IS LIFESTYLE MODIFICATION EFFECTIVE FOR GLYCEMIC CONTROL AMONG
TYPE II DIABETIC ADULTS IN SOUTHEAST ASIA?

by

ZAW WAI HTOO

M.B., B.S., University of Medicine, Mandalay, Myanmar, 2006

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College of Human Ecology

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Approved by:

Major Professor
Dr. Richard Rosenkranz

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ZAW WAI HTOO

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Abstract

Background: Type 2 diabetes mellitus (T2DM) is a costly and burdensome lifelong disease, and without proper glycemic control, severe life-threatening complications result. In Southeast Asia, the prevalence of T2DM is forecast to increase markedly from 2000 to 2030. Although literature reviews on lifestyle modification for glycemic control are available, these are mainly for the Western context, and there is a dearth of evidence for Southeast Asians who are at greater risk of T2DM and have differing patterns of diet, physical activity and body composition than Western populations.

Objective: To systematically review literature on the effectiveness of lifestyle modification interventions for glycemic control in T2DM patients from Southeast Asia.

Methods: Randomized controlled trials (RCT) with interventions $\geq$ 8 weeks that compared HbA1c or blood glucose for intervention (lifestyle modification) versus control groups were identified from searches in Cochrane Library, CINAHL, PubMed, ProQuest, Science Direct, SPORTDiscus, Scopus and Web of Science.

Results: Seven RCTs (679 participants) meeting inclusion and exclusion criteria were identified. There was a significant reduction in HbA1c% (MD = -0.56%; 95% CI = -0.95,-0.16%; p = 0.006; n = 5 studies) and in blood glucose mg/dl (MD = -16.76 mg/dl; 95% CI = -31.36, -2.17 mg/dl; p = 0.02; n = 4 studies) over 3 months for lifestyle modification intervention groups. Lifestyle interventions included diet (n = 2), exercise (n = 2), and general lifestyle interventions (n = 3). Duration of interventions ranged from 12 weeks to 6 months. Studies included populations from Thailand (n = 5) and Malaysia (n = 2).

Conclusion: Overall, lifestyle modification interventions are effective for the glycemic control of T2DM patients in countries of Southeast Asia.

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Acknowledgements

Dedication

Dedicated to my parents and individuals who have provided the unconditional, endless and everlasting loving-kindness and support for me.

Chapter 1 - Introduction

Diabetes is a chronic disease of high blood sugar level either due to insulin resistance of the body or insufficient insulin production from pancreas[1]. There are mainly 2 types of diabetes mellitus: type 1 and 2. Type 1 diabetes mellitus, also known as insulin dependent diabetes mellitus, tends to occur at younger ages, and is mainly caused by insufficient insulin production from pancreas[1]. Type 2 diabetes mellitus, also called as non-insulin dependent diabetes mellitus, is mainly caused by impaired utilization of insulin[1]. Type 2 DM comprises 90-95% of all cases of DM[2,3].

Type 2 diabetes mellitus (T2DM) is a costly and burdensome lifelong disease which damages multi-organ systems in the human body. The World Health Organization (WHO) considers diabetes mellitus as "an apparent epidemic which is strongly related to lifestyle and economic change[4]". In the pathophysiology process of type 2 diabetes mellitus, the convergence physical inactivity, poor dietary habits, and obesity may increase the risks of developing diabetes[5]. Decreased physical activity may affect insulin action and/or insulin secretion[5]. Glycemic control is paramount in the management of diabetes. Without proper glycemic control, severe life-threatening complications result such as heart diseases and stroke, nerve damage (neuropathy) especially in the feet, which can eventually require limb amputation, and cause kidney failure and blindness. The Centers for Disease Control and Prevention (CDC) reported that about 60% of non-traumatic lower-limb amputations among adults aged 20 years or older occur in people with diagnosed diabetes[6]. WHO indicated that the overall risk of dying among people with diabetes is twice of their peers without diabetes[1].

Diabetes has been a worldwide epidemic; the world prevalence of diabetes among adults was estimated 285 million in 2010 and is estimated to become 439 million by 2030[7]. Between the two decades, diabetes prevalence is estimated to increase by 69% in developing countries and 20% in developed countries[7]. WHO estimated 9% of adults aged 18 years and above had diabetes in 2014 and 1.5 million death was directly caused by diabetes in 2012[1]. More than 80% of diabetes deaths occurs in low- and middle-income countries, and WHO projected diabetes mellitus would be 7th leading cause of death in 2030[1]. Total expenditure on health per capita (international dollar; 2006) ranged from 43 USD to 500 USD and gross national income per capita (international dollar; 2006) ranged from 500 USD to 12,160 USD in the Southeast Asia Countries[8] (table 1.1).

Diabetes rates can vary by race and ethnicity[9]. CDC reported that diabetes prevalence rates of American Indian, Alaska Native, African American, Hispanic/Latino, and Asian/Pacific Islander adults were about twice as likely as white adults to have type 2 diabetes[9].

From 2000 to 2030, the prevalence of T2DM in Southeast Asia was forecasted to increase by 169% (22.3 million to 58.1 million of cases), in the United States and Canada the prevalence was forecasted to increase by 72% (19.7 million to 33.9 million of cases) and in Australia the prevalence was forecasted to increase by 89% (0.9 million to 1.7 million cases)[10]. Since many years ago, advice on diet and exercise were part of the treatment of T2DM[11]. Stampfer stated that adoption of healthy lifestyle may provide protective effect associated with T2DM[12]. Although literature reviews on lifestyle modification for glycemic control are available, these are mainly in the Western context, and there is a dearth of review evidence for Southeast Asians, who are at a greater risk of T2DM and have differing lifestyle in the patterns of diet, physical activity, and body composition from Western populations.

Asians have many differences from Western people in physical appearance, cultural behaviors, and genetics. Asians have high susceptibility to conventional T2DM risk factors, such as age, body-mass index, and upper-body adiposity[13]. So, diabetes develops much earlier in Asians than in white people even a decade earlier[13]. Asian people are hyperinsulinemic which is the characteristic of insulin resistance[13], especially in Southeast Asian populations. Even for the same body mass index, Asians have a higher body fat percentage, a significant central obesity, a higher intramyocellular or liver fat content compared to Caucasians[14]. These factors may put the Asian people a higher risk to insulin resistance at a lesser degree of obesity than Caucasians[14]. Insulin resistance, increased abdominal or visceral fat are seen even in non-obese Asian populations[13]. T2DM was increasing in native and migrant Asian populations than in white populations[13]. Manderson et al[8] reported that the chronic, non-communicable diseases occurred in the Southeast Asia mainly relates to the lifestyle conditions associated with psychosocial stress, over-nutrition, consumption of high levels of saturated fats and excess salt, lack of physical activity and consequent overweight and obesity[8].

Moreover, in terms of diets, potatoes and wheat are usually the main sources of carbohydrate in Western countries while Asian people eat rice as the staple food[15], white rice has higher glycemic index and is associated with increased incidence of type 2 diabetes[15,16].

The Southeast region of Asia is mainly composed of developing countries; many people are not able to access timely medical attention or expensive medical treatments, especially if the illness is a lifelong chronic disease such as T2DM, hypertension, and heart diseases. Although medical treatment and drug interventions are available, lifestyle intervention may be cost effective, less drug side-effects and capable of chronic diseases. Knowler et al found that

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lifestyle changes and treatment with metformin both reduced the incidence of diabetes in persons at high risk and lifestyle intervention was more effective than metformin[17].

Regular exercise is usually included in the management of type 2 diabetes, however most of the patients with T2DM are unlikely to be undertake the recommended moderate to vigorous aerobic exercises. This could be due to the patients' impaired tolerance of physical capacity[18]. Many individuals are not able to achieve good glycemic control or to adhere to regular exercise due to lack of motivation and or other self-management skills[19,20].

Previous systematic reviews and meta-analyses[18,21-24] have shown that physical activity and/or dietary interventions can improve glycemic control, but no extant study has focused on reviewing literature focused on countries of Southeast Asia. Therefore the objective of this review is to assess whether lifestyle modification (physical activity and diet modification) is effective for glycemic control in type 2 diabetes patients in Southeast Asia context.

To assess the glycemic control, "Glycosylated hemoglobin (HbA1c)" is used as the long term marker of glycemic control[25] of the diabetes patients as HbA1c corresponds to the lifespan of red blood cells (120 days)[23,26]. For short term interventions, fasting blood glucose/ fasting blood sugar (FBS) is usually used to assess the glycemic control instead of HbA1c[27,28]. For the present study, both HbA1c and fasting blood glucose serve as outcome variables to assess the glycemic control. HbA1c is widely used routine monitoring of long-term glycemic status in both type 1 and type 2 diabetes[1]. WHO recommends that HbA1c can be used for diagnosis of diabetes if rigorous quality assurance checks are in place and assays are standardized[29].

Table 1.1 Development indicators; Select countries in Southeast Asia[8] *

Indicator	Philippines	Malaysia	Thailand	Indonesia	Cambodia	LaoPDR	Vietnam	Myanmar
Total population (millions)	86,264	26,114	63,444	228,864	14,197	5,759	86,206	48,379
Gross national income per capita (international dollar)	3,430	12,160	7,440	3,310	1,550	1,740	2,310	510
Life expectancy at birth (M/F)	64/71	69/74	69/75	66/69	59/65	59/61	69/75	57/63
Total expenditure on health per capita (international dollar; 2006)	223	500	346	87	167	85	264	43

* Source: WHOSIS (World Health Organization Statistical Information System); select indictors.

Hypothesis

Lifestyle modification is effective for glycemic control among type 2 diabetic adults in Southeast Asia.

Chapter 2 - Method

A systematic review and meta-analysis was conducted on the randomized controlled trials (RCT) with interventions at least 8 weeks in duration that compared HbA1c or blood glucose for lifestyle modification (diet modification or physical activity) versus a control group. The RCTs were identified in the electronic databases - the Cochrane Library, CINAHL PubMed, ProQuest, Science Direct, SPORTDiscus and Scopus (from the start of database up to 31st December 2014) and Web of Science (from 1945 to 31st December 2014). Database searching started from September 2014. Database searching identified 255 articles, from which 62 articles were screened for full text review, from them 7 articles were included for final qualitative analysis (Figure 3.2).

Inclusion and exclusion criteria for considering studies

Study designs

Only randomized controlled trials that included lifestyle modification, dietary modification and physical activity for the glycemic control (HbA1c or blood glucose level) among diabetes patients were considered. Only RCTs were included because RCT is a more valid study design for causal factor inferences[30]. By randomization, the studies minimize the chances of biases and confounding[30].

Participants

Trials enrolling type 2 diabetes adult patients (men and women) aged 19 years and above from Southeast Asian countries: Lao, Brunei, Cambodia, Indonesia, Malaysia, Myanmar (Burma), Philippine, Thailand, Vietnam and Singapore were included. Mekong Valley, Borneo and East Timor were included as per the PubMed databases and MeSH term definition of

"Southeast Asia". Trials with emphasis on people with diabetes insipidus, gestational diabetes, type 1 diabetes, non-diabetic people and those not from the Southeast Asia area were excluded.

Interventions

Trials of interventions relating to the lifestyle modification, physical activity and diet modification for eight weeks or more which compared with conventional care control groups were included. Studies without any of lifestyle modification or physical activity or diet modification or studies with these interventions but for different purposes other than type 2 diabetes mellitus patients or pharmaceutical studies comparing drugs for diabetes were excluded.

Outcomes

Trials which had glycemic control assessment of the type 2 diabetic patients i.e., glycated hemoglobin, HbA1c, blood sugar level were included. Trials which did not measure any of HbA1c or blood sugar level were excluded.

Data extraction

Data from identified trials were extracted and recorded on the summarized form. The authors of the identified articles were contacted for necessary data information. The authors[25] of identified articles were requested to confirm for certain data as necessary and the confirmed data were used as final. Standard errors were converted to Standard deviation. The blood sugar level and HbA1c values were converted to mg/dl and % to be standardized and in line with the majority of RCTs reports. HbA1c_IFCC (mmol/mol) is converted to HbA1c_DCCT (%) using the equation HbA1c_IFCC = (HbA1c_DCCT - 2.15) x 10.929[31,32]. Blood glucose mmol/L is converted to mg/dl by using the equation blood glucose mmol/L to mg/dl = mmol/L x 18.0182[33]. The original authors were contacted, if necessary, to confirm the data or to provide the exact

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numerical values if they were not already presented. The exact values of blood sugar (mg/dl) mean and SD baseline and end point (13 weeks) of dietary intervention trial[34] were provided by the original author Kamonpun Wattanakorn. The standard deviation values for HbA1c% for a general lifestyle intervention trial[35] were provided by original author M.Y. Tan. The standard error values for HbA1c (mmol/mol) and fasting blood glucose (mmol/L) in physical activity trial[25] were confirmed with the original author D. Suksom. However the standard error for HbA1c from the trial[25] was used as was stated in the published paper instead of author's reply for standard error value as zero justifying that the published standard error values more conformed to standard error values of similar study in Southeast Asia.

Statistical analyses

Subsequent to extraction and aggregation of sufficient study information, the effect size (standardized mean differences, SMD), absolute value (mean differences, MD) were calculated for the glycemic control outcomes i.e. glycosylated hemoglobin (HbA1c) and blood sugar levels of post intervention mean values. RevMan5 software (version 5.3.0)[36] of the Cochrane Collaboration was used for the analyses.

Assessment of heterogeneity

To assess the heterogeneity, I^2, Tau[2], Chi-square statistics were generated[37]. The statistical significance level of 0.1[37] was used as evidence of heterogeneity. The Cochrane guide to interpretation of I^2 is as follows: 0% to 40%: might not be important, 30% to 60%: may represent moderate heterogeneity, 50% to 90%: may represent substantial heterogeneity, 75% to 100%: considerable heterogeneity[37]. The Cochrane guide also reminds that thresholds for the interpretation of I^2 can be misleading, since the importance of inconsistency depends on several

factors[37]. The random-effects model is used to incorporate the heterogeneity that cannot readily be explained.

Chapter 3 - Results

Search results

Our search identified 7 RCTs (679 participants). Study interventions types included diet only (n = 2 studies), exercise only (n= 2 studies), and general lifestyle intervention, including diet and exercise (n = 3 studies). Duration of interventions ranged from 8 weeks to 6 months. Studies included populations from Thailand (n = 5 studies), Malaysia (n = 2 studies). Search results are shown in the PRISMA[38] flow diagram (Fig. 3.1). Summary of selected randomized trials is shown in table 3.3.

Study design / quality assessment

The quality assessment / risk of bias assessment for the included trials were made based on ten criteria adapted from the "Consolidated Standards of Reporting Trials (CONSORT)" assessment criteria for reporting randomized trials of non-pharmacologic treatments[39]. The ten criteria are detailed in the table 3.1. The risk of bias assessment for each criteria was scored as low risk (score 0), not sure/ not clear (score 1), high risk (score 2). The assessment results are reported in the table 3.2, and figure 3.1. The scores for the studies ranged from low risk (0/20 to 6/20), not clear/ not sure risk (7/20 to 13/20) to high risk (14/20 to 20/20). As expected for non-pharmaceutical trials, none reported double-blinding, but only 1 trial mentioned 'single-blinding'. No trial explicitly mentioned blinding of the assessors. All trials stated the inclusion and exclusion criteria of participants, although only one trial explicitly mentioned both inclusion criteria and exclusion criteria.

Dietary modifications included "low glycemic diet" and "eating behavior modification program" addressing food control, effective eating, eating with others, eating in restaurants, cooking at home, and healthy menus for people with obesity, low-sweet diet, low-fat diet, low-

salt diet and increased intake of fruits and vegetables. Dietary modification interventions

modalities were not precisely mentioned in detail for the self-management/ self-care intervention

programs although dietary modification was part of the intervention.

Table 3.1 Description of the randomized trial quality assessment criteria

No.	Criteria
1	**Participants (detailed inclusion/exclusion criteria)** Eligibility criteria for participants and settings and locations where data were collected. | Eligibility criteria for centers and those performing the interventions.
2	**Interventions** Precise details of the interventions intended for each group and how and when they were actually administered. |Precise details of both the experimental treatment and comparator | *Quality of exposure:* Description of the different components of the interventions and, when applicable, descriptions of the procedure for tailoring the interventions to individual participants | Details of how the interventions were standardized | *Intended dose of behavioral medicine*: Details of how adherence of care providers with the protocol was assessed or enhanced
3	**Quality of random assignment:** Method used to generate the random allocation sequence, including details of any restriction (e.g., blocking, stratification). |When applicable, how care providers were allocated to each trial group | Method used to implement the random allocation sequence (e.g., numbered containers or central telephone), clarifying whether the sequence was concealed until interventions were assigned | Who generated the allocation sequence, who enrolled participants, and who assigned participants to their groups
4	**Blinding:** Whether or not participants, those administering the interventions, and those assessing the outcomes were blinded to group assignment
5	**Results:** Flow of participants through each stage (a diagram is strongly recommended)---specifically, for each group, report the numbers of participants randomly assigned, receiving intended treatment, completing the study protocol, and analyzed for the primary outcome; describe deviations from study as planned, together with reasons | The number of care providers or centers performing the intervention in each group and the number of patients treated by each care provider or in each center
6	**Implementation of intervention:** Details of the experimental treatment and comparator as they were implemented
7	**Baseline data:** Baseline demographic and clinical characteristics of each group | When applicable, a description of care providers (case volume, qualification, expertise, etc.) and centers (volume) in each group
8	**Numbers analyzed:** Number of participants (denominator) in each group included in each analysis and whether analysis was by "intention-to-treat"; state the results in absolute numbers when feasible (e.g., 10/20, not 50%)
9	**Outcomes and estimation** For each primary and secondary outcome, a summary of results for each group and the estimated effect size and its precision (e.g., 95% confidence interval)

