A systematic Review of Health Promotion Model for Type 2 Diabetes Prevention

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Abstract: *This research to present the most common quality criteria in health promotion model for type 2 diabetes mellitus prevention. A systematic literature search was conducted to identify review articles, health technology assessments and policy reports of evaluated health promotion interventions in type 2 diabetes mellitus. The articles and researches were searched from the accessible databases such as research in Thailand, Pubmed, CENTRAL, MEDLINE, ScienceDirect, and SciSearch. A quality coding system was developed and included studies were rated independently by three researchers.The experimental and quasi-experimental research designs conducted between the year of 1998 and 2014 were reviewed. A descriptive analysis of study characteristics and evaluation criteria are presented. Fourteen studies were included in the review. Almost all (35.7 %) provided details on* participation; *however, only 28.6 % reported the coverage of their target population (*penetration). *Program intensity or implementation as measured by frequency of contacts during first year and intervention duration was identified in all of the reported studies, and 85.7 % of the studies also reported implementation fidelity; however, only 28.6 % of studies employed quality assurance measures to assess the extent to which the program was delivered as planned. Two and 14.3 % of studies reported 'highly' or 'moderately' positive changes (*effectiveness*) respectively, based on weight loss. Two (14.3 %) studies reported 'high' diabetes risk reduction but 'low' to 'moderate' weight loss only. Our findings identify that program intensity plays a major role in weight loss outcomes. However, programs that have high uptake both in terms of good coverage of invitees and their willingness to accept the invitation can still have considerable impact in lowering diabetes risk in a population, even with a low intensity intervention that only leads to low or moderate weight loss. From a public health perspective, this is an important finding, especially for resource constrained settings. More use of the PIPE framework components will facilitate increased uptake of type 2 diabetes mellitus prevention programs around the world.*

Keywords: *A systematic Review, Health Promotion, diabetes type 2, diabetes.*

I. Introduction

Type 2 diabetes mellitus constitute a major and growing burden on health care systems globally[1]. People with chronic conditions are their own principal caregivers and health care professionals, regardless of degree of specialization, ought to act as consultants supporting patients in their self-management role. Diabetes is a social problem that demands for re-education and reorientation of health care professionals and health care settings, readiness from policy makers and relevant stakeholders, as well as robust national policies and strategies developed, owned and monitored by national authorities. Health promotion, as defined by the Ottawa Charter for Health Promotion in 1986[2], refers to the process of "enabling people to increase control over, and to improve, their health". In the 4th International Conference on Health Promotion in 1997, The Jakarta Declaration was set out, and gave the following five key prerequisites of success for health promotion strategies[3] 1) build healthy public policy 2) create supportive environments 3) strengthen community action 4) develop personal skills 5) reorient health services. Health promotion strategies in type 2 diabetes mellitus may consist of one or a combination of programs targeting healthand dietary education, self-management, psychological support, or constitute initiatives targeting health care professionals or community stakeholders, and in addition have an intention to increase partnership across sectors. Also, patient empowerment is an upmost important and central topic in health promotion interventions. Mechanisms that explain success or failure of such initiatives remains mainly unclear or unknown, as there exists no consensus or validated framework to evaluate the structure, process and outcome indicators among complex interventions. Even more so, patient perspectives, experiences, values and preferences are seldom taken into account when it comes to evaluation, as anticipated in health promotion interventions. The overall aim of the systematic literature search was to bring attention to the most commonly used health promotion interventions in type 2 diabetes mellitus, and to provide a deeper understanding of the scope of such interventions and how they are evaluated in order to present quality indicators of good practices.

II. Research Objective

This research aims to present the most common quality criteria in health promotion model for type 2 diabetes mellitus prevention.

III. Research Methodology

Method and Sample size

A systematic literature search was conducted to identify review articles, health technology assessments and policy reports of evaluated health promotion interventions in type 2 diabetes mellitus. The articles and researches were searched from the accessible databases such as research in Thailand, Pubmed, CENTRAL, MEDLINE, ScienceDirect, and SciSearch. A quality coding system was developed and included studies were rated independently by three researchers.The experimental and quasi-experimental research designs conducted between the year of 1998 and 2014 were reviewed.

Data extraction

A descriptive analysis of study characteristics and evaluation criteria are presented. Three reviewers independently assessed titles and abstracts of all the relevant publications and made decisions on inclusion. Discrepancy in opinion was discussed and no third party was required in the process of study selection. Full-texts were sought and read for all articles that met the inclusion criteria (except one study that was unavailable in full text[4]. In the case of duplicate reports related to the same study, both articles were evaluated to extract the maximum amount of information. Data was extracted by one author, and checked for accuracy by a second investigator. For each article design, authors and year of publication, as well as type of intervention, evaluation method and reported quality criteria were extracted.

