	• Able to perform SMBG • Take oral hypoglycaemic agents (OHAs) • Understand the study goals • Excluded if with complications	59	3 months

(continued)

Table 1 (continued)

Reference	Country	Study Objective	Design	Inclusion Criteria	Sample	Duration
Shi et al[48]	China	Examine the effect of a hospital-based clinic intervention on glycemic control self-efficacy and glycemic control behavior of Chinese patients with T2DM	RCT	• At least 1 year diagnosis • Able to communicate, verbally, read, and write in Mandarin • Willing to participate • No previous DSME • Excluded if <30, with type 1 or gestational diabetes or with complications	157	5 months
Liu et al[47]	China	Develop a Chinese diabetes group visit program and examine its effectiveness on self-management behavior, self-efficacy, and health status for patients with T2DM	RCT	• Aged 35-80 years • Excluded if outside the age range or with complications or physical disability	208	12 months
Al-haddad et al[49]	Malaysia	Measure the effectiveness of 2 different diabetes educational programs (less structured vs structured)	Prospective observational study	• T2DM patients • Able to communicate in Malaysian national language	74	8 months
Gagliardino et al[50,51]	27 developing countries	Evaluate the impact of diabetes education provided to patients with T2DM in noncontrolled studies (real-world conditions) on quality of care, resource consumption, and conditions of employment	Cross-sectional and longitudinal survey	• Excluded if with active participation in a clinical study or recent short-term insulin treatment	11 384	9 months

Abbreviations: T2DM, type 2 diabetes mellitus; RCT, randomized controlled trial; TOFHLA. Test of Functional Health Literacy in Adults; DSME, diabetes self-management education; T1DM, type 1 diabetes mellitus; DM, diabetes mellitus; SMBG, self-monitoring blood glucose; HBM, Health Belief Model; NR, not reported.

Table 2

Study Characteristics for T2DM in High Mortality Developing Countries (n = 5)

Reference	Country	Study Objective	Design	Inclusion Criteria	Sample	Duration
van der Does et al[54]	South Africa	Evaluate the Take Five School (TFS) group education program for patients with T2DM in South Africa	Mixed methods pre/posttest	NR	84	1 month
Price et al[52,53]	South Africa	Determine the long-term (4 years) glycemic outcome of a structured nurse-led intervention program for T2DM patients in rural Africa	Cohort study	NR	320	4 years
Mahant[56]	India	Evaluate the impact of a model program of diabetes on diabetes control	Prospective study	• All included without bias for gender, age, duration of disease, severity, or educational status	1050	3 years
Mahajan et al[55]	India	Improve the health and blood sugar control in T2DM by giving health education, dietary advice, and encouraging them for regular blood sugar monitoring and physical exercise	Cross-sectional	• >40 years old	300	12 months
Malathy et al[57]	India	Assess the baseline levels of knowledge, attitude, and practices of diabetes patients visiting 2 multispecialty hospitals and 1 private diabetes clinic regarding disease management	RCT	• >30 years old • Excluded pediatric and pregnant patients	207	9 months

Abbreviations: T2DM, type 2 diabetes mellitus; NR, not reported; RCT, randomized controlled trial.

Table 3

DSME Intervention/Programs Characteristics for T2DM in Low Mortality Developing Countries