10	**Interpretation:**
	Interpretation of the results, taking into account study hypotheses, sources of potential bias or imprecision, and the dangers associated with multiplicity of analyses and outcomes | In addition, take into account the choice of the comparator, lack of or partial blinding, and unequal expertise of care providers or centers in each group
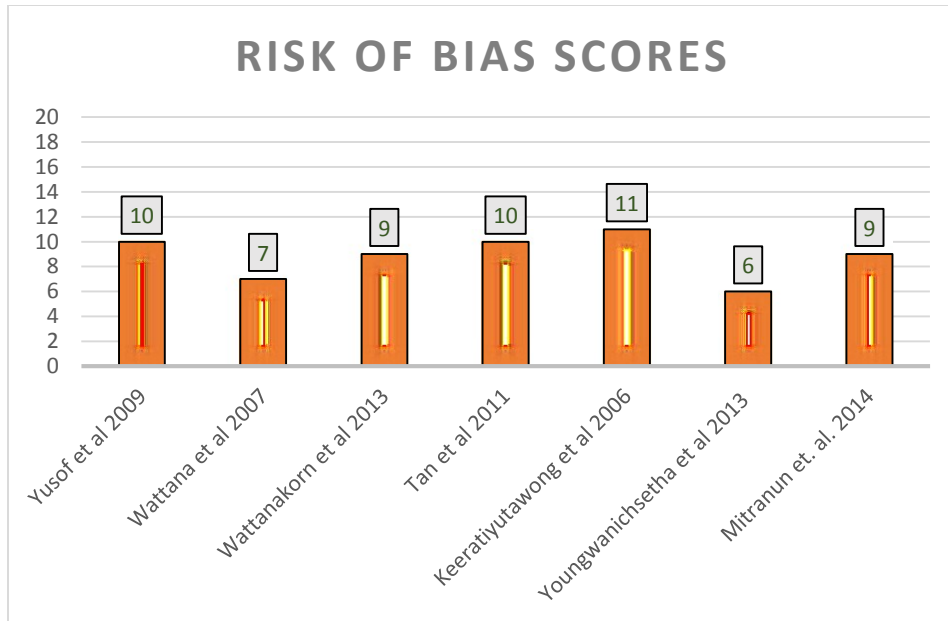
Figure 3.1 Risk of bias scores

Table 3.2 Assessment of risk of biases of the randomized trials

Criteria / checklist of items for reporting trials of non pharmacologic treaments (adapted from Consolidated Standards of reporting trials)	Yusof et al 2009	Wattana et al 2007	Wattanakorn et al 2013	Tan et al 2011	Keeratiyutawong et al 2006	Youngwanichsetha et al 2013	Mitranun et. al. 2014	Total assessed scores
Participants (detailed inclusion/exclusion criteria)	1	1	1	1	1	1	1	7
Interventions	2	1	1	1	2	1	1	9
Quality of random assignment:	2	1	1	2	0	0	1	7
Blinding:	1	1	1	1	1	1	2	8
Results:	1	1	1	1	1	0	1	6
Implementation of intervention:	0	0	0	0	0	0	0	0
Baseline data:	1	1	1	1	2	1	1	8
Numbers analyzed:	0	0	0	0	0	0	0	0
Outcomes and estimation	0	0	2	1	2	1	0	6
Interpretation:	2	1	1	2	2	1	2	11
Risk of bias scores	10	7	9	10	11	6	9	62
Total scores	20	20	20	20	20	20	20	140
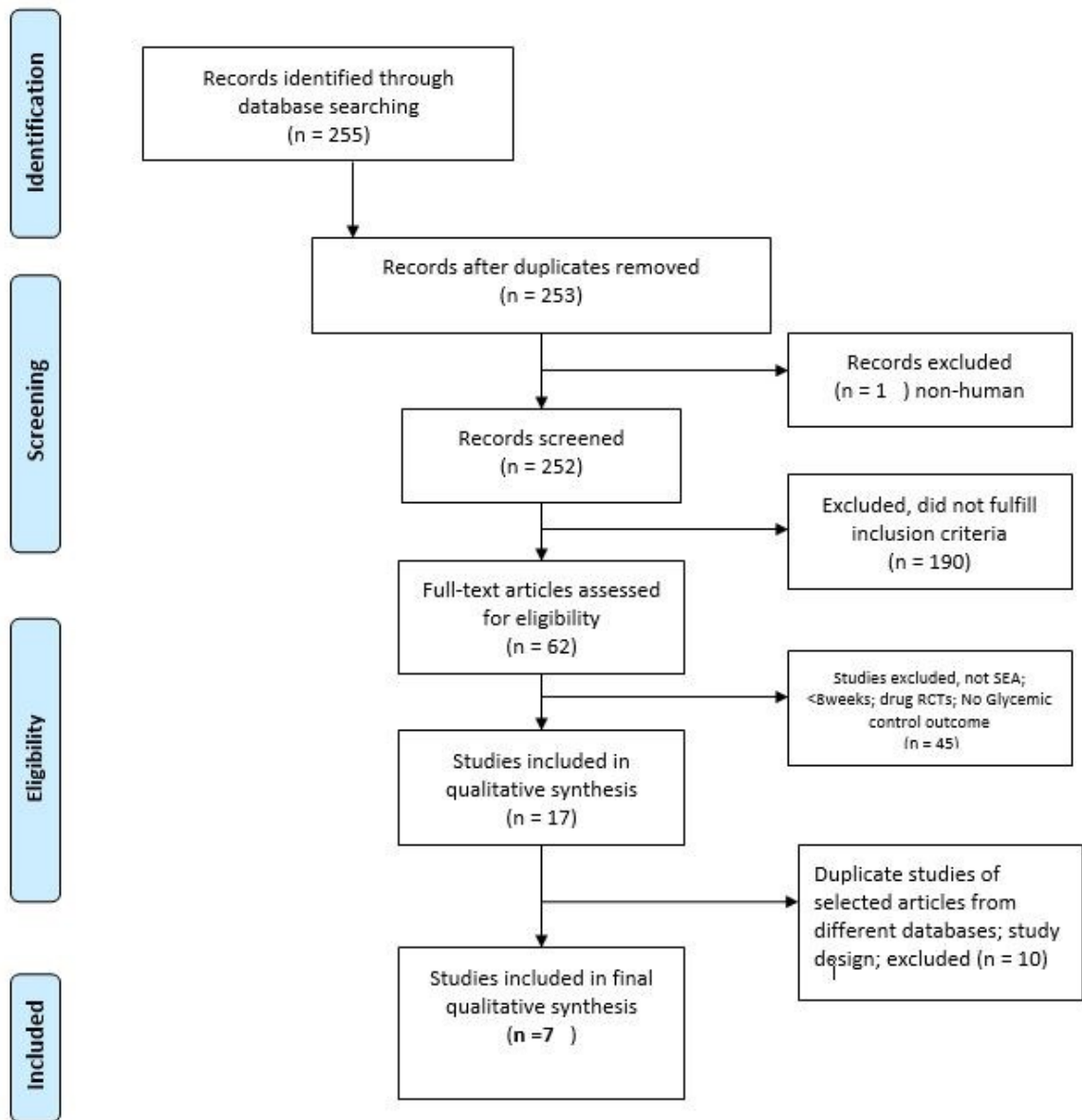
Figure 3.2 PRISMA Flow Diagram[38]

Baseline characteristics

Five out of seven randomized trials showed no significant differences in demographic and dependent variables between the intervention and control groups and mentioned that baseline characteristics were well balanced in the two groups. One trial[25], however, did not explicitly mention statistically significant differences between the intervention and control groups at the baseline demographic and dependent variables. In one trial[40] there were significant differences in mean HbA1c levels between the intervention and control groups at the baseline time point. Also, in one trial[41], the mean age of the experimental group was older compared to control group.

Sample size

In the final analysis, 679 participants were included in the seven randomized trials reviewed. The sample sizes of individual randomized trials ranged from 43 to 164 participants.

Age

The ages of participants were reported in 5 trials[25, 19,34,35,41] and stated in mean ages ranged youngest from 35 ($\pm$ 5.6 SD) years to eldest 61.7 ($\pm$ 10.5 SD) years for intervention group and youngest 36.2 ($\pm$ 4.5 SD) years to eldest 60.9 ($\pm$ 9.3 SD) years for the control group. One trial[40] set the age range from 27 to 60 years and one trial[15] did not report age.

Gender

The majority of the participants were female within the trials, and the number of female participants was almost 3 times of the number of male participants. Male-to-female ratio was 1:2.9 in the 5 trials[25, 19,34,35,41] (125:370) that reported these data. In one trial[40] 74% of 81 participants were female, and another trial[15] did not report male female ratio.

Duration of diabetes

In five trials[19,25,34,35,41] out of total seven trials that reported on mean duration of diabetes among included participants, the duration ranged from 2.5 (± 1.2 SD)[19] years to 20.5 (± 1.5 SD)[25] years in the intervention group and ranged from 2.8 (± 1.2 SD)[19] years to 21.1 (± 2.3 SD)[25] years in the control group. In one of the remaining two trials, diabetes duration of the subjects had to be less than 10 years[40] to participate in the study. In the remaining trial[15], only subjects who had diabetes for at least 3 months to be included in the study.

Status of diabetes treatments being undertaken by the subjects

The majority of intervention and control group subjects from all included trials were either on oral hypoglycemic agents or no medication. The diabetes treatment status detailed the existing and ongoing treatment status of the subjects, not as the part of the interventions of the experiments. Detailed diabetes treatments status were "no medication" in 64 post-partum Thai women included in the tai chi qigong RCT[19], "only with oral medication" in 81 type 2 diabetes mellitus Thai patients involved in the self-management program randomized trial[40], "diet or combination of oral hypoglycemic agents" in 104 patients from Malaysia involved in the low glycemic index diet randomized trial[15], "no medication or one drug or combined drugs therapy" in 147 Thai patients with type 2 DM patients participated in the self-management program RCT[41], "Oral hypoglycemic agent or insulin or combined treatment" in 164 diabetic patients from Malaysia involved in the brief education program, self-care practices RCT[35], no specific treatment was reported for 76 Thai people with diabetes and obesity who involved in the eating behavior modification RCT[34] and "antihyperglycemic medications" for all 45 type 2 diabetes Thai patients who involved in the continuous and interval training randomized trial[25].

Comorbidities and diabetic complications

The most commonly reported comorbidities in these trials were hypertension and overweight or obesity. One trial[35], with poorly controlled diabetic patients, did not explicitly report the comorbidities. Two RCTs[40,41] excluded the patients with comorbidity or serious illness from the studies. One trial[25] mentioned all participants were free from diabetic complications such as diabetic nephropathy, diabetic retinopathy, severe diabetic neuropathy, and severe cardiovascular and cerebrovascular diseases. One trial[15] excluded poorly controlled diabetes patients from selection, although the author also highlighted the fact that both intervention and control study groups had poor glycemic control as per higher level of HbA1c.

Participant attrition

Many trials reported that the attrition rates were within the "acceptable level" and mostly were small percentages. Weighted average attrition of included studies was 6.6% (47/709), detailed rates of attrition for 7 trials were 3.8%, 4%, 5%, 6.37%, 7%, 8% and 10%. Two trials[15,35] applied the intention-to-treat analysis. All trials reported the reasons for attrition and half of the trials[15,19,35] reported this information in the flow diagram, as per CONSORT. The reasons included: patients' treatment needed to change from oral hypoglycemic drugs to insulin; not completing interventions; moving to another town to work; not turning up; lack of interest; discharge to other centers; being unable to measure post HbA1c due to severe anemia. One trial[25] with attrition rate 4% did not explicitly mentioned the specific reasons for attrition though it was mentioned that participants with <80% training completion would be excluded. In one trial[35], the authors reported that 18 out of 78 in the intervention group received lesser than intended amount of 3 times of intervention than other 60 intervention participants due to telephone access problem, transport problem.

Interventions

In the selected 7 randomized controlled trials, 2 trials conducted dietary modifications, 2 trials conducted "physical activity", and 3 trials conducted general lifestyle intervention (self-management / self-care). All trials assessed glycemic control in the type 2 diabetes patients. All trials except 1 trial[34] (6 out of 7) measured HbA1c, all trials with 12 weeks intervention except 1 trial[35] (4 out of 5) measured blood sugar level. Both trials[40,41] with 6 months or 24 weeks intervention measured HbA1c. Three trials[15,19,25] out of all 7 trials measured both HbA1c and blood sugar level.

Dietary modification

Two trials conducted dietary modifications "eating behavior modification program[34]" and "using low glycemic index diet[15]". One trial was from Thailand[34] and the other was from Malaysia[15].

Duration

Both trials were short-term intervention. Duration of eating behavior modification program intervention[34] was 13 weeks and that of low-glycemic index diet intervention[15] was 12 weeks.

Frequency

Eating behavior modification program had four intervention sessions across four weeks. Then, all outcome data were gathered at week 5, 9 and 13. The low glycemic index diet trial gave dietary advice to all subjects over the 12 week period and evaluations were made for 3 times on week 0, 4 and 12.

Modality

Eating behavior modification program[34] emphasized on behavior change communication steps providing the background knowledge on how to control food, how to eat with others, how to eat effectively, how to cook at home, how to eat restaurants, what were the healthy menus for obese people and written guidance on low sweet, fat, salty diet, increasing fruits and vegetables intake. Participants' cognitive illness representation, emotional representations and illness comprehensibility were assessed by brief illness perception questionnaire (BIPQ) and three-factor eating questionnaire (TEFQ) for patients' dietary restraints, disinhibition and hunger assesses were employed. Low glycemic index diet program[15] used a "This for That" approach, instructing intervention group participants to eat at least one low glycemic index food from the list and to spread the carbohydrate containing foods evenly throughout the day. The control group was advised to implement conventional carbohydrate exchange for each meal limiting refined sugars without the GI concept. Nutritional prescription were based on medical nutrition therapy for type 2 diabetes. The dieticians assessed the participants' compliance to dietary instruction.

Physical activity

There were two trials in this systematic review that assessed the effectiveness of physical activity. The activities included tai chi qigong exercise[19] and continuous, interval training[25] for the glycemic control of the T2DM patients.

Duration and Frequency

All trials conducted short-term interventions with a duration of 12 weeks. Tai chi qigong exercise had initial training for 3 times of 50 minute session then assign to continue 5 times a week for 12 weeks. The continuous and interval training program included walking on treadmill for 30 and 40 minutes per day, three times a week for 12 weeks.

Modality

In the tai chi qigong intervention, post-partum women with T2DM during their 3 to 6 months post-partum period were trained initial three 50 minutes sessions to perform tai chi qigong exercise. Then these intervention group post-partum women were assigned to continue tai chi qigong exercise at home 5 times a week for 12 weeks. Each 50- minute session was designed with warming up for 15 minutes, tai chi qigong exercise comprising eighteen movements for 30 minutes and cooling down with five qigong movements for 5 minutes. The control group post-partum women received standard diabetes care.

Interval and continuous aerobic training were 3 phase programs: phase 1 (weeks 1-2), phase 2 (week 3-6) and phase 3 (weeks 7-12). The interval training program, phase 1: warming up to achieve 50% VO_2peak within 5 minutes maintained that intensity for 20 minutes and 5 minutes for cooling down, so total 30 minutes. In phase 2: same warming up as in phase 1 within 5 minutes, participants needed to perform interval of four 1 minutes high-intensity exercises at 80% of VO_2peak with a 4 minutes low intensity exercise at 50% of VO_2peak. Then the participants finish up exercise session with a 5-min cool-down period, so total 30 minutes. In phase 3, all participants needed to warm up to achieve a 60% of VO_2peak within 5 min, then to perform the interval of six 1-min high-intensity exercise at 85% VO_2peak with a 4-min low-intensity exercise at 60% VO_2peak and a 5-min cool-down period, giving a total session time of 40 min.

The continuous exercise program: in phase 1, was the identical training program as in the interval exercise program. In phase 2, after warming up to reach the 60% of VO_2peak within 5 min, the participants had to maintain this intensity for 20 and 5 min for cooling down, a total time of 30 min. In phase 3, after warming up to reach the 65% of VO_2peak within 5 min, then the

participants had to maintain this intensity for 30 min and perform 5-min cooling down, giving a total time of 40 min.

General lifestyle (combine self-management program)

There are 3 trials[35, 40, 41] of general lifestyle interventions known as self-management or self-care practices on glycemic control of the T2DM patients. Two trials[40, 41] were from Thailand and one trial[35] from Malaysia.

Duration

The duration of this general lifestyle interventions included both short term and long term studies. Two trials from Thailand were 6 months long and one trial from Malaysia was 12 weeks long. One[40] of the 6 months long intervention trials conducted midpoint assessment at 3months' time.

Frequency

Frequency of intervention ranged from 3 times (once a month for 3 months, in one trial) to 7 times over 6months in the remaining 2 trials.

Modality

There are 3 modalities under general lifestyle (self-management/self-care program) intervention trials. Of which, two self-management programs were in Thailand and the structured program of self-care was in Malaysia. The first self-management program[40] based on self-care theory and cognitive behavioral therapy. The intervention group had 5 sessions for cognitive improvement and skills in diabetic care, exercise assignments. The 5 sessions were (1) a pathology of diabetes mellitus, cognitive restructuring and goal setting skills (2) dietary control and communication skills (3) diabetes medication, and problem solving skills (4) foot care and

self-monitoring and (5) exercise. First session was held on weekend morning for 2 hours in a private room in the hospital and the rest 4 sessions (sessions 2 to 5) were conducted in the following week, two hours per session. Written diabetes materials were also given and Hanucharurnkul et al's[40] diabetic self-care 5 video tapes were also included. The diet component of the intervention was improved for cultural and local context and diabetic self-care regimen included diet, exercise, self-monitoring, foot care and medication-taking. The follow up phone calls and discussion were made on patient's self-management practices in the middle and end time of the intervention. The control group received five video tapes, a set of written diabetes materials and usual diabetes education program.

The second self-management program trial[41] was also from Thailand. The intervention group received a 2 hour long small group diabetes education class about meal planning, appropriate physical activity, foot care, proper use of medicine, monitoring for signs and symptoms complications, and meditation techniques for stress reduction. Following that, the intervention group received a 1½ hour long four small group discussions and two times of 45 minutes long individual home visit sessions from the researcher and a patient education manual "Living Well with Diabetes." The control group received the usual nursing care, routine physical examination and individual health education from a registered nurse and/or other health-care provider. The health education for the control group was delivered as per institutional guidelines, but not a structured program.

The modality of the last trial[35], brief structured education on self-care practices, was from Malaysia and included three research instruments: (1) an education program (2) an assessment tool and (3) measurement of HbA1c. The education program consisted of monthly interventions over 3 months of which the first session was the 45 minutes long face-to-face individual

education sessions on self-care practices of healthy eating, physical activity, medication adherence and self-monitoring of blood glucose (SMBG). Based on the SMBG results after 1st session, the following 2nd and 3rd educational sessions provided problem-solving skills related to hyperglycemia, hypoglycemia, sick day and emotional episodes for 30 minutes and 15 minutes accordingly. As an assessment tool, Revised Diabetes Self-care Activities (RDSA) Questionnaires (24-hour dietary recalls and a Food Frequency Questionnaire with 100 commonly consumed Malaysian food list, physical activity recall, medication adherence recall and SMBG recall for last 7 days) were employed. The control group was provided with usual care, however what kind of standard care was not specified in detail.

Supervision and compliance

In the dietary modification trials, the three factor eating questionnaire (TEFQ) was used to assess the compliance of patients' dietary restraints, disinhibition and hunger. In low glycemic index diet trial, the dieticians assessed the participants' compliance to dietary instruction. In the physical activity modification trial, in fact the trial design relied on patients practice of tai chi qigong at home rather than under the supervision at the research center. Similarly in the self-management / self-care program trials, the phone call follow-up actions were taken for two times in 6 months at 3rd and 5th months only and the patients' compliance could not be supervised in the research center. In the second self-management trial, the principal researcher provided 2 home visits of 45 minutes over the 6-month intervention period. The designs mostly relied on the patients' own volitional actions which were not under strict supervision at research centers.