IV. Results

A detailed PRISMA flow diagram is attached as shown in Fig.1. The initial literature search (October 2014) returned 1,879 publications and 61 additional articles were identified through hand searching of references from the bibliographies of articles identified. Two thousand thirty-nine articles were screened after removing duplicates. An additional 5 articles were included after updating the search until December 2015. A total of 180 articles were assessed for eligibility. A total of 76 articles from 38 studies were included in the review to describe the characteristics of the included studies as shown in Table 1.
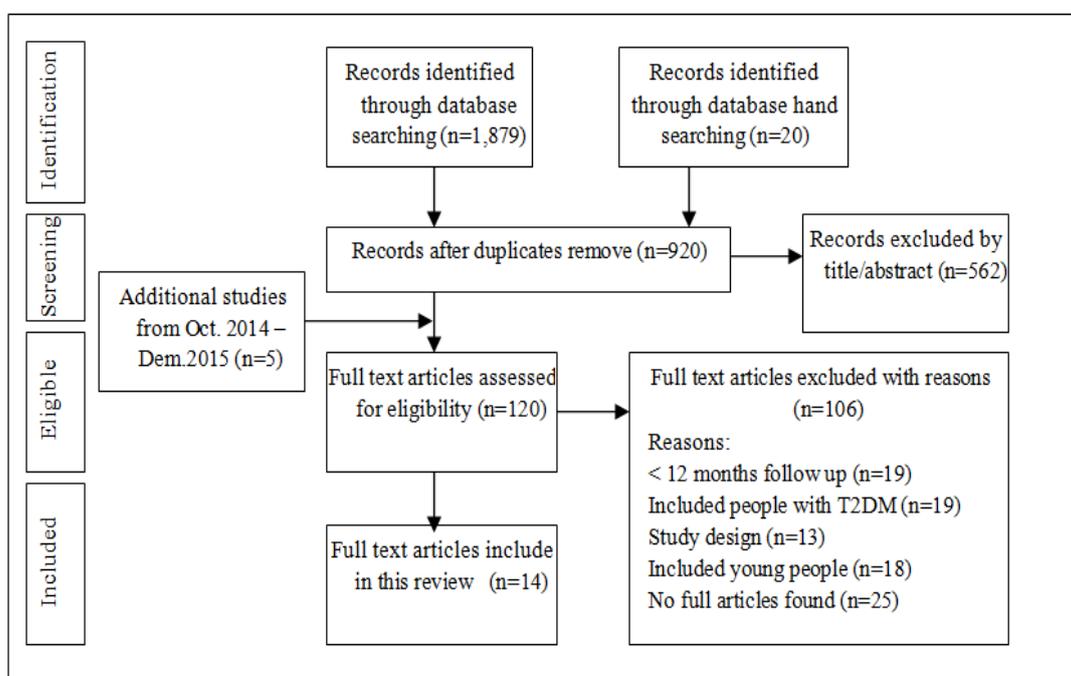