Reference	Intervention for T2DM	Provider	Provider Training	Theoretical Model	Measures	Main Outcomes	Comments
Negarandeh et al[23]	Two interventions and 1 control Group 1: 3 weekly individual teach back sessions each lasting 20miutes Group 2: 3 weekly individual pictorial image sessions each lasting 20minutes Control group: received usual care—presentation of an educational brochure on diabetes control	Community health nurse	NR	NR	• Level of health functional literacy • Diabetes knowledge • Adherence to medication and diet	Statistically significant differences ($P < .05$) between intervention and control	The intervention was effective, all measures were significant in both intervention groups than control.
Aliha et al[34]	2 group educational sessions for 60 minutes on 2 consecutive days using face-to-face lectures and film demonstration and 16 follow-up telephone calls by nurse (first month 2 calls per week and second and third months 1 call per week) + booklet Control group: conventional care and usual education for diabetes patients	Diabetes nurse	Yes	NR	• FBS • A1C • Blood glucose 2 hours after meals blood sugar (2 hppBS) • Adherence to treatment	FBS, 2hppBS, A1C were statistically significant. Adherence increased from 6.5% to 90.3% in intervention group while in control it decreased from 12.5% to 0%.	The intervention was effective, in all measures there was a significant difference in intervention than control group.
Samadi et al[39]	8 weekly face-to-face group quality of life educational sessions for 90 minutes + handout and 1 month telephone follow-up Control group: received handout + education after follow-up	Nurse, physiotherapist, nutritionist, orthopedist, psychologist	NR	NR	• Self-concept • Self-esteem • Body image • BMI	BMI was statistically significant, $P = .004$. Increased self-esteem and self-concept.	Intervention was effective, significant differences in all outcomes were observed in the case than control group after intervention.
Bayat et al[35]	Two 30-to 40-minute individual face-to face-lectures via pamphlets and question and answer method + telephone follow-up Follow-up at 3 and 6 months	NR	NR	HBM	• HBM constructs • Self-efficacy • At 3 and 6 months follow-up	Significant impact $P <$ .0001on extended HBM constructs	The intervention showed a positive and significant impact on extended health model belief constructs. However, perceived susceptibility and self-efficacy remained constant at 6 months.
Farsaei et al[36]	2 group pharmacist-led educational sessions and weekly telephone follow-up and appointments for 3 months Control group: general education by nursing staff	Pharmacist	NR	NR	• A1C • FBS	A1C decreased significantly in intervention than control ($P < .001$).	Intervention was effective. Glycemic control was significantly decreased in intervention than control groups.

(continued)

Table 3 (continued)

Reference	Intervention for T2DM	Provider	Provider Training	Theoretical Model	Measures	Main Outcomes	Comments
Sharifirad et al[40]	4 group sessions each lasting 40 minutes + 1-month follow-up	NR	NR	HBM	• Nutritional knowledge • HBM constructs • Nutritional practice • Weight, BMI, FBS	Statistically significant results ($P < .001$) in intervention compared to control group in knowledge and perceived susceptibility. Behavior increased significantly ($P < .001$) in intervention than in control.	Intervention significantly improved knowledge scores and FBS compared to the control group, but perceived severity, threat, and benefits remained the same.
Hazavehei et al[37]	6 group educational sessions using lectures, question and answer, and group discussions, each session lasting 55 to 60 minutes over 1 month + 3-month follow-up	NR	NR	BASNEF model	• BASNEF model components • A1C • FBS • Eye care practice	A1C decreased significantly ($P < .001$).	The BASNEF model components, knowledge, and all other outcomes were significantly improved in the intervention group compared to the control group after follow-up.
Kashfi, et al[38]	3 sessions (each 60 minutes) of training on jogging and control of sugar + 3 months follow-up.	NR	NR	HBM	• HBM constructs • Practices • A1C • FBS	A1C decreased significantly ($P < .001$).	Intervention was effective; all outcomes were significant in case than in control group after intervention.
Vatankhah et al[41]	Single 20-minute individual face-to-face foot education session + booklet and follow-up after 6 months	NR	NR	NR	• Knowledge • Foot care practice	Improved knowledge and practice about diabetes foot care ($P < .0001$ and $P = .011$)	Intervention effective in increasing knowledge and practice scores significantly.
Gagliardino et al[42]	Group structured educational courses: Group 1: control Group 2: physician education only Group 3: patient education only Group 4: patient and physician education 4 weekly 90- to 120-minute teaching sessions using illustrative materials + program book and a reinforcement session at 6 months	Trained educators	Yes	NR	• A1C • Lipid profile and BP • Psychological state	A1C decreased significantly ($P < .05$) at 42 months. Largest decrease in groups where patients and physicians were educated.	All outcomes measures were significant in case groups being largest in combined programs after intervention, but psychological state was significant in both groups.
Perman et al[43]	4 group education workshops for 2 hours per year and individual counseling on nonpharmacological treatment by physician assistants and follow-up through mails and delivery of educational material Other "informal" education also available	Diabetes educators (family physicians/ endocrinologists)	Yes	Patient Empower-ment Model	• All-cause mortality	Crude hazard ratio after adjustment was decreased from 33% to 18% (HR, 0.82; 95% CI, 0.61-1.08).	Workshop attendants had 33% lower all-cause mortality rate at 6 years of follow-up, but impact of intervention not clear.
Atak et al[44]	2 weekly group question-based patient-centered sessions each lasting 45 minutes	Researcher	NR	NR	• Knowledge • Self-reported self-management	Significant differences in self-reported self-management between case and control groups, P values <.05.	Limited effect on knowledge and behavior but significant on self-efficacy