Evidence of intervention effects

Dietary modification

There were 2 dietary modification trials, including: (a) use of low glycemic index and (b) eating behavior modification programs. The use of low glycemic index diet[15] had significant changes in plasma glucose over 12 weeks compared to that of the control group with conventional carbohydrate exchange. However HbA1c and blood glucose of low glycemic index group was not significantly different from the control group. The post intervention mean values of HbA1c% at the week 12 were 7.2 ± 0.1 for low glycemic index intervention group and 7.2 ± 0.2 SE for control group (CCE), p value = not significant. The post intervention mean values of blood glucose level at the week 12 were 7.3 ± 0.3 SE for low glycemic index intervention group and 7.7 ± 0.4 SE for control group (CCE), p value = not significant. The eating behavior modification intervention[34] for 13 weeks significantly reduced blood sugar level in the intervention group, compared to the control group. The post-intervention mean values of blood glucose level at week 13 were 107.9 (SD = 15.8) for eating behavior modification (EBM) intervention group and 140.4 (SD = 31.0) for control group, had significant difference, $p < 0.001$.

Physical activity

Tai chi qigong exercise[19] had a statistically significant reduction in fasting plasma glucose (mg/dl) and glycosylated hemoglobin (HbA1c%) compared with the control group at 12 weeks. Mean fasting plasma glucose (mg/dl) in intervention and control groups at 12 weeks were 120.2 (SD = 17.5) mg/dl and 129.9 (SD = 15.2) mg/dl, $p = 0.02$ and HbA1c% in intervention and control groups at 12 weeks were 6.8% (SD = 1.0%) and 7.7% (SD = 0.8%) $p =$ 0.04.

In the continuous and interval training trial[25], the post intervention mean values of HbA1c (mmol/mol) at the week 12 were 54 ± 0 SE for interval (INT) training intervention group, 59 ± 0 SE for continuous (CON) training intervention group and 65.1 ± 0 SE for sedentary (SED) control group, $p < 0.05$ for only interval training intervention vs sedentary control group. The post intervention mean values of fasting blood glucose (mmol/L) at the week 12 were 6.6 ± 2.3 SE for interval (INT) training intervention group, 6.7 ± 2.0 SE for continuous (CON) training intervention group and 7.3 ± 2.0 SE for sedentary (SED) control group, p value not significant for interval intervention vs sedentary control group or continuous interventions vs sedentary control group. (The standard error values for this trial were mentioned as per the original author's confirmed value.)

General lifestyle intervention (self-management/ self-care intervention)

The included self-management program[41] had a statistically significant reduction in HbA1c comparing with the control group at 6 months. The mean HbA1c% in intervention and control groups at 6 months were 7.4% (SD = 1.25%) and 8.02% (SD = 1.75%), $p = 0.014$. In another self-management trial[40], the mean HbA1c levels were found higher in intervention group comparing to control group throughout the time baseline, mid-point of intervention (3 months) and post-intervention (6 months) but not statistically significant at 3 months and 6 months. HbA1c in intervention and control groups at 6 months were 8.6 ± 1.6 SD and 8.3 ± 1.6 SD, the mean HbA1c values at 3 months were 8.2 ± 1.6 SD and 8.1 ± 1.7 SD, $p = 0.097$ (group), $p = 0.39$ (group x time), and $p = 0.362$ (time). However the author of this trial claimed that the HbA1c results showed clinical significance. The brief structured education program[35] for self-care practices had improved HbA1c ($p = 0.03$) at week 12 compared with control group. HbA1c in

intervention and control groups at 12 weeks were 8.74 % (SD = 1.78%) and 9.54 % (SD = 2.07 %) p = 0.01. These detailed statistics were received from the author, M.Y. Tan upon request.

Outcome measurement

To assess the outcome of glycemic control in the type 2 diabetes patients, all trials included in this review included a measure of either glycosylated hemoglobin (HbA1c) or blood sugar level. One of the two dietary modification trials measured both HbA1c and fasting blood sugar and the other one only measured blood sugar. Both physical activity only trials in this review measured both HbA1c and fasting blood sugar. All of three trials for general lifestyle intervention (self-management/ self-care intervention) measured HbA1c. Looking into the quality, standardization and reliability of the measuring methods, two trials mentioned the blood samples were analyzed in the same laboratory approved by the country medical science center for quality control[40,41]. One trial specifically mentioned that they used hospital laboratory using the respective country's standardized method[19] of the National Glycohemoglobin Standardization Program (NGSP) and the Diabetes Control and Complications Trial (DCCT) assay. One trial[25] mentioned that fasting concentrations of blood glucose, hemoglobin A1c (HbA1c) were measured with standard procedures at the clinical laboratory (Bria Lab, Bangkok, Thailand). The other two trials specifically mentioned the analyzers they had used were the COBAS Integra 800 automated analyzer (Roche Diagnostic, Basel, Switzerland)[15], and Bayer DCA 2000 analyzer[35]. One last trial used "Accu-Chek Performa[34]" Portable meter to assess participants' blood sugar levels.

Adverse events

The trial of physical activity (tai chi qigong exercise) explicitly mentioned that there were no adverse events during the trial. The continuous and interval training randomized trial also

stated that no subjects in the interval training group suffered from injury or cardiovascular event throughout the intervention period. Apart from these 2 trials the other 5 trials – dietary modification (low glycemic index diet and eating behavior modification program) and general lifestyle interventions (self-management programs / brief structured education program enhancing self-care practices) - did not state any specific information on adverse events relating to the interventions.

Table 3.3 Summary of the randomized trials

Study name	Study Country	N	Mean Age (years)	Gender	Type of diabetes	Duration of diabetes	Treatment mode	Comorbidity +/-	Modality	Diet modification	Physical Activity	General lifestyle	Duration of Intervention	Glycemic control	Participant Attrition
Wattana et al 2007	Thailand	147	I=58.4 (10.05) ; C=55.14 (10.22) p=0.053	M=34, F=112 p=0.268	II	I=6.52(4.71), C= 5.82 (5.32) p=0.087	No medication, One drug, Combined drugs, Other drugs	None, H/t, Cardiomegaly, Cataract, Proteinuria, Previous stroke	RCT			self-management	6months	HbA1c	6.37% 157 to 147 (final I=75,C=72) reasons=C' (OHA to insulin, not completed intervention), no flow digaram
Keeratiyutawong et al 2006	Thailand	81	ranged 27 to 60	both; 74% were female	II	<10 year (inclusion criteria)	only with oral medication (inclusion criteria)	Serious illness / Diabetes complications were in exclusion criteria	RCT			self-management	6 months (3 mth, 6 mth assessments)	HbA1c	10 % (9/90 total; I=5/45 and C= 4/45); reasons=not to do with dissatisfaction with the program. No flow diagram

Study	Country	N	Age	Gender	Type	Duration of diabetes	Medication	Inclusion criteria	Study design	Intervention		Duration	Outcomes	Attrition
Youngwanichsetha et al 2013	Thailand	64	I=35 (5.63); C= 36.16 (4.48) =0.34	exclusively women (post-partum)	II	I=2.47(1.24); C=2.78 (1.18) p=0.82	no medication	18 had C' (I=8, C=10); 46 did not have C' (I=24, C=22)	single blinded RCT		Tai Chi Quigong	12 weeks	HbA1c; FBS	7 % (5/69 total; I=32/34 and C=32/35) reasons given , flow diagram given, moved to another town to work
Yusof et al 2009	Malaysia	104	NR	both, breakdown NR	II	The subject who had T2DM at least 3 months before the study were selected.	diet / or combined with OHA	overweight, high waist circumference, poor glycemic control	Randomized trial	low glycemic index diet		12 weeks	HbA1c;Fructosamine; FBS	3.8% (I=52to51; C=52to49) ITT reasons given I=insulin therapy started; C= did not turn up. Flow diagram given
Tan et. al.2011	Malaysia	164	I=54 (9.94); C=54 (10.74) *p*=not significant	M=63, F=101 *p*=not significant	II (157 patients); I (7 patients, 4%) poorly controlled	I=12.1 (8.6); C=10.49 years (8.93) *p*= not significant	OHA/ Insulin/ Combined	poorly controlled diabetes	single blinded RCT		brief structured education, self-care practices	12 weeks	HbA1c	8% (164 to 151) reasons given, flow diagram given

Study	Country	N	Age	Sex	Type	Duration of disease	Comorbidity	Population	Design	Intervention	Follow up	Outcome	Attrition
Wattanakorn et al 2013	Thailand	76	I=49.89 (7.8) C=49.87 (7.71); p=0.99	M=12, F=64 =1.0	II	I=5.7 (4.9); =4.61 (2.88) years p=0.25	NR	people with obesity, no comorbidity, non-pregnant, (inclusion criteria)	RCT	eating behavior modification program	13 weeks	Blood sugar	5% (C=1 died with heart failure, another 1 moved to other province I=2 participated in only 2 sessions) I=40 to 38; C=40 to 38. No flow diagram
Mitranun et al 2014	Thailand	43	I= 61.7 (2.7 SE); 61.2 (2.8 SE); C= 60.9 (2.4 SE)	M=5+5+5 (control, Continuous, Interval) =15 ; F=10+9+9=28 p= not reported	II	I=20.5 (0.4) Conti; 19.5 (0.4) Int; C=21.1 (0.6) years p=0.26	Anti-hyperglycemic medication	no comorbidity; all female were post-menopausal	Randomized trial	continuous, interval training	12 weeks	HbA1c; FBS	4% (2/45) (I ,continuous = 1; I, interval = 1)

I=Intervention, C= Control, M=Male, F=Female, Conti=Continuous training, Int=Interval training

Chapter 4 - Meta-analysis results

Data were pooled from the selected 7 randomized clinical trials that reported on the glycemic control in either HbA1c or blood sugar level. The heterogeneity test results for the outcome of HbA1c for lifestyle modification interventions were $Tau^2 = 0.16$, $Chi^2 = 19.16$, $df = 5$ ($p=0.002$), $I^2 = 74\%$ which suggested a substantial heterogeneity and heterogeneity test results for the outcome of blood sugar level for lifestyle modification interventions were $Tau^2 = 0.22$, $Chi^2 = 15.84$, $df = 4$ ($p = 0.003$), $I^2 = 75\%$ which suggested a substantial heterogeneity. Therefore, in this case, the "random effects model" was used to do the meta-analysis on the glycemic control outcomes. Regarding the heterogeneity for sensitivity analysis/ sub group analysis for physical activity sub group, $I^2 = 0\%$ for HbA1c% and for blood sugar level, which suggests heterogeneity might not be important[37]. However for the sub-group analysis of self-management/ self-care over the 3-month's period, $I^2 = 77\%$ (substantial heterogeneity[37]) for HbA1c% and the sub group analysis of diet modification over 3 month's period, $I^2 = 92\%$ (considerable heterogeneity[37]) for blood sugar level.

Overall, the absolute value (mean difference) of the studies included in this review showed statistically significant reduction of HbA1c% in lifestyle modification intervention (n = 5 studies) for 3 months (n = 5 studies) but not in 6 months (n = 2 studies); and the effect size (standardized mean difference) showed lifestyle modification interventions (n = 5 studies) had statistically significant reduction in HbA1c at 3 months however it (n = 2 trials) became statistically not significant at 6 month of intervention. Here it is noted that for 6 months intervention, only self-management/ self-care intervention studies were available for analysis. The studies checking for blood sugar level were 3-month interventions only. No study with long term (>3 months) intervention was found for diet only and physical activity only interventions.

Overall, diabetic patients who received lifestyle modifications (dietary modification or physical activity or general lifestyle intervention including behavior change management such as self-management and self-care interventions) for 12 weeks had statistically significant reduction in HbA1c, standardized mean difference (SMD) = -0.48 (95% CI -0.87, -0.10), $p = 0.01$, number of trials (n) = 6 trials (figure 4.1) and statistically significant reduction in absolute value of HbA1c% mean difference (MD) = -0.56% (95% CI -0.95, -0.16%), $p = 0.006$, number of trials (n) = 6 trials (figure 4.2), compared with the diabetes patients under the control groups. For long term, there were only general lifestyle modification intervention (Self-management and self-care interventions) for 6 months, which showed a reduction in HbA1c effect size, SMD = -0.14 (95% CI -0.7, 0.42), $p = 0.62$, n = 2 trials (figure 4.3) and absolute value HbA1c% MD = -0.21% (95% CI -1.08, 0.66%), $p = 0.63$, n = 2 trials (figure 4.4), in the intervention group than the control group however they were not statistically significant.

The reduction in blood glucose (absolute value) was statistically significant MD = -16.76 mg/dl (95% CI = -31.36, -2.17 mg/dl), $p = 0.02$; n = 5 trials (figure 4.10), though was not statistically significant in terms of effect size SMD = -0.47 (95% CI = -0.9, 0.02), $p = 0.06$, n = 5 trials (figure 4.9), for overall lifestyle modification interventions (dietary modification or physical activity for 12 -13 weeks) than the standard care control groups.

Subgroup analyses showed that physical activity for 3 months intervention had statistically significant reduction of HbA1c both in effect size SMD = -0.95 (95% CI -1.33, -0.57), $p<0.00001$, n = 3 trials (figure 4.5) and absolute value of HbA1c% MD = -0.85% (95% CI -1.15, -0.55%, $p<0.00001$, n = 3 trials (figure 4.6) compared with control group. And in terms blood sugar level, there was statistically significant reduction in absolute value blood sugar level mg/dl MD = -9.71 mg/dl (95% CI -17.70, -1.72 mg/dl), $p = 0.02$, n =3 trials (figure 4.12) though

no statistically significant reduction in effect size of blood sugar level SMD = -0.34 (95% CI - 0.70, 0.02), $p = 0.07$, n = 3 trials (figure 4.11).

Subgroup analysis of diet modification for 12-13 weeks did not have statistically significant reduction of blood sugar level, compared with the control group in both effect size SMD = -0.72 (95% CI -1.85, 0.41), $p = 0.21$, n = 2 trials (figure 4.13) and absolute value MD = -20.83 mg/dl (95% CI -45.54, 3.88 mg/dl), $p = 0.10$, n = 2 trials (figure 4.14).

Subgroup analysis for general lifestyle intervention including behavior change (self-management and self-care) for 3 months intervention period, had no statistically significant reduction in HbA1c compared to the control group in both effect size SMD = -0.23 (95% CI -0.78, 0.33), $p = 0.42$, n = 2 trials (figure 4.7) and absolute value MD = -0.42% (95% CI -1.45, 0.61%), $p = 0.43$, n = 2 trials (figure 4.8).

For publication bias assessment, there were 7 studies for this review and no evidence of very significant asymmetry could be observed in the funnel plots (figure 4.15 and 4.16). However, it is noted that there were only 7 RCTs (<10 studies) in this review so it was difficult to determine whether there was a real asymmetry[37].

Study or Subgroup	Experimental			Control			Weight	Std. Mean Difference IV, Random, 95% CI	Std. Mean Difference IV, Random, 95% CI
	Mean	SD	Total	Mean	SD	Total			
Keeratiyutawong et al 2006	8.22	1.59	40	8.09	1.71	41	18.5%	0.08 [-0.36, 0.51]	
Mitranun et al 2014	7.548	1.06	14	8.106	0.71	15	12.7%	-0.61 [-1.35, 0.14]	
Mitranun et al 2014 (a)	7.091	0.71	14	8.106	0.71	15	11.6%	-1.39 [-2.21, -0.57]	
Tan et. al 2011	8.75	1.75	82	9.67	2.01	82	20.9%	-0.49 [-0.80, -0.18]	
Youngwanichsetha et al 2013	6.83	0.97	32	7.7	0.84	32	16.9%	-0.95 [-1.47, -0.43]	
Yusof et al 2009	7.2	0.72	52	7.2	1.44	52	19.5%	0.00 [-0.38, 0.38]	
Total (95% CI)			234			237	100.0%	-0.48 [-0.87, -0.10]	

Heterogeneity: Tau² = 0.16; Chi² = 19.16, df = 5 (P = 0.002); I² = 74%

Test for overall effect: Z = 2.44 (P = 0.01)

Figure 4.1 Forest plot comparison of HbA1c standardized mean difference (effect size) for 3 months lifestyle modification intervention vs control

Study or Subgroup	Experimental			Control			Weight	Mean Difference IV, Random, 95% CI	Mean Difference IV, Random, 95% CI
	Mean	SD	Total	Mean	SD	Total			
Keeratiyutawong et al 2006	8.22	1.59	40	8.09	1.71	41	13.7%	0.13 [-0.59, 0.85]	
Mitranun et al 2014	7.548	1.06	14	8.106	0.71	15	14.7%	-0.56 [-1.22, 0.10]	
Mitranun et al 2014 (a)	7.091	0.71	14	8.106	0.71	15	17.4%	-1.01 [-1.53, -0.50]	
Tan et. al 2011	8.75	1.75	82	9.67	2.01	82	16.3%	-0.92 [-1.50, -0.34]	
Youngwanichsetha et al 2013	6.83	0.97	32	7.7	0.84	32	18.9%	-0.87 [-1.31, -0.43]	
Yusof et al 2009	7.2	0.72	52	7.2	1.44	52	19.0%	0.00 [-0.44, 0.44]	
Total (95% CI)			234			237	100.0%	-0.56 [-0.95, -0.16]	

Heterogeneity: Tau² = 0.17; Chi² = 16.17, df = 5 (P = 0.006); I² = 69%

Test for overall effect: Z = 2.72 (P = 0.006)

Figure 4.2 Forest plot comparison of HbA1c mean difference (absolute value in %) for 3 months lifestyle modification intervention vs control

Study or Subgroup	Experimental			Control			Weight	Std. Mean Difference IV, Random, 95% CI	Std. Mean Difference IV, Random, 95% CI
	Mean	SD	Total	Mean	SD	Total			
Keeratiyutawong et al 2006	8.56	1.63	40	8.29	1.62	41	46.7%	0.16 [-0.27, 0.60]	
Wattana et al 2007	7.4	1.25	75	8.02	1.75	72	53.3%	-0.41 [-0.73, -0.08]	
Total (95% CI)			115			113	100.0%	-0.14 [-0.70, 0.42]	