Fig.1- PRISMA flow diagram

Table 1- Characteristics of the included studies

Year	Author	Study ID	Country	Setting	Study population	Sample size	Study design	Intervention
2003	Mensink et al.	SLIM	Netherlands	Unclear	Adults at risk of type 2 diabetes mellitus	114	RCT	3 individual and 1 group session during 1 year + participants were encouraged to participate in the exercise program 3 times a year
2005	Kosaka et al.	Japanese DPP	Japan	Hospital-based	Adults with IGT	458	RCT	Detailed instructions on lifestyle were repeated every 3 to 4 months during hospital visits
2006	Oldroyd et al.	Newcastle lifestyle intervention	UK	Primary care	Adults with IGT	78	RCT	12 individual 15- to 20-min review appointments over 24 months (6 in the first 6 months, 1 after 9 months and 5 at 2 monthly intervals between 12 and 24 months)
2007	Absetz et al.	GOAL LIT	Finland	Primary care	Adults at risk of type 2 diabetes mellitus	352	Before and after	Six 2-hourly group counselling sessions over 8 months
2008	Payne et al.	BDPPI	Australia	Outpatient setting	Adults at risk of type 2 diabetes mellitus	122	Before and after	6-week group self-management education program, 12-week gym- or home-based resistance training, and three 2-h group reinforcement sessions during 34-week maintenance program
2009	Kramer et al.	GLB (2007–2009)	USA	Community	Adults with pre-type 2 diabetes mellitus	42	Before and after	12 weekly sessions (~60 min) and participants were offered the opportunity to attend monthly support meetings for 9 months after completion of the intervention
2010	Vermunt et al.	APHRODITE	Netherlands	Primary care	Adults at risk of type 2 diabetes mellitus	925	RCT	11 consultations of 20-min over 2.5 years, five 1-h group meetings and 1-h personal consultation with the dietician
2012	Piatt et al.	GLB (2005–2008)	USA	Community	Adults with metabolic syndrome	105	Before and after	12 weekly sessions over 12 to 14 weeks (lasted ~90 min) in the groups of 5 to 13 participants
2013	Jiang et al.	SDPI-DP	USA	Community	Adults with pre-type 2 diabetes mellitus	2553	Before and after	16 group sessions in the first 16 to 24 weeks and monthly individual lifestyle coaching sessions
2013	Ma J et al.	E-LITE	USA	Primary care	Overweight/obese adults with increased cardiometabolic risk	241	RCT	12 weekly group sessions (1.5 to 2 h each) in the first 3 months. From month 4 to 15, contact every 2 to 4 weeks depending on participant needs and preferences. Individual,

Table 1- Cont.

Year	Author	Study ID	Country	Setting	Study population	Sample size	Study design	Intervention
2014	Duijzer et al.	SLIMMER	Netherlands	Primary care	Adults at risk of type 2 diabetes mellitus	31	One group pre-test post-test	In addition to 6 individual consultations (in total 4 h per participant), on average, participants received 5.2 consultations by dieticians and 34.1 sports lessons
2014	Sepah et al.	Prevent	USA	Online platform	Adults with pre-type 2 diabetes mellitus	220	Quasi-experimental research design	16 online weekly lessons. Participants were then offered to continue with a post-core lifestyle change maintenance intervention, with the entire intervention
2014	Zyriax et al.	DELIGHT	Germany	Primary care (workplace)	Adults at risk of type 2 diabetes mellitus	241	Before and after	12 weekly sessions (for the first 6 months), 6 monthly and 6 biweekly sessions (for the next 6 months). For year 2 and 3 quarterly 1.5-h
2015	Savas et al.	IGT care call	UK	Primary care	Individuals with IGT	55	Observational study	A telephone service providing a 6 month lifestyle education program (20 min × 6), in addition to an introduction call (10 min) and action planning call (40 min)

Studies that met the eligibility criteria for this review were mainly based on either the US-DPP or Finnish-DPS. Seventeen 6 studies were implemented in the USA, 2 in the UK, 2 in the Netherlands, 2 in other European countries, 1 in Australia, and 1 in Japan. There were no studies from low and middle income countries that met our eligibility criteria. The sample size for the participants enrolled in each of these studies ranged between 31 and 2,553 participants. The studies were conducted in a range of settings including primary health care, faith-based, workplace, and other community-based settings. Each study was describes the ratings of all included studies based on the elements of the PIPE Impact Metric as shown in Table 2.

Table 2- Scoring for each PIPE element by study

Author Year	Study	Penetration	Implementation			Participation	Effectiveness		
			Frequency	Duration	Fidelity		Success rate	Weight loss	Risk reduction
Mensink et al. 2003	SLIM	High	Low	High	Low	Low	NAC	Moderate	High
Kosaka et al. 2005	Japanese DPP	NAC	Low	High	Moderate	NAC	NAC	Moderate	High
Oldroyd et al. 2006	Newcastle LI	NAC	Moderate	High	NAC	Low	NAC	Low	NR
Absetz et al. 2007	GOAL LIT	NAC	Moderate	Moderate	Moderate	High	NAC	Low	NR
Payne et al. 2008	BDPPI	NAC	High	High	Moderate	NAC	Moderate	Moderate	NR
Kramer et al. 2009	GLB (2007 – 2009)	NAC	High	Moderate	Moderate	Low	NAC	High	NR
Vermunt et al. 2010	APHRODITE	NAC	Moderate	High	NAC	Low	NAC	NAC	NR
Boltri et al. 2011	DPP (church-based)	NAC	Low (2 churches)	Low	Moderate	Low	NAC	Low	NR
Piatt et al. 2012	GLB (2005–2008)	NAC	Moderate	Moderate	Moderate	Low	Moderate	NAC	NR
Jiang et al. 2013	SDPI-DP	NAC	High	Moderate	Moderate	Low	NAC	Moderate	NR
Ma J et al. 2013	E-LITE	High	High	High	High	Low	High	High	NR
Duijzer et al. 2014	SLIMMER	NAC	Low	Moderate	Moderate	Moderate	NAC	Moderate	NR
Sepah et al. 2014	Prevent	NAC	Moderate	High	Moderate	High	High	NAC	NR
Zyriax et al. 2014	DELIGHT	High	High	High	Low	Low	NAC	NAC	NR
Savas et al. 2015	IGT Care Call	NAC	Low	Moderate	High	High	NAC	Moderate	NR