(continued)

Table 3 (continued)

Reference	Intervention for T2DM	Provider	Provider Training	Theoretical Model	Measures	Main Outcomes	Comments
Karakurt et al[45]	Individual narrative, question and answer educational sessions, each lasting 45 to 60 minutes Education repeated twice every other month + booklet	Researcher	NR	NR	• Self-care activities • Metabolic control • A1C • Lipid profile	A1C decreased significantly ($P < .001$) from pretest to posttest. Triglycerides were statistically significant ($P < .05$) after intervention.	Only high density lipoproteins, BMI, and waist circumference were not statistically significant after intervention.
Song et al[46]	2-day group and individual educational sessions + weekly telephone counseling Patients free to call nurse at any time	Endocrinologist, nurse, physician, rehabilitation therapist, dietitian, dermatologist, psychologist, pharmacist, ophthalmologist, physiotherapist	NR	NR	• A1C • Adherence to diet	A1C significantly decreased ($P < .05$) in intervention group after the intervention. Significant difference in adherence ($P = .0001$) was also observed in intervention after intervention.	Significant differences were observed overtime in A1C and adherence to diet in intervention than control.
Shi et al[48]	Group education, with 4 weekly sessions, 1-2 hours per session for a month using discussions, videos, demonstrations, role plays, and written literature Telephone follow-up, 2 calls each week, each 5-15 minutes for 4 months	Researcher	NR	Health educational strategies and self-efficacy theory	• Glycemic control self-efficacy • Glycemic control behavior	Statistically significant improvements in glycemic control self-efficacy and glycemic control behavior ($P < .05$) in experimental group compared to control group.	Intervention showed statistically significant improvement in glycemic control self-efficacy and glycemic control behavior immediately and 4 months after the intervention.
Liu et al[47]	12 monthly interactive group sessions lasting 90 minutes + 1 hour for individual consultation	General practitioner Nurse Preventive doctor	Yes	The Cooperative Health Care Clinic Model	• Behaviors • Self-efficacy • Health status	Significant differences in behavior change ($P < .05$) in case compared to control group	Significant increase in self-efficacy and measures of illness. On average intervention group increased their exercise duration.
Al-haddad, et al[49]	Group based monthly less structured versus structured teaching sessions each lasting 90 to 120 minutes for 4 months Patient could call the researcher at any time	Pharmacists Doctor Nurse	NR	NR	• A1C • BMI • BP	A1C significantly decreased ($P = .004$) in the structured group than in the less structured group.	Significant increase in A1C levels was observed in the less structured group while significantly reduced in the structured group. BMI and diastolic BP were not significant.
Gagliardino et al[50,51]	Face-to-face consultation and referral to ad hoc structured group education programs with different degrees of complexity and number of sessions and a 9-month longitudinal follow-up	Nurse Dietitian Educator	NR	NR	• Clinical: weight, height, WC, BP, foot evaluation • Metabolic: A1C, lipid profile	A1C control significantly higher in case group.	Intervention significantly improved the percentage of patients achieving target values set by international guidelines.

Abbreviations: T2DM, type 2 diabetes mellitus; NR, not reported; A1C, glycated hemoglobin; FBS, fasting blood glucose; 2 hppBS, 2 hour after meals blood sugar; BMI, body mass index; HBM, health belief model; BASNEF, Belief, Attitude, Subjective Norm, and Enabling Factors; BP, blood pressure; WC, waist circumference.