Heterogeneity: Tau² = 0.12; Chi² = 4.22, df = 1 (P = 0.04); I² = 76%

Test for overall effect: Z = 0.49 (P = 0.62)
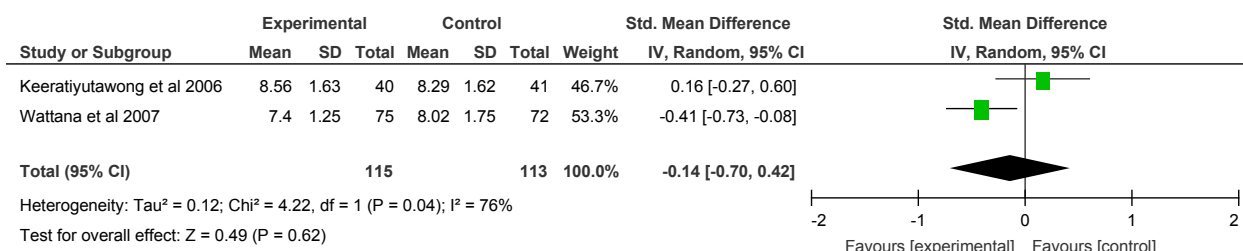
Figure 4.3 Forest plot comparison of HbA1c standardized mean difference (effect size) for 6 months lifestyle modification intervention vs control
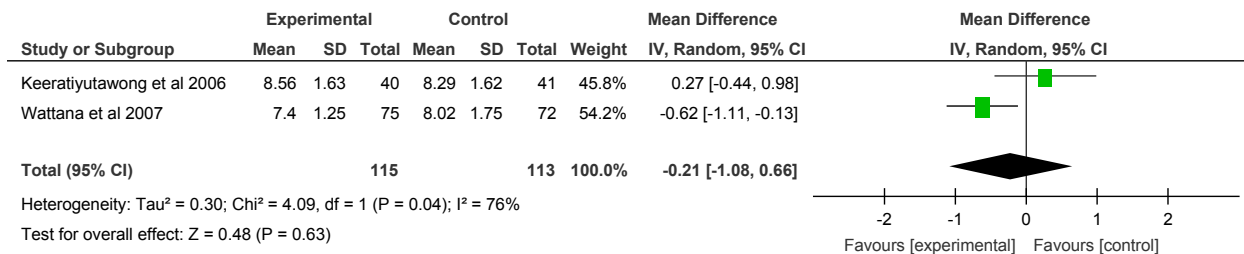
Figure 4.4 Forest plot comparison of HbA1c mean difference (absolute value in %) for 6 months lifestyle modification intervention vs control
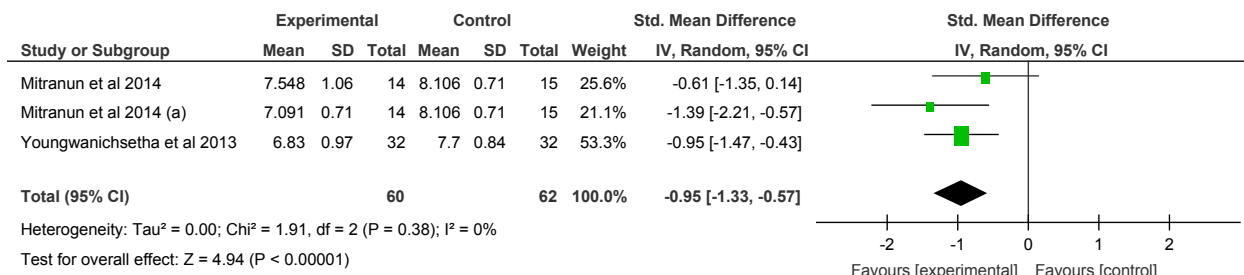
Figure 4.5 Forest plot of comparison of HbA1c standardized mean difference (effect size) for 3 months physical activity intervention vs control
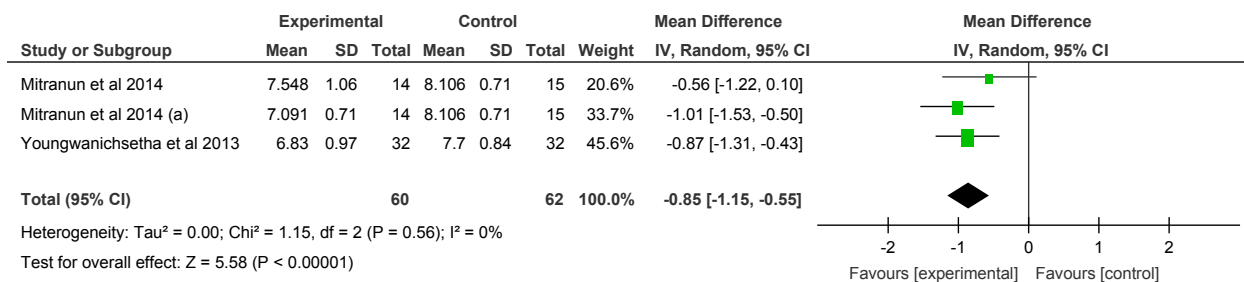
Figure 4.6 Forest plot comparison of HbA1c mean difference (absolute value in %) for 3 months physical activity intervention vs control

| Study or Subgroup | Experimental | | | Control | | | | Std. Mean Difference | Std. Mean Difference |
	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI
Keeratiyutawong et al 2006	8.22	1.59	40	8.09	1.71	41	46.2%	0.08 [-0.36, 0.51]	
Tan et. al 2011	8.75	1.75	82	9.67	2.01	82	53.8%	-0.49 [-0.80, -0.18]	
Total (95% CI)			122			123	100.0%	-0.23 [-0.78, 0.33]	

Heterogeneity: Tau² = 0.12; Chi² = 4.26, df = 1 (P = 0.04); I² = 77%
Test for overall effect: Z = 0.80 (P = 0.42)

Figure 4.7 Forest plot of comparison of HbA1c standardized mean difference (effect size) for 3 months general lifestyle modification intervention vs control

| Study or Subgroup | Experimental | | | Control | | | | Mean Difference | Mean Difference |
	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI
Keeratiyutawong et al 2006	8.22	1.59	40	8.09	1.71	41	47.8%	0.13 [-0.59, 0.85]	
Tan et. al 2011	8.75	1.75	82	9.67	2.01	82	52.2%	-0.92 [-1.50, -0.34]	
Total (95% CI)			122			123	100.0%	-0.42 [-1.45, 0.61]	

Heterogeneity: Tau² = 0.44; Chi² = 4.99, df = 1 (P = 0.03); I² = 80%
Test for overall effect: Z = 0.80 (P = 0.43)

Figure 4.8 Forest plot of comparison of HbA1c mean difference (absolute value in %) for 3 months general lifestyle modification intervention vs control
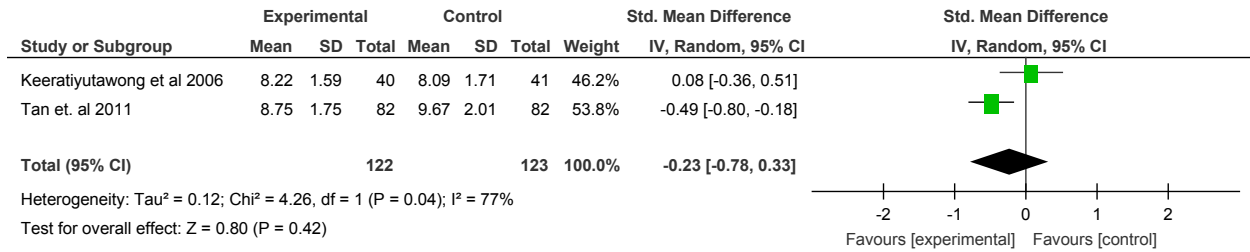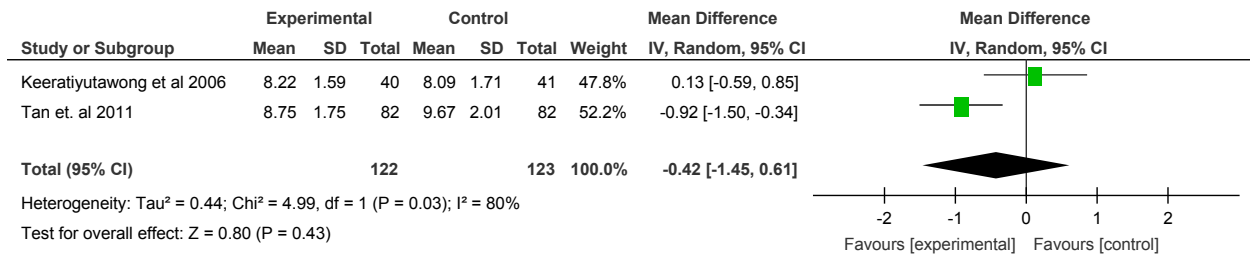
| Study or Subgroup | Experimental | | | Control | | | | Std. Mean Difference | Std. Mean Difference |
	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI
Youngwanichsetha et al 2013	120.19	17.51	32	129.88	15.23	32	21.3%	-0.58 [-1.08, -0.08]	
Yusof et al 2009	131.53	38.98	52	138.74	51.97	52	23.5%	-0.16 [-0.54, 0.23]	
Wattanakorn et al 2013	107.92	15.81	38	140.42	30.99	38	21.3%	-1.31 [-1.81, -0.81]	
Mitranun et al 2014	120	134.83	14	130.99	139.57	15	17.0%	-0.08 [-0.81, 0.65]	
Mitranun et al 2014 (a)	118.92	155.06	14	130.99	139.57	15	17.0%	-0.08 [-0.81, 0.65]	
Total (95% CI)			150			152	100.0%	-0.47 [-0.95, 0.02]	

Heterogeneity: Tau² = 0.22; Chi² = 15.84, df = 4 (P = 0.003); I² = 75%
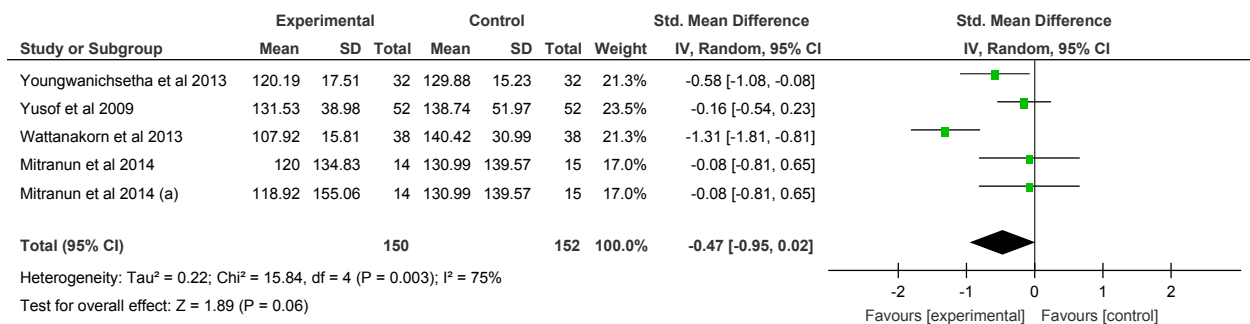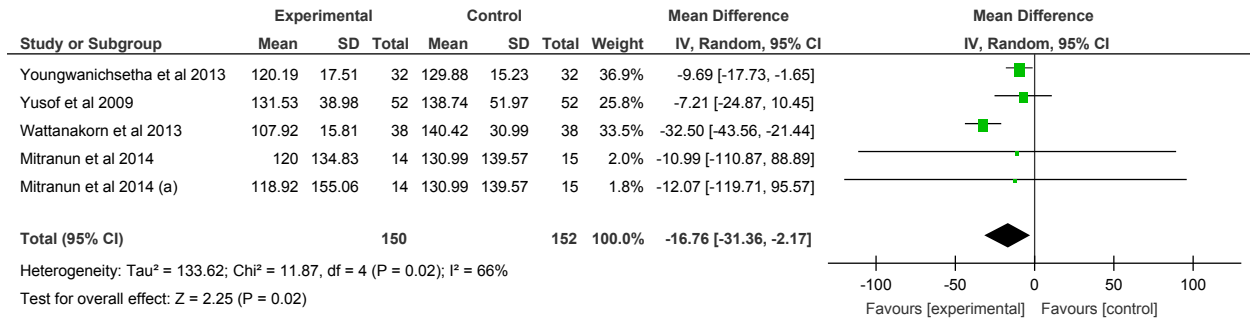Test for overall effect: Z = 1.89 (P = 0.06)

Figure 4.9 Forest plot of comparison of blood sugar level standardized mean difference (effect size) for 3 months lifestyle modification vs control
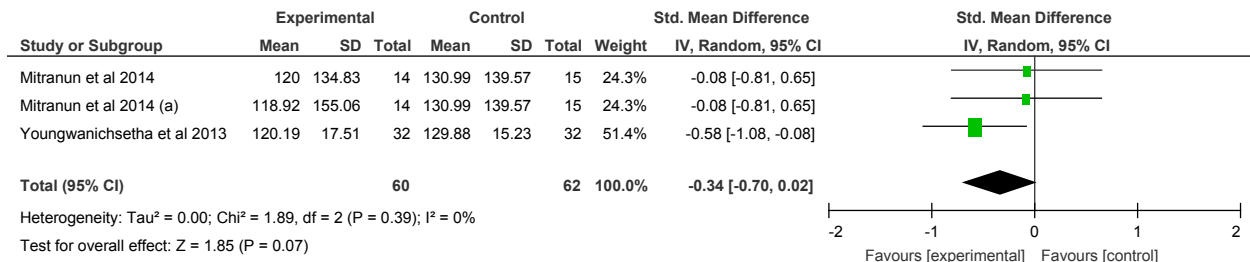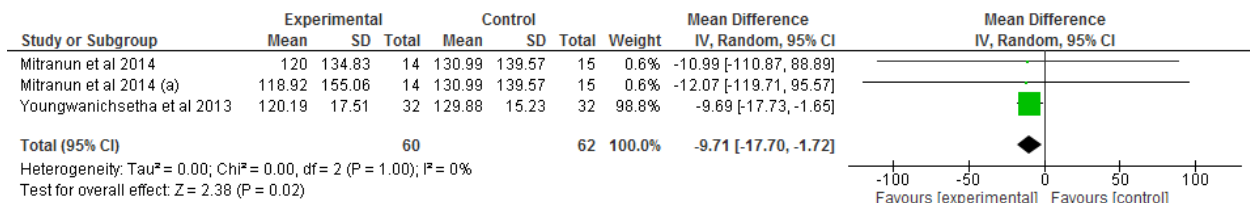
| Study or Subgroup | Experimental | | | Control | | | | Mean Difference | Mean Difference |
	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI
Youngwanichsetha et al 2013	120.19	17.51	32	129.88	15.23	32	36.9%	-9.69 [-17.73, -1.65]	
Yusof et al 2009	131.53	38.98	52	138.74	51.97	52	25.8%	-7.21 [-24.87, 10.45]	
Wattanakorn et al 2013	107.92	15.81	38	140.42	30.99	38	33.5%	-32.50 [-43.56, -21.44]	
Mitranun et al 2014	120	134.83	14	130.99	139.57	15	2.0%	-10.99 [-110.87, 88.89]	
Mitranun et al 2014 (a)	118.92	155.06	14	130.99	139.57	15	1.8%	-12.07 [-119.71, 95.57]	
Total (95% CI)			150			152	100.0%	-16.76 [-31.36, -2.17]	

Heterogeneity: Tau² = 133.62; Chi² = 11.87, df = 4 (P = 0.02); I² = 66%
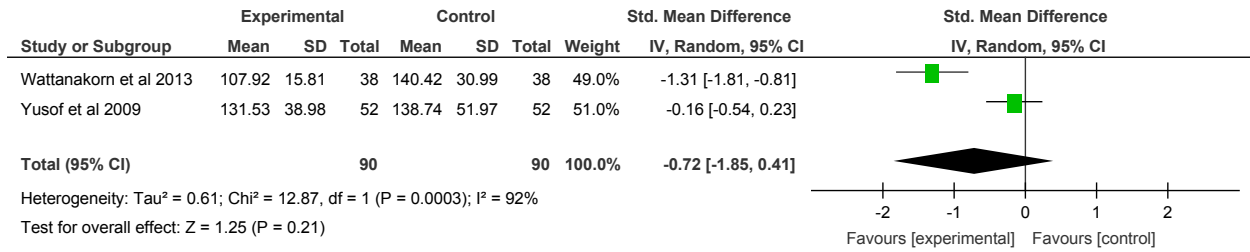Test for overall effect: Z = 2.25 (P = 0.02)

Figure 4.10 Forest plot of comparison of blood sugar level mean difference (absolute value in mg/dl) for 3 months lifestyle modification vs control
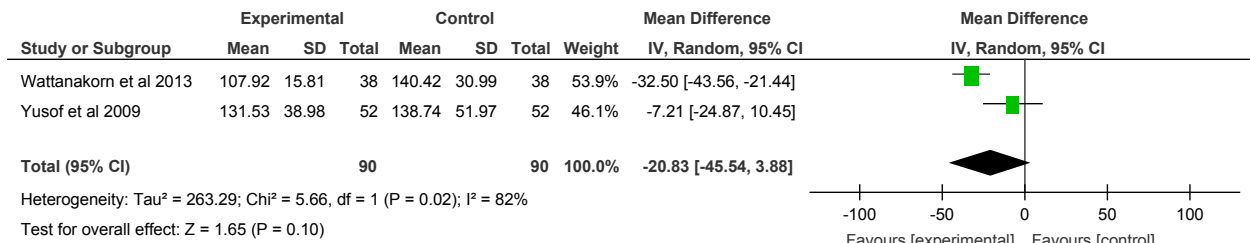
| Study or Subgroup | Experimental | | | Control | | | | Std. Mean Difference | Std. Mean Difference |
	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI
Mitranun et al 2014	120	134.83	14	130.99	139.57	15	24.3%	-0.08 [-0.81, 0.65]	
Mitranun et al 2014 (a)	118.92	155.06	14	130.99	139.57	15	24.3%	-0.08 [-0.81, 0.65]	
Youngwanichsetha et al 2013	120.19	17.51	32	129.88	15.23	32	51.4%	-0.58 [-1.08, -0.08]	
Total (95% CI)			60			62	100.0%	-0.34 [-0.70, 0.02]	

Heterogeneity: Tau² = 0.00; Chi² = 1.89, df = 2 (P = 0.39); I² = 0%
Test for overall effect: Z = 1.85 (P = 0.07)

Figure 4.11 Forest plot of comparison of blood sugar level standardized mean difference (effect size) for 3 months physical activity vs control

| Study or Subgroup | Experimental | | | Control | | | | Mean Difference | Mean Difference |
	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI
Mitranun et al 2014	120	134.83	14	130.99	139.57	15	0.6%	-10.99 [-110.87, 88.89]	
Mitranun et al 2014 (a)	118.92	155.06	14	130.99	139.57	15	0.6%	-12.07 [-119.71, 95.57]	
Youngwanichsetha et al 2013	120.19	17.51	32	129.88	15.23	32	98.8%	-9.69 [-17.73, -1.65]	
Total (95% CI)			60			62	100.0%	-9.71 [-17.70, -1.72]	