Program penetration

Our analysis shows that only two (14.3 %) studies reported their estimated target population, from which only seven studies reported the proportion of the target population that was reached with invitations to engage in the program or intervention. Out of these eleven studies, three had 'high', no had 'moderate', and no had 'low' penetration into their target populations as shown in Table 2. Target populations included patients, employees, and church attendees. Each study used various strategies to recruit potential participants including mail invitations, posted flyers, advertising through media, contacting local physicians, local churches, or using intranet or work meetings in the workplace setting.

The three studies that were rated as having 'high' penetration in our analysis applied heterogeneous strategies to reach their target group. Two studies contacted a pre-defined group of people at risk: one at worksite, where all employees who had above average waist circumference were invited for screening[4], and in the other study[5] all eligible subjects with high risk for glucose intolerance from a cohort representing general population were contacted. The only study contacted 70 %[6] of the target population for selective screening either by mail or by appointment.

Program implementation

In order to assess implementation, we evaluated the degree of contact (based on number, length, and type) during the first year of the intervention as frequency; the duration of the entire intervention; and the fidelity of the intervention. All studies in our analysis reported on frequency 28.6% and duration 57% of all studies implemented 'high'. In addition, groups led by volunteers as opposed to health care professionals and use of telephone as opposed to face-to-face delivery of individual sessions were also frequently observed adaptations. Only a small proportion (16 %) of studies reported 'low' duration, i.e. intervention delivered over the period of 6 months or less.

Program participation

The majority of the studies in our analysis (n = 8; 57.1 %) reported participation. In fourteen (65.8 %) of these 9 studies achieved 'low' participation rates. Half of these studies achieved participation rates equivalent to or lower than 10 %. Only 4 (28.6 %) studies had 'high' participation rates. The only study[8], participants were recruited by referral from physicians, general practitioners (GPs), or nurses from the participating health facilities and invited to attend a screening clinic. One study recruited participants from online advertisement, seeking individuals with a self-reported clinical diagnosis of prediabetes occurring within the past year; however, recruitment was based on self-selection by participants, which does not reflect a truly random sample[9].

The only study was scored as having 'moderate' participation, where 57 %[10] available for both penetration and participation, it was observed that 'high' penetration into the target population did not have positive effect on participation. All five studies rated as 'high' penetration in the analysis, reported 'low' participation. Also, none of the seven studies that were rated as 'high' participation provided enough information on reaching out to their target populations, and hence, penetration could not be calculated. However, the information available suggests that the studies where high-risk participants were identified and referred through their GPs or nurses resulted in 'high' participation rates.

Program effectiveness

Effectiveness was rated based on three criteria: proportion of successful participants; average weight loss; and diabetes risk reduction (absolute/relative). None of the studies reported on all three criteria. Seventeen (45 %) studies reported the use of intent-to-treat analysis; however, for the purpose of our analysis, effectiveness indicators were considered as presented in each of the studies.

One third (n = 3, 21.4 %) of the studies reported the proportion of successful participants who achieved the primary outcome (i.e. 14.3 % weight loss). The proportion of successful participants ranged between 20 and 64 %. Six (42.8 %) studies reported average weight loss by participants at 12 months, with a range from 0.45 to 7.7 kg. Only 3 of these studies were rated 'high' where average weight loss by participants was more than 4.6 kg. Sixteen (42 %) studies were rated 'low' on the basis of average weight loss of ≤2.3 kg as shown in Table 2.

V. Discussion

This is the first systematic review to evaluate the implementation of real-world diabetes prevention programs using the PIPE Impact Metric framework that deploys four highly relevant elements for monitoring program impact in real-world settings. As such, this review complements other recent reviews, e.g. Dunkley et al. 2014[11], by providing a more detailed understanding of key factors underlying successful translation and implementation of diabetes prevention programs in real-world contexts. We have also defined the specific scope of services for calculating the overall costs of services being provided. From both an organizational and societal perspectives, these issues are important to consider since the relative costs and benefits of such services and

programs are important determinants of their uptake and adoption. Our review of studies published over the last 15 years aims to identify the components of diabetes prevention programs with the highest population impact.