Table 4

DSME Intervention/Programs Characteristics for T2DM in High Mortality Developing Countries

Reference	Intervention for T2DM	Provider	Provider Training	Theoretical Model	Measures	Main Outcomes	Comments
van der Does et al[54]	Weekly group education classes, each lasting 60 minutes for 4 weeks	Dietitian Heath promoter Doctor	NR	NR	• Self-care activities	No statistically significant reduction in smoking (P = .08)	Intervention was effective in improving adherence to a diabetes diet, physical activity, foot care, and the perceived ability to teach others was seen, but no significant change in smoking or adherence to medication was noticed.
Price et al[52,53]	Structured group nurse-led diabetes care 3 monthly group sessions using picture-based flip charts + booklet and reinforcements per each clinic visit for 4 years	Nurses Community support workers	NR	Empowerment theory	• BMI • A1C	A1C decreased significantly compared to baseline at 6 and 18 and 24 months (P < .001) and at 48 months it was (P = .015),	There was significant improvement in A1C up to 18 months follow-up, but thereafter BMI was no longer significant and there was glycemic slippage.
Mahant[56]	30 minute counseling at 6 months visit for 3 years + booklet in Hindi	Physician	NR	NR	• Knowledge • Practices • Attitudes, blood glucose level • A1C	A1C and blood glucose level decreased significantly (P < .05).	The intervention was effective especially in monitoring of blood and urine glucose test and knowledge about hypoglycemia.
Mahajan et al[55]	Monthly 45-minute group education and individual consultations + comprehensive medical treatment, eye care, and monitoring of blood sugar	Dietitian Doctors	NR	NR	• Lifestyle • Self-care practices • Illness perception • Glycemic status • BMI	Significant improvements in lifestyle, self-care practices, illness perception, and glycemic status.	Intervention was effective in improving outcome measures.
Malathy et al[57]	Monthly counseling sessions each lasting 20-25 minutes for 3 months + handouts	Pharmacist	NR	NR	• Knowledge, Attitude, Practices (KAP) • Post prandial blood glucose • Lipid profile	KAP scores of test patients improved significantly (P < .0001).	Intervention proved to be effective.

Abbreviations: T2DM, type 2 diabetes mellitus; NR, not reported; BMI, body mass index; A1C, glycated hemoglobin.

Tailoring to Culture

Thirteen studies (57%) from both high and low mortality developing countries reported aspects of cultural sensitivity. Nine of these studies reported programs that were using the local language and incorporating the existing materials and local guidelines. Two studies from low mortality countries required speaking and understanding the local language as inclusion criteria for the program. Another 9 studies required information on needs assessment of the target population before designing the intervention program. Two of these studies were from high mortality countries. All the studies from high mortality countries, except 1, were accessible to people with low levels of literacy. Four studies from low mortality countries reported access to people with low literacy; 5 studies reported programs that excluded patients with low literacy. Other studies did not report on this issue (Tables 1 and 2).

Outcome Measures

Different outcomes were measured across studies. The most commonly measured (in 70% of the studies) was behavior change (eg, diet, physical exercise, self-monitoring of blood glucose [SMBG]). A1C was measured in less than half of the studies (49%). Other outcome measures included knowledge and other individual dispositions, fasting blood sugar (FBS), body mass index (BMI), lipid profiles, and psychological states (Table 3 and 4).

Effectiveness of DSME Interventions

Nearly all the identified studies indicated a significant difference on outcome measures between the intervention group and the control group or from pretest to posttest. Six studies (26%) did not find a significant difference between intervention and control groups or from pretest to posttest on some of the outcomes measured, which included knowledge, psychological state, behavior, and BMI. The change in A1C was significant in all the studies where this indicator was used as an outcome measure. In most studies, effectiveness of the interventions was only considered at short-term follow-up. Four studies measured follow-up over a longer period, but in 1 of them (with a 6-year follow-up), it was not clear whether the improvement was an effect of the intervention or of other factors. In the other study, with a 4-year follow-up, glycemic slippage was observed over time, indicating less impact at longer term follow-up.