Heterogeneity: Tau² = 0.00; Chi² = 0.00, df = 2 (P = 1.00); I² = 0%
Test for overall effect: Z = 2.38 (P = 0.02)

Figure 4.12 Forest plot of comparison of blood sugar level mean difference (absolute value in mg/dl) for 3 months physical activity vs control

Study or Subgroup	Experimental			Control			Weight	Std. Mean Difference IV, Random, 95% CI
	Mean	SD	Total	Mean	SD	Total		
Wattanakorn et al 2013	107.92	15.81	38	140.42	30.99	38	49.0%	-1.31 [-1.81, -0.81]
Yusof et al 2009	131.53	38.98	52	138.74	51.97	52	51.0%	-0.16 [-0.54, 0.23]
Total (95% CI)			**90**			**90**	**100.0%**	**-0.72 [-1.85, 0.41]**

Heterogeneity: Tau² = 0.61; Chi² = 12.87, df = 1 (P = 0.0003); I² = 92%

Test for overall effect: Z = 1.25 (P = 0.21)

Figure 4.13 Forest plot of comparison of blood sugar level standardized mean difference (effect size) for 3 months diet modification vs control

Study or Subgroup	Experimental			Control			Weight	Mean Difference IV, Random, 95% CI
	Mean	SD	Total	Mean	SD	Total		
Wattanakorn et al 2013	107.92	15.81	38	140.42	30.99	38	53.9%	-32.50 [-43.56, -21.44]
Yusof et al 2009	131.53	38.98	52	138.74	51.97	52	46.1%	-7.21 [-24.87, 10.45]
Total (95% CI)			**90**			**90**	**100.0%**	**-20.83 [-45.54, 3.88]**

Heterogeneity: Tau² = 263.29; Chi² = 5.66, df = 1 (P = 0.02); I² = 82%

Test for overall effect: Z = 1.65 (P = 0.10)

Figure 4.14 Forest plot of comparison of blood sugar level mean difference (absolute value in mg/dl) for 3 months diet modification vs control
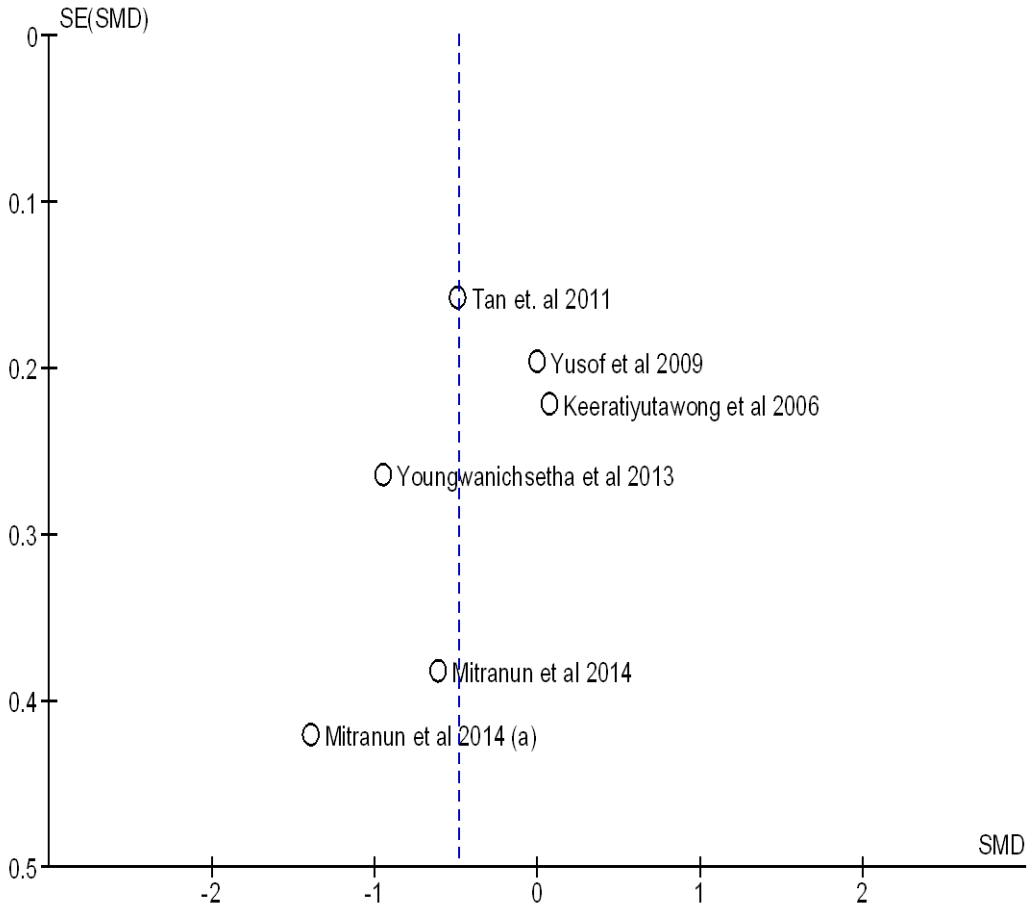
Figure 4.15 Funnel plot of comparison for glycemic control HbA1c for 3 months.
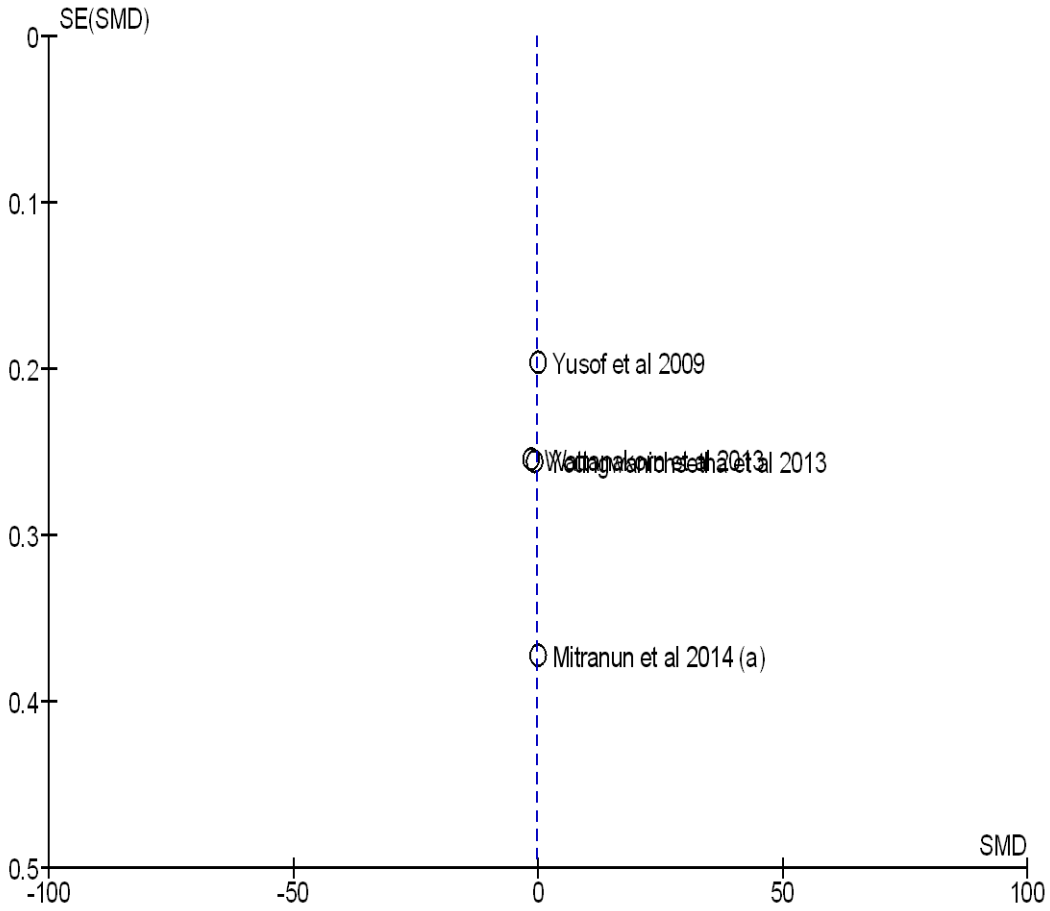
Figure 4.16 Funnel plot of comparison for blood glucose level for 3 months

Chapter 5 - Discussion

In this review, lifestyle modifications interventions (dietary modification or physical activity or general lifestyle interventions including behavior change- self-management and self-care interventions) showed a statistically significant reduction in HbA1c compared to the control groups. The reduction effect size, (standardized mean difference, SMD), for HbA1c was -0.48, and absolute value of HbA1c% reduction (mean difference, MD) was -0.56%, which conforms to the reduction range (-0.3% to -0.8 %) that other systematic reviews and meta-analyses on the similar interventions had found. Stratton and colleagues stated that any 1% reduction in HbA1c is likely to reduce the risk of diabetes related complications, and the lowest risk is in those with HbA1c values <6%[42]. The US department of Health and Human Services states that 0.3% decrease in HbA1c is clinically meaningful[43]. Absolute value of blood sugar level reduction in intervention group (for short term, 3 months intervention) was -16.76 mg/dl compared with control group. Regarding to blood glucose reduction, it is worth to note that even drugs (e.g., thiazolidinediones/ PPAR agonists) takes 6 weeks' time to achieve a reduction in fasting blood glucose of 20 mg/dl[43]. The effect size is a standardized measures of effect, which are calculated to transform the effect to an easily understood scale. General interpretation[44, 45] for effect size is 0.2 (small effect), 0.5 (medium effect), 0.8 (large effect) and 1.3 (very large effect). Overall lifestyle modification showed moderate effect of HbA1c reduction (-0.48) and physical activity points to large effect (-0.95).

Heterogeneity was substantial and considerable for HbA1c and blood glucose effect size analyses. Heterogeneity for sub-group analysis of physical activity trials for short term blood glucose control was found not important heterogeneity. Literature indicated that since clinical and methodological diversity are common for a meta-analysis, statistical heterogeneity is in fact

inevitable and heterogeneity can always be found whether or not it is detected by using a statistical test[37]. Higgins stated "any amount of heterogeneity is acceptable, providing both that the predefined eligibility criteria for the meta-analysis are sound and that the data are correct[46]."

There were not many RCTs in the Southeast Asia which studied on the lifestyle modification for glycemic control in diabetes patients and that met the inclusion criteria of this review. The randomized trials for this review included different modalities of lifestyle modifications but each sub-group did not have many identical or similar trials. The possible reason for getting the diverse modalities of trials is the difficulty to have a single fixed method of lifestyle modification that fits different disease severity of different patients.

Supervision on the interventions

Supervision is very important to measure the real effects of the interventions minimizing the biases. Most of the interventions of the randomized trials included in this review were not undertaken in the research centers under the supervision of the therapists / researchers. Thus, there could be under/over reporting on the compliance and real practices of lifestyle modifications that the participants were supposed to do. A systematic review [47] from Australia, which reviewed the effects of resistance training on glycemic control and insulin sensitivity in type 2 diabetes adult patients, reported that supervised resistance training has improved glycemic control and insulin sensitivity but compliance and glycemic control decreased when supervision was removed. This factor is a possible reason for getting small or insignificant effect sizes for dietary modification and self-management/self-care interventions. The physical activity interventions were mostly performed under supervision and compliance were monitored by the investigators though tai chi qigong was practiced at home after initial three 50 minutes training

sessions in the center. Therefore, the physical activity intervention had the highest effect size of HbA1c% reduction and significant blood sugar level mg/dl (absolute value) reduction.

Duration of the interventions

Duration of intervention appeared to be one of the most important factors for the effect on glycemic control. Intervention periods of the trials included in this review were either 3 months or 6 months. It was observed that the short term interventions (3 months) have significant pooled effect size (SMD) of improved glycemic control, however the pooled effect size was not statistically significant for longer term interventions for 6 months. This could be due to the nature of life-long disease that the patients were quite difficult to sustain the lifestyle modifications at the effective dosage level for longer term (6 months in this review) although they could try to comply with interventions for short-run (3-month time point). To sustain a long-term effect, the diabetes patients might need physical, mental, social and motivational supports to be able to comply with the prescribed lifestyle modification interventions. For lifestyle modification and glycemic control, the randomized trials with longest intervention available in the Southeast Asia region, so far, was the trial studied only up to 6 months. So, in order to better understand longer term effect of the lifestyle modification interventions, more randomized trials with longer intervention periods are in need. There were different conclusions about the intervention period from other systematic reviews. Similarity was observed in one of the Cochrane systematic review[48] in which type 2 diabetes patients who did not use insulin had small glycemic control effect by means of self-monitoring of blood glucose up to six months after initiation but the effect subsided after 12 months.

Intensity and dosage

Intensity and dosage of lifestyle modification interventions are very important to achieve the intended results. It is understood that there couldn't be one-size fits all lifestyle modification intervention or package, likewise the pharmacological medications, lifestyle modification would need to tailor and adjust the lifestyle modification interventions intensity, dosage and duration for different individuals by close monitoring and supervision of the trained care persons to achieve the best outcomes. A systematic review[22] from Australia which found out that prescribing longer duration and greater frequency exercise training in high-risk, ethnic populations with T2DM got better results but inadequate interventions had no effect. The RCT conducted by McAuley et al.[49] concluded that significant improvement in insulin sensitivity resulted only in normoglycemic insulin resistant people with intensive dietary and exercise program and not in the moderate exercise programs comparing to control group. The intensive exercise program was at least 20 min per session five times a week for at an intensity of 80–90% of age-predicted maximum heart rate. So the intensity of the physical interventions of the randomized trials included in this review might have reached the intensity and dosage to give the significant short-term reduction in HbA1c. However, to conclude so, there were only a few RCTs available in this moment. This systematic review findings should be interpreted for general idea for overall that lifestyle modification works for glycemic control for type 2 diabetes patients in the Southeast Asia context

Dietary modification

Generally dietary interventions (for diabetes) are acknowledged difficult to perform and also difficult to assess very accurately what the patients really ate. Out of the two dietary modification randomized trials, the eating behavior modification program conducted in Thailand

had significant reduction of blood glucose in the intervention group compared with the control group. Low glycemic index diet modification, conducted in Malaysia, did not have significant difference of HbA1c% or blood glucose level from the control group (conventional carbohydrate exchange group). The pooled effect size for diet modification (n = 2 studies) for 12-13 weeks did not show a statistically significant reduction of blood sugar level than the control group (figure 4.13 and 4.14). This is likely multifactorial, as it could be due to different nature of intervention modalities, selection of the participants, frequency and duration of contact time between therapist and the diabetes patients, availability and familiarity of low-glycemic food in the community because the intervention did not provide low-glycemic food on site etc. Moreover, in low-glycemic index diet intervention, the study participants were with poor glycemic control and there were high possibility of under-reporting and uncertainty in the reliability of dietary data. These factors suggests that if the participants were planned to eat the low-glycemic index foods prepared by the research center under supervision, glycemic control results of low glycemic index diet might have shown a significant difference. But on the other hand, such intervention design might affect the external validity of the trial. To interpret more confidently on the subgroup analysis for the Southeast Asia region, enough randomized trials for sub-group dietary modifications with similar intervention modality are in need. Still in the low glycemic index diet intervention, the changes in fasting glucose level, serum fructosamine was significantly lower than the control group (conventional carbohydrate exchange group) over 12 weeks' time despite there were no significant differences between intervention and control groups. This suggested that low glycemic index diet had some positive impacts on glycemic control and it could pronounce more if the compliance was ensured. Compliance with the prescription of low glycemic index diet also depends on the availability and accessibility of the low glycemic index

diet in the traditional foods of the study community. The author stated that low glycemic index intervention had limitations for standardization of dietary education for every participant, supervision and assessment of real consumption of diets. And it could be due to patients were not aware of the portion size they usually eat. These could be the basis for not having significant difference from control group.

Comparing with other review findings for dietary modification interventions, low-glycemic diet intervention, although low-glycemic diet modification did not show significant reduction in glycemic control in short term compared with control group in the Southeast Asia (in Malaysia), a systematic review[23] from Australia studied on the use of low-glycemic index diet in diabetes for 4 weeks concluded that lowering the glycemic index had a significant decrease in HbA1c than using the control diet with the mean difference (WMD) -0.4% HbA1c and low-glycemic index diet had a decrease in fructosamine than using the control diet with WMD -0.23 mmol/L.

Another systematic review[21] from Australia reviewed on low-glycemic index diets in the management of diabetes upon type1 and type 2 diabetic patients including type 1 diabetic children with mean duration of intervention for 10 weeks (12 days to 12 months) concluded that low-glycemic index diet instead of high-glycemic diets had a small but clinically useful effects on medium-term glycemic control in the diabetic patients. Moreover these authors found out that the incremental benefits was similar to that of pharmacological agents for controlling postprandial hyperglycemia. This review found low-glycemic index diets helped 0.43% point reduction in HbA1c than high GI diets.

The Cochrane systematic reviews[50,51] on dietary advice for treatment of type 2 diabetes mellitus in adults reviewed 18 trials of various dietary approaches such as low-fat/high-

carbohydrate diets, high-fat/low-carbohydrate diets, low-calorie (1000 kcal per day) and very-low-calorie (500 kcal per day) diets and modified fat diets. These authors concluded that there were no high quality data to determine with certainty the efficacy of dietary treatment of type 2 diabetes but the exercise appeared to improve glycated hemoglobin in 6 months and 12 months duration of interventions, however all of those studies were found to be at high risk of bias.

Physical activity

As the subgroup analysis, physical activity, tai chi qigong, continuous and interval trainings for 3 months, had highest and statistically significant HbA1c% reduction effect size comparing to control groups and statistically significant reduction in absolute value of HbA1c% and blood sugar level mg/dl. Although both physical activity intervention trials were conducted in Thailand, the demographic and history of diabetes of the participants of physical activity were quite different. The mean duration of diabetes of the participants of tai chi qigong study were around 2½ years while that of the participants from continuous and interval training study were around 21 years. The mean age of tai chi qigong[19] trial was middle age around 35 years while the mean age of continuous and interval training trial[25] was around 60 years. All in all, physical activity interventions still showed highest pooled effect size -0.95 and absolute value -0.85% for HbA1c% reduction. These results give the impression that the diabetes patients in the Southeast Asia tend to accept and comply with physical activity prescription better than those for dietary modification. This review finding is in line with other systematic reviews findings for physical activity and glycemic control HbA1c% reduction ranged from -0.3% to -0.8%.