Our review highlights several important findings. First, confirming earlier reviews, our analysis demonstrates that lifestyle-focused diabetes prevention programs that have a 'high' degree of contact have more potential to achieve effective outcomes, especially when measured by weight loss. These programs have typically been based on the US-DPP model and have used a very structured protocol to maximize program fidelity. However, the problem with this approach is that in these studies, program participation tends to be quite low; and furthermore, none of these studies reported diabetes risk reduction.

Second, six of the studies showed different degrees of effectiveness for different outcomes. For example, diabetes risk reduction could be 'high' even when effectiveness in weight loss was 'low' or 'moderate'. Surprisingly, these were all studies of 'low' or 'moderate' frequency, but 'high' duration. This could be very promising especially for settings where intervention resources are constrained but when large populations can be reached by such programs.

Third, we found that 'high' penetration into the target population with invitations to engage prospective participants in the program do not necessarily result in 'high' participation. However, three studies with 'high' penetration resulted in either 'high' weight loss or 'high' diabetes risk reduction. Hence, scalability of the program to reach a large audience appears to be an important ingredient for population-level impact. In summary, while an intensive intervention plays an important role in achieving successful weight loss outcomes, highly scalable moderate- to low-frequency interventions appear to have major potential to achieve diabetes risk reduction in populations. We found estimates of target populations to be reported by less than one third of included studies. Hence, it is possible that many of these programs were delivered to highly selected populations which limit their generalizability. The research found that adherence to guidelines on the content and delivery was significantly associated with a greater weight loss. Our findings on the potential of 'low' to 'moderate' frequency interventions with longer duration to achieve significant risk reduction support earlier findings[12-13]. A recent CPSTF review[14] shows lower weight loss than the US-DPP but still concluded strong evidence of effectiveness.

Examining the implementation component further, in calculating 'frequency', we have used contacts made in the initial 12 months only because most of the studies did not extend beyond 12 months. In those that did, the initial 12 months can be considered as the 'action' phase, bringing about the lifestyle changes, and beyond that is a follow-up and maintenance phase, which some studies support with less frequent contacts. In translational research, a systematic evaluation of program fidelity is important to assess the extent to which program was implemented as designed. We based our definition of fidelity on whether a standard curriculum was used to guide the delivery of intervention and whether quality assurance measures were placed to monitor the implementation of the intervention. Not many studies clearly reported whether the quality assurance measures were able to guarantee 'high' fidelity, this clearly being one of the next important steps in program development. This needs to be examined in future studies.

The PIPE Impact Metric elements are interrelated in that participation is always a proportion of penetration and effectiveness can only be attributed to those who participated. Effectiveness, in this context, is defined as the number or proportion of participating cases who reached a priori defined success criterion. In prevention of T2DM, diabetes risk reduction is one such success criterion. In many studies, however, weight loss was also a main outcome either in individual cases as a percentage of overall body weight or across a population as an average percentage of weight loss. In our review, we used either criterion diabetes risk reduction or weight loss to assess effectiveness.

However, examination of studies with 'low' effectiveness reveals that for some of the studies the reported changes in weight loss were very small. Some of these studies reported a significant reduction in weight following the active intervention phase, but the weight was partly or, in some studies, entirely regained by the end of 12 months. Lack of consistency in the way weight loss outcomes are reported and analysed needs to be addressed in future translational research[15].

Our review includes diabetes prevention translational programs published since 2001 and until 2015. The studies included in this review have implemented 'high' (34 %), 'moderate' (37 %), and 'low' (29 %) frequency interventions; however, we noticed that most of the 'low-frequency' interventions were conducted in earlier years, whereas, designing 'moderate' to 'high' intensity interventions occurred in more recent years. However, 'participation' has been consistently low in a majority of the studies over the last 15 years. One of the reasons for this may be the fact that program planners focus on the content of the interventions instead of balancing the content with the experience of the participant that is, on the 'participation' dimension and the engagement factor that connects the participant with the intervention.

Future translational research in this field needs to invest in designing recruitment more carefully to ensure high program reach; examining factors that optimize engagement and retention in the structured lifestyle programs; and maximizing adherence to the long-term behavior changes[16].

Acknowledgments

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