Discussion

The limited studies available suggest that DSME programs in developing countries have positive effects on A1C, knowledge, glycemic control, and behavioral outcomes on short-term follow-up. This finding is consistent with existing literature that reports a positive impact on glycemic control after the delivery of interventions in developing and developed countries.[7,11-16]

Despite these positive results, the review also identified shortcomings in the DSME programs. Most interventions were provided by a range of health professionals. While this suggests progress in the provision of DSME, it is quite clear that developing countries are not equipped for this kind of implementation due to the shortage of health care professionals, especially in rural areas.[58] Therefore it is advisable that where there is not enough professional capacity, peers and community health workers can be trained to provide DSME while professional staff like nurses can be wisely used in supervisory and training roles for the nonprofessionals in these resource-poor settings. This strategy has proven to be effective.[16,59-62]

Only a few studies in the current review reported on the training of the providers. This finding is consistent with the findings of the review by Lou et al,[33] who found that of the 34 studies reviewed from China, not a single study mentioned training of providers. Without training of providers, the quality of a DSME program cannot be guaranteed, since the information provided to patients is not adapted to the needs of the particular target group.

Furthermore, few studies reported on accessibility of the intervention by patients with low literacy levels. People with diabetes and low literacy are more likely to have poor glycemic control, find it difficult to read food labels, estimate portion sizes, and therefore have low self-confidence in management of diabetes.[23,63,64] In previous studies, the use of pictorial aid and teach back strategies have been shown to enhance the comprehension and recall and adherence for people with low literacy levels.[65,66]

Only a few interventions included in this review were guided by behavior change theories yet interventions supported by a theoretical framework have been found to have positive results on the participants.[35] In addition, significant improvement still needs to be effected with regard to the strength and rigor of the study designs used in the interventions.

Our review suggests that DSME interventions in developing countries address the surface cultural aspects

such as language tailoring of reading materials. However, deep cultural factors were rarely reported. The results are similar to other reviews reporting that most interventions focus on surface structures of culture while ignoring its deep structures.[58] Rawal et al[7] suggest that developing linguistically appropriate and context-specific lifestyle interventions that are tailored to the cultural, religious, and socioeconomic needs of the target population will enhance the sustainability of the interventions.

Studies from both low and high mortality developing countries differed in many ways. There were more studies in the low mortality countries than in the high mortality countries, implying that very little research on the topic is being done in high mortality developing countries. Most interventions from high mortality countries were culturally sensitive and were accessible to people with lower levels of literacy but did not report on provider training. Most importantly, of the entire interventions only 1 from a high mortality developing country used community support workers as providers in addition to nurses.

Limitations

There are a number of limitations of this review that should be mentioned. First, it included only studies published in peer-reviewed, English journals from 2009 to 2013, thus excluding useful information that may not have been peer reviewed, may be in other languages, published before 2009, or unpublished studies. Second, the results of this review may also have been affected by publication bias, in that only studies with positive results were published and those with negative results were unavailable or unpublished. Despite these limitations, however, we believe that the review provides a clear state of the art that may inform DSME educators in developing countries.

Conclusion

DSME programs have been shown to be effective in these limited numbers of studies from low and high mortality developing countries, especially on short-term follow-up. However, there are several gaps that need to be addressed if programs are to be sustainable: guiding programs by behavior change theories, training professional and nonprofessional providers (community health workers, health promoters, peer support leaders), addressing the cultural sensitivity of programs, and making them more accessible to people with low literacy. These gaps if addressed could enhance the effectiveness of DSME programs in developing countries.

As such, the findings of this review have important implications for diabetes education in developing countries. Since diabetes continues to affect millions of people in developing countries, it is imperative that health workers providing education in developing countries continue to examine the sustainability and effectiveness of interventions by tailoring them to the culture and literacy levels of the target population. Many techniques can be used to address the burden of low literacy, such as the use of pictures and teach back techniques that have previously been proved successful.[23,65,66] In addition, as professional staff should be wisely used in resource-poor settings, trained nonprofessionals can be included to provide diabetes education with professional staff assuming a supervisory and training role.

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