A systematic review[18] on the impact of walking for ≥ 8 weeks on glycemic control and other cardiovascular risk factors in type 2 diabetes concluded that walking can significantly decrease HbA1c among type 2 diabetes patients by 0.5%; and if the walking was under

supervision, more pronounced reduction 0.58% in HbA1c was found. In the Irvine et al systematic review[52] (n = 9 trials), it concluded resistance exercise had significant reduction in HbA1c by 0.3% comparing with not exercising though no significant differences were found comparing with aerobic exercise. The Cochrane systematic review[24] on exercise for treatment of type 2 diabetes mellitus (n=14; exercise types = resistance and aerobic based exercises such as continuous and intermittent cycling, progressive increases in walking and mixed aerobic sessions of running, cycling, skiing, and swimming, mixed aerobic and resistance training sessions and a two hour session of Qi-gong) found a statistically and clinically significant reduction in glycated hemoglobin levels of 0.6% in the intervention groups. The decrease in the glycated hemoglobin was more significant in shorter studies (<3 months) than longer interventions (<6 months).

The Sukala et al. systematic review[22] on exercise training- aerobic training, resistance training or a combination of them with duration ranged from 8 weeks to 52 weeks, 5 to 7 sessions per week for exercise training and 30-60 minutes duration, 4-10 repetitions for aerobic training in high-risk ethnic populations with type 2 diabetes reported improvements in HbA1c, insulin actions in several trials.

The Gordon et al systematic review on resistance training for metabolic health in type 2 diabetes[28] included 21 trials with various frequency (2-5days/week) and intensity (from % 1 repetition maximum to 10 repetition maximum) and duration (from 4 - 6 weeks to 12 months) of resistance training concluded there were improvements of glycemic control and insulin sensitivity when resistance training was under supervision. The glycemic control decreased when no supervision was put on resistance training however this systematic review did not provide overall effect size in glycemic control and insulin sensitivity.

General lifestyle (self-management/ self-care) intervention

Based on the review and analysis, for the general lifestyle interventions such as self-management/ self-care/ brief structured education program, contact time with the therapist (duration), frequency of contacts (monthly/ bimonthly etc.), continuous motivational communication and monitoring were observed as very important factors for significant results.

The self-management/ self-care intervention subgroup analysis showed pooled effect size was not statistically significant for both short term (3 months) and longer term (6 months). The self-management/ self-care/ brief structured education program had their own implementation details however they had common components such as giving information/ education, motivating, skills training, monitoring and assessments. Two out of three trials[35,40,41] were from the same country Thailand with long-term intervention for 6 months and the rest one was from Malaysia with short term intervention for 3 months. One[41] of the 2 Thai studies showed significant favorable effect in intervention group while the other one[40] did not. In the study that showed no significance, the intervention strategy included 5 sessions of knowledge, skills and exercise training at the beginning week and follow up was giving a phone call to the participants at 3 and 5 months, data collection was made in the middle of intervention and end of 6 months. Therefore the intensity and dosage of the intervention to achieve the significant results was questionable. Moreover the HbA1c level of the intervention participants were higher than control group participants at the base line and the difference was statistically significant[40]. The study that showed significant effect had similar interventions with apparently more contact hours, smaller group education sessions and 2 times of 45 minutes long home visits from the researcher. The baseline conditions and illness situation of both groups were similar in this study and no statistically significant base line differences. In the remaining trial from Malaysia, three times of

interventions, baseline and end line assessments were done, it showed favorable improvement in intervention group and statistically significant difference from control group. The intervention included week 0 face to face session, second face to face session 1 month later and 15 minutes phone call as the 3rd session in the last month (end of 2nd month). This study was a short term intervention model and the participants got monthly contact/ meeting with the therapist and one additional component in this trial was measuring the "self-monitoring of blood glucose (SMBG) level". Both groups of this trial had similar characteristics at the baseline and no statistical significant differences at the baseline.

The present systematic review and meta-analysis finding on general lifestyle intervention (self-care/self-management) is more or less similar to the trend of another systematic review findings from Western literature. A systematic review[53] on multifactorial lifestyle interventions in the primary and secondary preventions of cardiovascular disease and type 2 diabetes mellitus conducted by the authors from Germany[53] (n= 7 trials) found out that the evidence for multifactorial lifestyle interventions was weak.

The interventions included different elements such as diet, physical activity and stress management for high risk people or those with coronary heart disease or type 2 diabetes mellitus. Seven out of 25 trials were study on type 2 diabetes mellitus patients. These authors reported that the interventions were found varied a lot in terms of concept, intensity and providers and there were no small effects on HbA1c. Glycemic control (HbA1c %) was significantly favorable in lifestyle intervention groups after 6 months (mean difference -0.4%) but it was not after 12 months (mean difference -0.12%). There was one trial in that review, each for longer durations of 36 months and 48 months though both of them had significant advantage of lifestyle interventions with (mean difference -0.6%) and (mean difference -0.8%).

Strengths

The strengths of the present study are: a focus on the region with one of the highest T2DM disease burden and greatest increase in prevalence increase rate in the world; The review included all relevant randomized trials from Southeast Asia countries by extensive search in many electronic databases, in which region, to my best of our knowledge, there were no previous systematic reviews on the effects of lifestyle modification on glycemic control; The review included a broad range of lifestyle modifications: dietary modification, physical activity, general lifestyle interventions including the behavior change interventions such as self-management and self-care interventions for the glycemic control of a range of patients with different characteristics. Therefore, the results from this review counts for more external validity and applicable for the communities with similar context.

Limitations

Systematic review and meta-analysis relies on the availability and quality of the randomized trials. There were not many relevant randomized trials conducted among the type 2 diabetes adults from Southeast Asia which assessed the effect of lifestyle modification on glycemic control. Only limited number of randomized controlled trials which met the inclusion/exclusion criteria were available for this systematic review. Being a region wise review, it was more challenging to get many randomized controlled trials conducted in all countries in the Southeast Asia region.

A randomized study[35] included in this review checked the glycemic control effects in poorly controlled type 2 diabetic patients and another randomized study population[19] was post-partum women only. One study[35] included type 1 diabetic patients however the author of the randomized trial justified that the number of type 1 patients were very few number (7 out of 164

patients) to affect the overall outcomes of the type 2 diabetes patients. Only one trial[19] was without medication for diabetes and the rest trials, except one trial[34] which did not report on treatment, were on medical treatment for diabetes ranged from one drug, combined drugs, other drugs and insulin or combined. However it is difficult to have many RCTs doing the exactly same lifestyle interventions modalities for comparison, meta-analysis. Therefore the results for the diabetes patients with certain situations could be different from diabetes patients in general and this diversity could influence on the pooled data analysis generating overall effect size of the lifestyle modifications. These factors are the most likely reasons for generating substantial heterogeneity. Therefore, the review author used "random effect model (RE)" in meta-analysis taking in to consideration of heterogenic/ diverse situations of all diabetes patients from the Southeast Asia region included in the review.

Other limitations were some trials did not report all relevant results explicitly, they were sometimes shown only in the diagrammatic representations however the authors of the randomized trials did provide the relevant data upon request by the reviewer. For the education interventions, blinding of the participants and therapists were difficult. In this review, two trials[19,35] reported as a single-blinded randomized trial but the remaining trials did not explicitly report on the blinding.

Conclusion

Overall, lifestyle modification interventions (dietary modification, physical activity, general lifestyle ones- self-management/self-care interventions including behavior change interventions) are effective for glycemic control among type 2 diabetes adult patients in the Southeast Asia context. The glycemic control effect is significant in short term (3 months) and modest in long term (6 months), which conforms to the other systematic review findings in a

Western context. Physical activity interventions have most significant effect on glycemic control among diet, physical activity and general lifestyle interventions in the Southeast Asia. Therefore, the lifestyle modification interventions should be adjunct and/or integral part of the therapeutic management of type 2 diabetes in the Southeast Asia context as well.

Recommendation

The lifestyle modifications interventions need to integrate with a social support system that should be made available at the community and household levels integrating with clinical treatments/ medical care such that people from the support system can outreach to the diabetic patients to help them attain and sustain their achieved lifestyle modification habits and positive results of short-term glycemic control by the continued monitoring, motivating, communicating and creating opportunities for peer-group activities such as group exercise/ workouts, sharing success stories that promote social cognition and self-efficacy of each patient. The health care systems can have "case managers" work at the community level helping these chronic patients to keep on track of their lifestyle modifications actions and provide motivational supports whenever the patients go-slow or go back to early stages of lifestyle modifications from the later stages of improvements. As uncontrolled diabetes is the huge burden for the whole society, it is worthwhile to invest in the public health efforts/costs for the patients' sustainable long-term glycemic control and adherence to scientifically proven lifestyle modifications. The governments and health authorities shall prioritize to create an enabling environment for the diabetes patients such as ensuring the availability, affordability of the patients to easily access physical exercise programs and facilities, low glycemic index foods in the community.

The responses and compliance behavior may vary by geographical locations, health care policies, ethnicity, traditions, cultures and socioeconomic situations. This review findings on glycemic control suggested that compliance behavior in the Southeast Asia mostly conformed to the findings of other systematic reviews that included other parts of the world as well. Based on this review, in Southeast Asia, it is mostly likely to recommend physical activity intervention to effect glycemic control in type 2 diabetic adults. The general lifestyle modification intervention

had relatively weak effect on glycemic control and the responses on dietary modifications was not conclusive. General lifestyle modification and dietary modification need more intensive dosage activities, frequency and contact time with therapist.

Further studies may look into the sustainable methods and effectiveness of lifestyle modifications for long-term. Further reviews may replicate, upon availability of quality randomized trials with different participants: for all diabetes patients in general, for poorly controlled patients, for post-partum women, etc. with larger sample size for better representation and generalizability of the findings.

Chapter 6 - Field experience report

Introduction

My public health field experience was completed at the Riley County Research and Extension office at 110 Courthouse Plaza in Manhattan, KS, during January to March 2015, total 180 hour.

The objective of K-State Research Extension is to help the community by providing evidence-based university knowledge in the most practical ways so that people can apply in real-life and benefit in many areas such as agriculture, economics, family life, youth development, community leadership and business.

Cooperative Extension was established in 1914. Various level of government and land-grant universities funded the county extension programs to extend technical expertise and research findings to help people improving their homes, families, farms, business and communities[54].

In Riley County, Kansas State University is the land-grant university that supports the research extension[54]. The program is funded and guided by a partnership of federal, state and county government. The Riley County office is directed by a county Extension director, and there are four Extension agents, one receptionist and two assistants. The agents specialize in the disciplines of family and consumer sciences, 4-H, horticulture and agriculture[54].

I completed the internship under the supervision and guidance of Ms. Virginia (Ginny) Barnard, MPH, Family and Consumer Sciences Agent of the Riley County. Her specialization is in the areas of nutrition, food safety, health and indoor environments. Ginny has several program schedules and during my time the Head Start - Mothers (Parents) and Children Health and Nutrition Program was a new program possible to add into existing programs. That parents and

children health and nutrition program (Head Start) interested me and Ginny also found that program fitted my education, previous experiences and passions. Therefore, after consultations of myself, Ginny and Program Director of Head Start, I agreed to focus on this program as my internship program assignment.

Head Start/Early Head Start[55] is a free, federally funded early childhood program. The program serves families with low incomes in Riley County and the Manhattan-Ogden School District with education, health, nutrition, and social services. Head Start enrolls children ages 3-5 years and offers full-day and half-day preschool classes. Early Head Start is a home visitation program that enrolls pregnant mothers and children from birth to 3 years of age. Head Start promotes the belief that parents are their child's lifelong teacher, so it supports the involvement of parents, efforts to reach goals, changes and transitions in the family's life. Head Start provides a supportive learning environment for children, parents, staff, and the community. During my field experience, I was able to provide nutrition education for parents and children relating to some nutrition concerns that were widespread in the community but not frequently addressed.

Sugary drinks

More than 2 in 3 adults and 1in 3 children in the United States are overweight or obese[56]. This puts huge burden on the nation costing $190 billion a year to treat obesity-related complications[57,58]. Increased consumption of sugary drinks has been a key contributor to the obesity epidemic[57]. Sugary beverage consumption was reported to decrease[59] recently, however the average American per capita consumption is still 150 calories[59] of sugar-sweetened beverages a day, which is amounting to the total 45 gallons per year[60]. About 66% of children and 77% of adolescents[61] consume at least one sugar-sweetened beverage every day. Approximately 10% of teen's caloric intake is from sugary drinks[59, 62]. Most people usually think

about what they eat when they try to reduce the calorie intake and their bodyweight, however many of them do not realize how many calories beverages can contribute to their daily calorie intake[63]. The children's drinking a lot of sugary beverages has been the prevailing issue leading to the important public health issues such as tooth decay (cavities) and obesity. National figures and findings on sugary beverage consumption issues also imply the local concerns as well. To prevent and to combat the overconsumption of sugary beverages and its negative health consequences, there are CDC recommended strategies[64] based on the evidence. I applied these recommended strategies in the community level nutrition education for behavior change communication such as "to ensure ready access to potable drinking water, to limit access to sugar-sweetened beverage (SSBs), to promote access to and consumption of more healthful alternatives to SSBs".

Oral health

Tooth decay is the most common health problem of chronic childhood disease[65]. It is 5 times more common than asthma, 7 times more common than hay fever and 52 million school hours missed annually because of oral health problems[65]. Globally, tooth decay is still a major problem, even in the developed countries, it affects 60-90% of schoolchildren and a majority of adults[65]. Tooth decay affects more than one-fourth of U.S. children aged 2–5 years and half of those aged 12–15 years. About half of all children and two-thirds of adolescents aged 12–19 years from lower-income families have had decay[66]. The data from CDC showed that in 2011-2012, 37% of 2-8 years old children in the USA had dental caries in primary teeth. Dental caries were highly prevalent in Hispanic (46%) and non-Hispanic black (44%) children compared with non-Hispanic white children (31%) aged 2–8[67]. Dental caries prevalence in poor children are

twice of prevalence in their more affluent peers, and poor children's disease is more likely to be untreated[68] and these poor- non-poor differences continue into adolescence.

Therefore, to prevent early childhood caries, studies have shown that nutrition education and counseling needs to teach parents the importance of reducing their infant's or child's prolong and frequent exposures to sugary drinks and foods[69] at the same time giving them the knowledge that plaque reacts with sugar to produce acid; and acid reacts with tooth to get decay. I applied these important study findings and recommendation for the nutrition education and behavior change communication process during my internship project.

Field experience scope of work

My field experience work started with a planning process. I had a series of meetings with Ginny to plan for my internship project. I was called for an interview meeting by Ginny before I was accepted as her intern in the K-State Research Extension office. After this interview meeting and initial discussion on the need areas of nutrition education in the local context, I had developed the learning objectives and internship program framework in consultation my major professor and got approval from MPH Program Director to start the field experience.

When I started my internship, Ginny explained me the scope of mothers (parents) and children nutrition education which we were going to implement through Head Start program and she gave me the responsibilities relating to communication, coordination with Head Start Program, drawing the nutrition education program design and contents of education. She also provided some reading materials and online resources to use in drawing the course. Ginny, Andy and I consulted and scheduled this nutrition program "mothers (parents) and children nutrition education program for Head Start" to start in February 2015. The Head Start office hosted the

nutrition education session in the parents' meeting room in the Head Start Program Office, 1700 Leavenworth St Manhattan, KS 66502.

This parents-and-children nutrition program was targeted to serve low income families in Riley County through the network of Head Start program in Manhattan. The families included both Hispanic and non-Hispanic whites. This nutrition program included: (a) nutrition education and behavior change communication on dealing with sugary drinks/ sugar sweetened beverages (SSBs) and sweet tooth and dental health; (b) on-site nutritious meal provision for the whole families; (c) provision of low cost and nutritious meal recipes; and (d) fun, hands-on science activities for kids. These sessions were planned in the evening when most of the parents were done with their work and could participate in the program. In this internship program, I was responsible as the focal person for this Head Start nutrition program. This project required teamwork, efficient communication, coordination and collaboration, which were keys to successfully implementing a public health nutrition program in the community. As some participants were Spanish-speaking families, this program had the Spanish translator translate the handouts I prepared in English after being proofread by Ginny. The program had the Spanish translator to translate during the nutrition education sessions. Head Start Office provided the Spanish translator. My main responsibilities were planning the nutrition education sessions, designing, preparing the education materials including visual aids, delivering the nutrition education/ behavior change communication sessions, reviewing the 1st session delivery by sitting together with the supervisor and incorporating the findings of 1st session in the following session.

This nutrition education program was behavior change communication oriented, which required me to interact with the participant families during the session. The nutrition session on "how to deal with sugary drinks" was delivered in February, and the session on "sweet tooth and

dental health" was organized in March 2015. The program delivery was intended for behavior change not by means of one time meeting and interaction with the targeted families. The scope of this nutrition program (during my internship period) was to introduce an initial step of specific nutritional behaviors changes for some participants and/or to affirm and encourage to move forward those who have had nutritional positive behavior changes to some extent.

Head Start program had plans to continue with nutrition education for these families. Therefore, this behavior change communication on "sugary drinks, sweet tooth and dental health" implemented during my internship time would link with follow ups in the future nutrition sessions with similar scopes, which are likely to be run by upcoming MPH student interns from Kansas State University or other health and nutrition interns by the coordination between Research Extension and Head Start Program offices.

Learning objectives

My field experience learning objectives were set up in consultation with Ginny prior to starting my field experience period. The objectives were developed in relation with public health nutrition education and project management. My first objective was to understand the role of a public health agency in the community. This objective was fulfilled throughout my field experience period by undertaking the whole project cycle management of mother and child nutrition project. Ginny was the well experienced mentor, she helped me understand how the community expected the public health agency and how a public health agency could outreach to the community and provide the services, how the public health agency could work with community based center increasing its coverage to the people who really needed health and nutrition education services.

Secondly, I wanted to learn how a public health nutrition project is managed. With the guidance of Ginny, I was able to tackle the whole project management cycle. Since the inception time, I was able to communicate and collaborate with Head Start Program and identify which area of health and nutrition education would be relevant for the targeted beneficiaries. Based on the reviews and initial consultations with Head Start program director, we could identify "Sweet Drinks", "Sweet tooth" and "Oral Health" were relevant topics for the parents and children covered by Head Start program.

Another objective was to apply knowledge to implement parents and children health and nutrition project. I was able to apply the knowledge of nutrition education theories since the time of designing the contents and method of nutrition education sessions. As my field experience time was the beginning of a year (January), we considered time factor as one of the relevant factors to apply in designing the project. People might be interested in setting their own New Year resolution at the beginning of a year. And February had been "the children national dental health month." So taking into account of all these seasonal factors, I was able to incorporate in designing the health education sessions for sweet drinks, oral and dental health topics using "Transtheoretical model (stages of change)". Participants received the chance to draw their own action plan which was "preparation stage" in the stages of change model and it was like in line with sense of drawing new year resolution.

Finally I intended to understand barriers and motivation for the low income minority parents on provision of healthy food choices. Ginny helped me comprehend and prepare for probable challenges of nutrition education for the target group since the planning phase. Therefore I was able to prepare different plans (plan A, plan B) for possible situations such as I prepared how I would deliver if the participants were mainly Spanish speaking families, how I

would facilitate the session, if the participants were quiet, to be a participatory nutrition education session with behavior change oriented rather than one way communication. Trying to understand their motivations and limitations, I also planned what I would ask the participants and what might not. In this way, I was able to deliver the nutrition education sessions well as were planned. Therefore my learning objectives were met, I was able to facilitate the participants, understand their motivation and barriers, help them aware themselves and plan for further positive change actions to the extent as time allowed for my field experience.

Activities performed

Planning

Very first step, I had series of initiation meetings with my major professor and potential preceptor/mentor to plan for my internship/ field experience in the public health work. At this step, I was interviewed first by the preceptor whether to accept as her intern. Ginny and I went through the current nutrition programs which Research Extension Office was implementing and we explored the other nutrition related need areas prevailing in the community and which also fitted my education and passion. After reviewing, we found that nutrition issues on dealing with sugar drinks/ sugar sweetened beverages, sweet tooth and oral/dental health were less frequently addressed compared with other nutrition issues though these sugary drinks issues were in fact prevailing in the local community especially among the low income families. Moreover the preliminarily identified nutrition topics harmonized in timing with the national public health response on dental health because February was "*the Children's National Dental Health Month*".

In the literature and in the public health nutrition lecture (HN600, KSU), Head Start program was indicated as potential partner for dental health response. And based on the local context, we identified Head Start Program as most relevant community organization or program

to collaborate in delivering nutritional education on these topics because Head Start's program's scope of work and targets were in line with needs of our targeted beneficiaries. Then based on the information collected from Head Start Program, the nutrition education and behavior change communication program design and implementation plan was drawn. Detailed implementation plan (time, place, persons, communication channels) were set up.

Organizing

Based on the program design and implementation plan, I did a literature review and searched for resources to develop the nutrition education presentation and handouts, theory background for behavior change communication.

Transtheoretical model, Stages of change

The Transtheoretical Model (Prochaska & DiClemente, 1983; Prochaska, DiClemente, & Norcross, 1992) is an integrative, biopsychosocial model to conceptualize the process of intentional behavior change[70]. This model is one of the most popular model currently in use by professionals worldwide.

Stages of Change is the essence of the transtheoretical model - people change behavior by moving through a series of stages[70]. Stages of change is a temporal dimension, changes occur over time. Transtheoretical model's concept is change is a process that unfolds over time[70]. Progress of change can either be liner or nonlinear meaning that sometimes people recycle through the stages or regress to earlier stages from later stages[70].

The stages are (1) precontemplation (2) contemplation (3) preparation (4) action and (5) maintenance. The each stages of change are mentioned in table (6.1)[71].

Table 6.1 Stages of change model[71]

Stage	Definition	Potential Change Strategies
Precontemplation	Has no intention of taking action within the next six months	Increase awareness of need for change; personalize information about risks and benefits
Contemplation	Intends to take action in the next six months	Motivate; encourage making specific plans
Preparation	Intends to take action within the next thirty days and has taken some behavioral steps in this direction	Assist with developing and implementing concrete action plans; help set gradual goals
Action	Has changed behavior for less than six months	Assist with feedback, problem solving, social support, and reinforcement
Maintenance	Has changed behavior for more than six months	Assist with coping, reminders, finding alternatives, avoiding slips/relapses (as applicable)

I prepared the invitation flyers for the two sessions (figure 6.4 and 6.8), searched for the recipes, searched relevant video clips for visual aids, drafted the handouts (figure 6.4) and power-point presentations (Children playing education presentation design and Fall fun education presentation design layouts of Microsoft PowerPoint 2013 were used), got approval from Ginny after her review and the handouts were translated to Spanish by the help of a Spanish Translator provided by Health Start, and identified the printed materials, pamphlets / booklets to be used. Some teaching aids (figure B.5, B.6) and promotional items such as tooth brushes for adults and kids were mobilized from a dental care program in Wamego, Kansas. By the nature of the program and targeted families, the education session needed to plan for 30 to 45 minutes sessions. I applied the learning points from the MPH classes in preparing the PowerPoint

presentation to tailor to the audience and limited time, visual aids were mainly used rather than texts. As the nutrition education session was oriented for behavior change communication, individual action plan checklist was also prepared for the participants (figure 6.5)

Delivering

"How to deal with sweet drinks?"

The nutrition education- behavior change communication program was 1 hour program. The program started at 5:30 pm and served the families with a nutritious meal cooked by Ginny. The number of participating families (7 families) was good size to have more interactive discussion which were as planned for behavior change communication style. After the families had a meal, John Joe (4H Agent) had the kids play games and build blocks while I continued with the parents for behavior change communication session. I also observed that kids were interested in watching video as some kids asked me whether I was showing video to them as they saw screen and LCD projector set-up in the meeting room. So I used this observation in designing second nutrition education session in order to include some more edutainment video clips for kids.

First, I used the "social line-up method" for rapport building and quick assessment of the participants' current status relating to the perceptions and sugary beverages drinking practices and participants could learn each other during the discussion on their location on the lined. The social line results indicated that 67% of the participants (4/6) identified themselves that their daily consumption of sweetened beverages was a lot and 17% (1/6) thought very few consumption and 17% (1/6) thought moderate consumption. Two third (4/6) of the participants were not sure whether sugar sweetened beverages were good or bad for health, one third (2/6) thought sugary beverages were bad for health. Concerning with sugary drinks, 67% of 6

participants said they tried somehow to reduce consumption, 17% of them (1/6) said she tried not

to drink sugar sweetened beverages at all and 17% of them (1/6) said she was seriously wanting

to reduce sugar sweetened beverages (table 6.2).

Table 6.2 Rapid assessment results of participants' practice and view on sweet drinks

Line (1)	I'm having sweet drinks/ sugar sweetened beverages every day.	Not consume	Consume moderately	Consume a lot	Total
	Number (n)	1	1	4	6
	Percentage (%)	16.7%	16.7%	66.7%	100.0%
Line (2)	I think sweet drinks / SSBs are (bad/not sure/ good) for health.	Bad	Not sure	Good	Total
	Number (n)	2	4	0	6
	Percentage (%)	33.3%	66.7%	0.0%	100.0%
Line (3)	Concerning sweet drinks, I am going to / doing	To not drink at all	Try somehow to reduce	Not serious to reduce	Total
	Number (n)	1	4	1	6
	Percentage (%)	16.7%	66.7%	16.7%	100.0%

Following the lined-up exercise, the participants looked more relaxed, became more open and interactive throughout the remaining session. The rapport building and social lined-up helped for relationships, trust and supportive environment for learning for change.

Behavior change communication oriented

In every nutrition education sessions, I tried to increase the participants' awareness of the need of change, what were risks and what were the benefits of positive change. I had encouraged the participants to make specific action plans and setting goals meaningful for them. I helped the participants by answering their questions and concerns, appreciating some participants who had been taking some steps of actions etc.

I used the PowerPoint presentation in the way to enhance discussion points. This PowerPoint was designed to increase the participants' awareness of the need of change (targeting for those in precontemplation stage), to motivate and encourage them by showing some families as models who had been implementing the good behaviors for sweet drinks (targeting for those in contemplation stage) and to help them know what were recommended actions so that they could set up their own actions based on sound and effective recommended actions (targeting for those in preparation stage). During the discussion, overweight/ obesity, dental caries and malnutrition were identified as the key negative health outcomes of drinking a lot of sugar sweetened beverages. Then came up with some recommended actions for dealing with sugary drinks, preventing negative health outcomes such as to offer water to drink instead of sugary beverages, to keep a pitcher of cold water in the refrigerator at home, to limit sodas, to keep sugary drinks out of the house, to limit juice 4 to 6 ounce /day, to snack on fruits and vegetables and to model good habits for their child. I had the participants identify their status on "the 5 steps of behavior change model" locating where they were. The 5 steps of behavior change model was

described in terms of the actions relating to sweet drinks (not in the academic terminology) and was posted on the wall of the meeting room. The status of the participants are shown in table 6.3 and figure 6.1. One participant said he never think about needing to change with drinking sugar sweetened beverages. Then the participants were handed with one-sheet action plan to set their own action plan in dealing with sugary drinks. Provision of fruits and vegetables for snacks resulted as the most feasible strategy to deal with the sugar sweetened beverages issues among these participants and unsurprisingly many of them were not ready for limiting soda and juices. Their action plans results indicated most of the participants (100%, 6/6 participants) planned to "provide fruits and vegetables for snacks" and least participants (50%, 3/6) planned to "limit the soda, to keep sugary drinks out of the house" and "to limit juice to 4-6 ounces / day" (table 6.4).
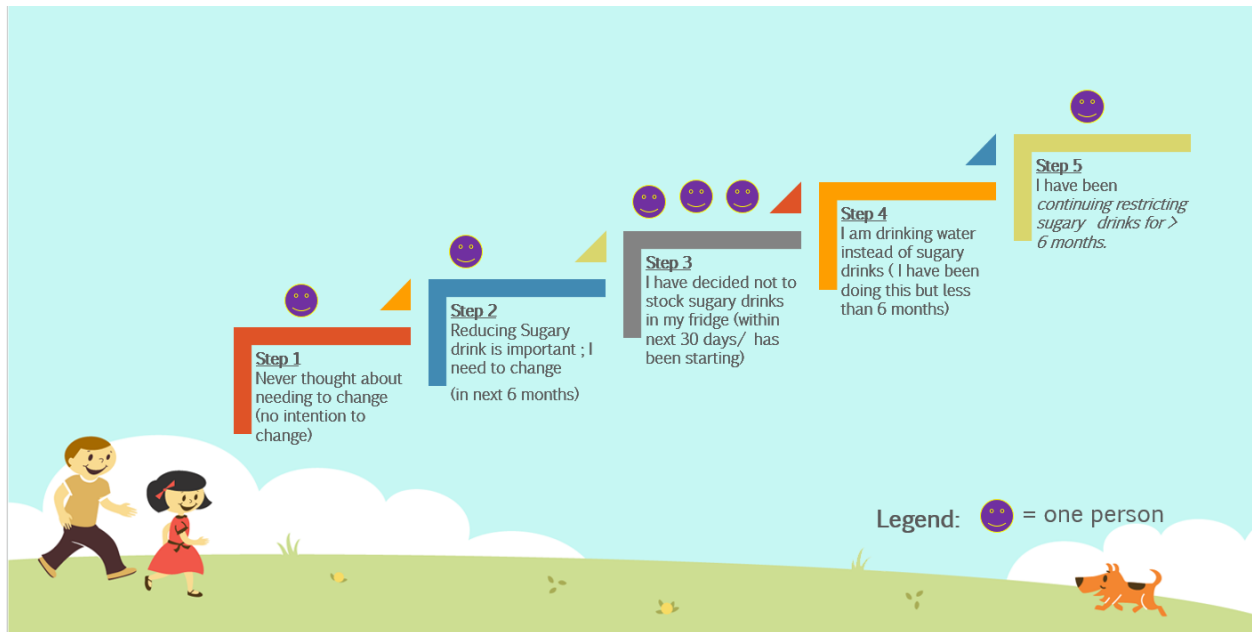
Figure 6.1 Stages of Change of the participants relating to the behavior of reducing sweet drinks and drinking water instead

Table 6.3 Stages of Change of the participants relating to the behavior of reducing sweet drinks and drinking water instead

Stages of change	Number (n)	Percentage (%)
Stage 1. Precontemplation (not ready)	1	16.7%
Stage 2. Contemplation (getting ready)	1	16.7%
Stage 3. Preparation (Ready)	3	50.0%
Stage 4. Action	0	0.0%
Stage 5. Maintenance	1	16.7%
Total	6	100.0%

One participant asked about "sport drinks" as he assumed sport drinks were good for health, he also asked about "whey protein shake". One participant asked about "fruit juices" as she assumed they were healthy. I replied to the questions that almost all sport drinks were in the same category as sugar sweetened beverages so they should be treated the same, whey protein was different from sugary drinks category, protein supplements were used by bodybuilders and athletics to support muscle protein synthesis. Normally, no objection for optimal consumption of non-sweetened whey protein supplements providing that there were no contraindication for one's medical condition.

I noticed that the participants were smiling when the concept of drinking water as a replacement of sugary drinks was discussed. Some participants admitted that they like sugar sweetened beverages and could not stop. In the "line-up" assessing amount of the participants' daily consumption of sugary drinks, a lady stood even at the point beyond 100% scale of the end of the line and when I asked why, she explicitly told, with a smile, to the group that she knew she drank sugary drinks way too much. It was acknowledged and congratulated among the participants as one participant was found to be quite knowledgeable and she said she had reduced sugary drinks already for more than 6 months as she had heard about negative effects of over-drinking of SSBs. This session concluded showing the video making "Falafel "and giving the

recipes notes and receiving feedbacks. The video and falafel recipe (figure 6.6) were from

YouTube: The Domestic Geek, Healthy Meal Prep, Week 2.

Table 6.4 Summary of the participants' individual action plan to deal with sweet drinks (linking to preparation stage of stages of change in transtheoretical model)

Participants	1	2	3	4	5	6	Total	% participants
Action plan								
1. I can offer my children water to drink	Y	Y	Y	Y	Y		5	83.3 %
2. I will keep a pitcher of cold water in my refrigerator	Y	Y	Y	Y	Y		5	83.3 %
3. I will limit sodas	Y	Y			Y		3	50.0 %
4. I will keep sugary drinks out of the house	Y	Y	Y				3	50.0 %
5. I will limit juice to 4-6 ounces / day			Y	Y	Y		3	50.0 %
6. I will provide fruits and vegetables for snacks	Y	Y	Y	Y	Y	Y	6	100.0 %
7. I will be the model of good habits for my children	Y	Y	Y	Y	Y		5	83.3 %
Total	6	6	6	5	6	1		
% out of 7 actions	85.7 %	85.7 %	85.7 %	71.4 %	85.7 %	14.3 %		

"Sweet tooth & dental health"

This nutrition education – behavior change communication session was also an hour session held in the evening from 5:30 to 6:30 pm. Ginny cooked nutritious foods for the participants and I helped in serving the meals to the participants. Based on the review on first nutrition education session, I designed to include some more edutainment video clips for kids such as "Clean teeth are healthy teeth", "How to brush your teeth properly" and "Crest dental defenders". I searched for these video clips from YouTube and confirmed with the preceptor. These videos worked very well in educating the kids what caused dental cavities, what happened if the kids did not regularly tooth brush and how to properly tooth brush. I found the kids were very interested in the edutainment cartoons and learnt some important information included in them. I assessed whether the kids learn some relevant information by asking questions and the kids could answer correctly.

Moreover, using the "tooth game board and magnets", I made a demonstration of sticky foods that harmed tooth. The kids liked this demonstration and they learned which kinds of foods were sticky for the teeth. The models of sticky foods/ sugar sweetened foods and drinks were made with magnet so they stuck on the tooth game board while the other models of fruits and vegetables were made without magnet so they did not stick on the tooth game board. This tooth game board attracted not only the kids but also parents, I could explain the concept that "Sugar + Bacteria = Acid" and "Acid + Plaque = Cavities" using these special magnets pieces. From this concept, my discussion with the parents was expanded to concepts that in fact any acids were bad for tooth even gastric acids from the stomach. Then John Joe (4H Agent) had the kids play science activity games in a separate room while I continued with the parents for nutrition education discussions. In this session, we discussed that too many sweets, too many empty

calories could cause malnutrition, obesity and dental cavities. Giving sweets to children easily ruined their appetite. The child would only eat sweet foods if the parents kept giving the sweet as they wanted their child to eat something. The worse thing was some parents thought giving long-lasting sweets such as suckers would keep the children calm longer so that it reduce the time the kids would disturb the parents by frequently for sweets. During the discussion, I highlighted that longer contact time of sweets with tooth was more harmful so if they were about to give sweets as special treats they should choose sweets with lesser contact time such as "chocolate" compared to sweets with longer contact time such as "suckers/ lollipops". I had the parents realize what the unhealthy tooth could affect their kids such as decreased school performance, poor social relationships, distracted and unable to concentrate on schoolwork etc. The education offered some recommended actions: to keep sweets out of the house, not to eat a lot of sweets themselves (parents), to enjoy eating smaller servings of sweet foods, to offer nutritious snacks with a natural sweet taste, to limit sweet drinks such as soda and fruit drinks, to limit fruit juice to 6 ounces or less each day, to offer 3 meals and 2 to 3 snacks each day and to offer foods with a sweet taste at the end of the meal, as part of the meal. To prevent cavities, we discussed the CDC's recommended actions to start cleaning teeth early, to use the right amount of fluoride toothpaste, to supervise the kids' brushing and to talk to their child's doctor or dentist. Then the parents answered the quiz followed by giving them with full answers. Summary scores of brush up quiz was tabulated (table 6.7). By the support from dental health care program in Wamego, I gave adult and kid tooth brushes to all participating families and also as a prize for highest scorer of the quiz. Same as the 1st session, the parents placed themselves on the 5 steps of behavior change model (table 6.5, figure 6.2) and drew personal action plans check list (table 6.6).

Table 6.5 Status of stages of change for limiting sweets and regular tooth brushing

Stages of change	number (n)	Percentage (%)
Stage 1. Precontemplation (not ready)	0	0.0%
Stage 2. Contemplation (getting ready)	0	0.0%
Stage 3. Preparation (Ready)	3	100.0%
Stage 4. Action	0	0.0%
Stage 5. Maintenance	0	0.0%
Total	3	100.0%
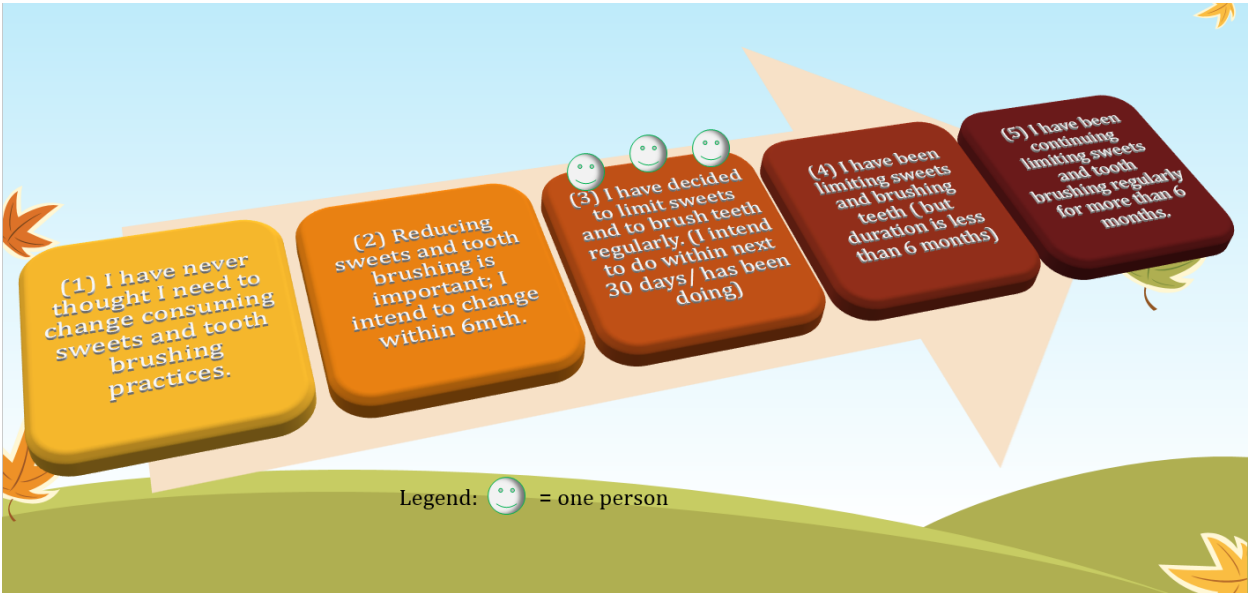
Figure 6.2 Status of stages of change for limiting sweets and regular tooth brushing

Table 6.6 Summary of the participants' individual action plan to deal with sweet tooth and dental cavities

Participants	1	2	3	4	Total	% of participants
Action plan						
1. I can keep sweets out of the house					0	0.0%
2. I won't eat a lot of sweets myself			Y	Y	2	50.0%
3. I will limit sweet drinks such as soda and fruit drinks			Y	Y	2	50.0%
4. I will limit juices to 6 ounce or less per day	Y		Y	Y	3	75.0%
5. I will offer nutritious snacks with a natural sweet taste	Y	Y	Y	Y	4	100.0 %
6. I will be the model of good habits for my children		Y	Y	Y	3	75.0%
Total	2	2	5	5		
% out of 6 actions	33.3 %	33.3 %	83.3 %	83.3 %		

Table 6.7 Summary scores of brush up knowledge quiz

Participants	A	B	C	D	Total	% of participants
Quiz						
1. All children older than 6 months should receive a fluoride supplement every day.	1	1	1	1	4	100.0%
2. Parents should start cleaning their child's teeth as soon as the first tooth appears.	1	1	1	1	4	100.0%
3. Parents should start brushing their child's teeth with toothpaste that contains fluoride at age 3.	0	0	1	0	1	25.0%
4. Children younger than 6 years should use enough toothpaste with fluoride to cover the toothbrush.	1	1	1	1	4	100.0%
5. Parents should brush their child's teeth twice a day until the child can handle the toothbrush alone.	1	1	1	1	4	100.0%
6. Young children should always use fluoride mouth rinses after brushing.	1	1	1	1	4	100.0%
Total	5	5	6	5		
Participant's individual score (%)	83.3%	83.3%	100.0%	83.3%		

Monitoring

The mothers (parents) and children nutrition education Head Start program was monitored throughout my internship time and necessary adjustments, improvements were made based on the monitoring findings such as in the second session I included more edutainment for kids.

Figure 6.3 Edutainment for kids

Evaluation

When we designed this nutrition education session, we had plan B to divide the session in to two groups if many families came in. However, the number of families were just the good size to have enough time for interactive discussion and more behavior change communication oriented. The Head Start program director said: "We haven't hosted activities, workshops, etc. on a very regular basis so we haven't trained parents to expect wonderful programs. Sweet/sugary drinks are extremely common and people are resistant to cutting them out of their diet/routine or people already avoid them and didn't connect with the content." Ginny was my great mentor, she was always there throughout the nutrition education sessions to monitor and to help if necessary. I got her recognition and positive feedback on the performance and contents of education sessions.

I got the positive feedbacks from participants in both sessions. One participant specifically mentioned the second session was better than first session. One participant told to Ginny and me that there were only one education session in Head Start last year (2014) this year their family had received two education sessions in February and March 2015. So he expected to have monthly education session this year.

Use of evaluation for planning next cycle

Based on the evaluations and participating families' feedback request, we, Ginny (K-State Research Extension Office) and Andy (Head Start Program, Manhattan and Ogden) and I discussed and plan to continue next rounds, to expand education sessions like these ones in the future and plan to integrate a brief follow up on their behavior change process as and when relevant.

Gardening and nutrition education activities

During my field experience, there were gardening and nutrition education activities for 4th graders in Northview elementary school. During the education sessions, we gave the varieties of seed sachets to the children, then discussed the characteristics of the seeds they got – what kind of seeds, where they were from originally, the time frame for growing and harvesting, the methods of growing, what kind of vitamins and minerals those fruits/vegetables have, how people usually eat these fruits/vegetables and how the children liked to eat the fruit/vegetables they got etc. The education session was led by Ginny and John mainly and two master gardeners also assisted. My responsibilities were to assist throughout the nutrition education activities, handing seeds and educational materials to the children, assisting the children in looking for the nutrient categories and answering children's questions during these exercises.

Products developed

During my field training, parents and children nutrition project was designed and developed. Invitation flyers, a low cost nutritious recipe handout, health and nutrition education handout and action plan sheet (part of the stages of change for transtheoretical model behavior change communication) were developed. Many other recipes which were already developed by Research Extension office were also given to the participants. Two health and nutrition education sessions were conducted which were integrated with onsite nutritious meal provision. This project report is also part of the field training products. The developed products were shown in the following figures (figure 6.4 to figure 6.19)

Figure 6.4 Invitation flyers for nutrition education session on "How to deal with sugary drinks?"

Sweet Drinks

Today's children drink a lot of sugary drinks such as soda, fruit drinks and other sweet drinks. This can be a problem!

Small children are usually good at controlling how many calories they eat. They tend to eat when they are hungry, and stop eating when they are full. However, drinking sugary drinks is not the same as eating solid foods. Studies have shown that the calories in sugary drinks are not as satisfying as the calories in solid foods.

Small children may become overweight from dinking too many sweet drinks. Sometimes a child's overweight problem is not caused by what the child eats. It may be caused by what the child drinks.

Cavities

Small children may develop cavities from drinking sweet drinks. Bacteria use sugar to make cavities in children's teeth.

Poor nutrition

Children who drink lots of sweet drinks are probably not drinking enough milk. Their diets can be low in calcium. Serve skim or 1% milk at meals for children over the age of 2 years. There are a lot of calories in sugary drinks. A 12 ounce can of soda has 150 calories. An average preschool child needs only 1600 calories per day. An extra can of soda every day can add up to 1050 calories in a week. At that rate, a preschool child could gain an extra pound each month or 12 extra pounds in a year above their normal growth.

Help your child develop healthy eating habits which will last a lifetime.

Limit sugary drinks!

- **Offer water to drink.** Small children can be thirsty. Drinking water is healthy habit your child can learn early in life.
- **Keep a pitcher of cold water in your refrigerator.** Your child will want a drink of the 'special water'. A cold glass of water is refreshing.
- **Limit sodas.** Don't drink soda every day.
- **Keep sugary drinks out of the house.** If there are sugary drinks in the house, your child will want to drink them.
- **Limit juice.** Too much juice can also be a problem. Limit juice to 4 to 6 ounces each day.

This sheet provides general nutrition information; medical advice should be obtained from your health care provider. Contents references: Nutrition Matters, Inc, Riley County Extension, www.riley.ksu.edu, Weekly meal preparation for healthy eating; Pictures sources: personalexcellence.co, www.usignolonews.com, www.tarazifoods.com, whatscookingmom.in, www.veggiebelly.com, brooklynbrewshop.com, www.girlsgonesporty.com, www.zastavki.com, www.desktopedia.com, www.boston.com, lexicondaily.blogspot.com, pixshark.com, king4m.com

Figure 6.5 Handout for dealing with sweet drinks

- **Snack on fruits and vegetables.** Fruits and vegetables are naturally high in water and will help satisfy your child's thirst. Enjoy apples, melon, kiwi, tangerines, carrots and oranges!
- **Model good habits for your child.** Your child will learn to drink what he sees you drinking. Drink water and limit soda to rare occasions.

Eating Smart

Falafel

1 can chickpeas, rinsed and drained
1 small red onion, minced
3 cloves garlic, minced
¼ cup fresh parsley, chopped
¼ cup fresh cilantro, chopped
1 tsp cumin
½ tsp coriander
½ tsp salt
3 tbsp olive oil

Preheat oven to 400°F.
In a food processor, combine chickpeas, red onion, garlic, parsley, cilantro, cumin, coriander, salt and 2 tbsp olive oil.
Pulse until mixture resembles fine crumbs.

Roll mixture into 12-15 balls and place on a parchment lined baking sheet.
Brush each ball with olive oil.
Bake for 40 minutes, turning once half way through cooking.
Serve immediately with tahini or garlic sauce.
Refrigerate for 4-5 days or freeze for up to six months.
Enjoy!

Tomato Cucumber Salad

2 tomatoes, diced
1 cup cucumber, diced
½ red onion, minced
¼ cup fresh parsley, finely chopped
½ lemon, juiced
1 tbsp olive oil
Salt and pepper

In a large mixing bowl, combine all of the ingredients. Stir to coat. Store in the refrigerator for up to 5 days. Enjoy!

Figure 6.6 Handouts for nutritious recipes (Falafel)

Figure 6.7 PowerPoint Presentation for "dealing with sweet drinks"
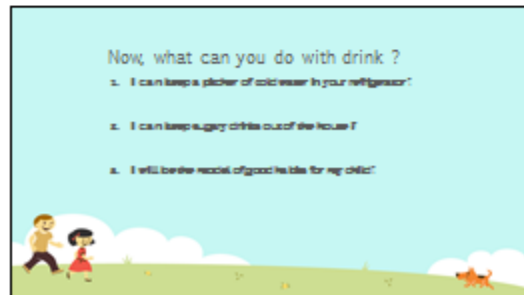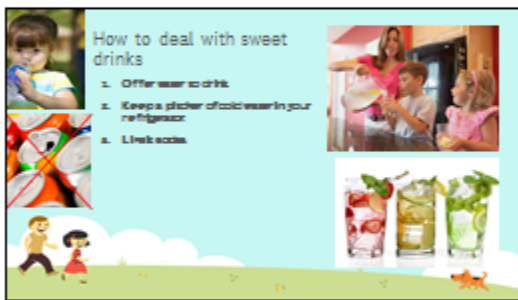
Figure 6.8 PowerPoint Presentation for "dealing with sweet drinks" continued 1

Figure 6.9 PowerPoint Presentation for "dealing with sweet drinks" continued 2

Please check on the number that you can do from now on:

1. I can offer my children water to drink.

2. I will keep a pitcher of cold water in my refrigerator.

3. I will limit sodas.

4. I will keep sugary drinks out of the house.

5. I will limit juice 4 to 6 ounce /day.

6. I will provide snack on fruits and vegetables.

7. I will be the model of good habits for my children.

Figure 6.10 Action plan for dealing with sweet drinks

How to deal with the sweet tooth?

Does your family consume a lot of sweet foods and drinks? Cookies, candy, cake, pie and soda are common. You are not alone. Come learn some easy ways to deal with the sweet tooth.

- Free meal for the whole family
- Fun, hands-on activity for the kids
- And a chance to win door prizes!

Every family will receive low-cost, easy meal ideas.

Date: **Tuesday, March 10**

Time: **5:30 pm to 6:30 pm**

Location: **Head Start**
               1700 Leavenworth St.
               Manhattan, KS 66502

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Figure 6.11 Invitation flyers for nutrition education session on "How to deal with sweet tooth?"
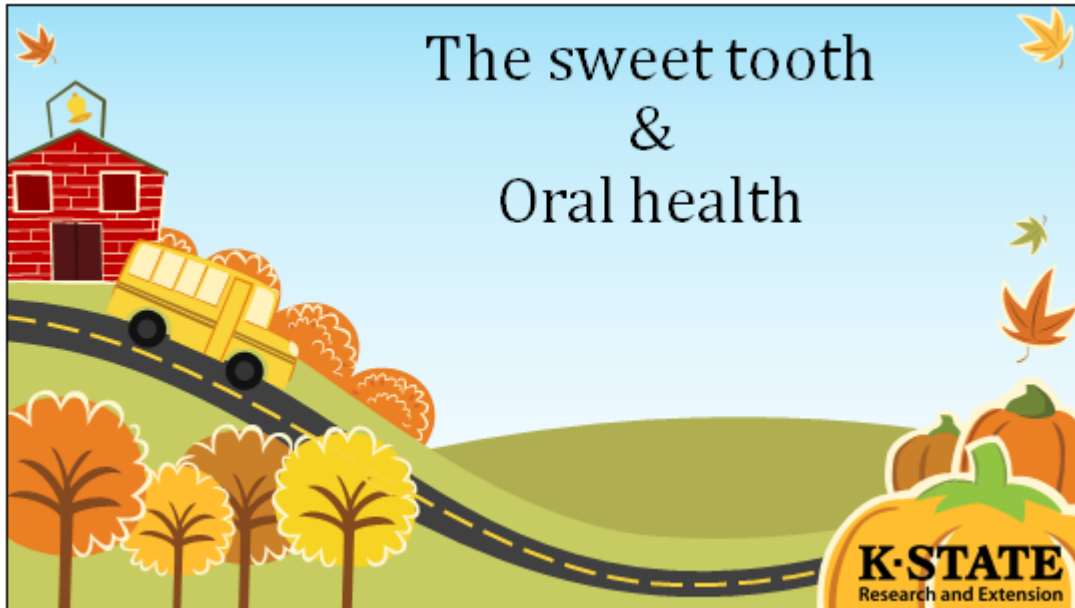
Figure 6.12 PowerPoint Presentation for "sweet tooth and oral health"

Figure 6.13 PowerPoint Presentation for "sweet tooth and oral health" continued 1

Figure 6.14 PowerPoint Presentation for "sweet tooth and oral health" continued 2

Figure 6.15 PowerPoint Presentation for "sweet tooth and oral health" continued 3

Figure 6.16 PowerPoint Presentation for "sweet tooth and oral health" continued 4

Figure 6.17 PowerPoint Presentation for "sweet tooth and oral health" continued 5

Figure 6.18 PowerPoint Presentation for "sweet tooth and oral health" continued 6

Please check on the number that you can do from now on:

1. I can keep sweets out of the house.

2. I won't eat a lot of sweets myself.

3. I will limit sweet drinks such as soda and fruit drinks.

4. I will limit juice 6 ounce /day or less each day.

5. I will offer nutritious snacks with a natural sweet taste.

6. I will be the model of good habits for my children.

Figure 6.19 Action plan for sweet tooth and oral health

Alignment with public health core competencies

My thesis research and field experience required me to apply all of the core competencies of a master's of public health. Biostatistics is the first core competency. I learned a great deal of knowledge and achieved good experience in biostatistics especially throughout my thesis research of systematic review and meta-analysis. I assessed many studies and identified the relevant studies, extracted data, decided the suitable statistical methods in pooling the extracted data (selecting either fixed effect model or random effect model), computed standard deviations from the studies which only gave standard error values, analyzed for overall effect size, standardized mean differences and heterogeneity etc.

The second core competency is environmental health / toxicology. I was able to meet this core competency, I needed this knowledge during my field experience because when I talked about dental health during the mother (parents) and children - Head Start- nutrition education program, fluoride was the one of the important key players to talk about. Water fluoridation in the public water supply and no fluoride in the bottled water were important factors included in deciding the need of fluoride supplementation for the kids. Long-term ingestion of fluoridated toothpaste in young kids if the parents did not supervise could cause dental fluorosis (white spots in the tooth). Moreover ingestion of fluoride could cause gastrointestinal discomfort at doses, which were much lower than lethal doses. Therefore, during the health education I had highlighted the parents to supervise the young kids' tooth brushing and to use the right amount of fluoridated toothpaste (i.e. pea size for small kids).

The third core competency is "Epidemiology". I got the chance to understand and apply this core competency in my thesis research and also for my field experiences. Epidemiology was

required to apply in my thesis research since the very beginning. I needed to apply this core competency throughout my research in many steps, to research the geographical distribution of diabetes mellitus, prevalence trends, to review the different type of research papers, to apply in search strategy for many electronic databases, to assess of the types of studies, to identify and select randomized controlled trials, to appraise the study design preliminarily selected articles, to analyze and generate pooled effect and to apply the understanding of "internal validity" and "external validity" in case of the judgment call.

The fourth core competency is the health care administration. This core competency is very relevant for public health practice and I was able to apply the learning from the coursework to meet this core competency. Medical care should not be the stand-alone program. Medical care needs to be strongly linked with public health care system for the best health outcomes. Otherwise, it would be just "sick care" rather than "health care". My field experience gave me the chance to practice "learning by doing" through the community public health interventions, to better understand how public health system is linking with medical care to prevent the disease primarily and to improve the health outcomes, for instance during my internship time I focused on the community public health nutrition intervention - Head Start nutrition program and the targeted beneficiaries of this program were families with low income whose health and nutritional illness were usually remain untreated due to lack of health insurance. So, primary prevention by public health nutrition education and behavior change communication is critically important.

The final core competency is social and behavioral sciences. I was able to meet this competency in both my thesis research and field experiences. My thesis question "Is lifestyle modification effective for glycemic control in type 2 adults in Southeast Asia?" based on the

understanding the differences of Southeast Asia in geographical, epidemiological and social and behavioral factors from the Western population. Southeast Asia is composed of developing countries, and in terms of eating behavior, their main staple food for carbohydrate is rice (white rice) while the carbohydrate for the western population come from potatoes, wheat etc. These differences need to be considered to generalize the findings of Western literature for the Southeast Asia. So, I was able to link and apply the socio behavioral concepts/ competency throughout my thesis research. Moreover, in my field experience program, the targeted families in the Head Start program are low income families with certain social and behavioral factors who usually do not have health insurance. So the dental problems, overweight issues were mostly untreated though the prevalence rate is higher in such populations. Therefore, the nutrition education targeted to these families by understanding their social and behavioral factors was of great help to design and address the health education for the better intervention.

Therefore, I was able to apply the learning from the coursework and meet all of the core competencies throughout my thesis research and field experience.

Conclusion

This MPH field experience gave me fruitful experiences of how a public health program works in the community and the whole project cycle management experiences- planning, organizing, developing, implementing, monitoring and evaluation. My internship in K-State Research Extension Office gave me the great opportunities to apply the theoretical backgrounds, literatures learned from the university in the real-life public health programming and implementation process, the exposure to directly deal with community who needs us. My thesis research also helped me to link with public health practice during field experience training.

Learning from my thesis relating to the facts that epidemiological differences, biomedical, genetics, social and behavioral factors, tradition and cultural differences may be important modifying factors for the health and nutrition situation of the population enabled me to appropriately program the health and nutrition project for targeted community during my field experience training. Theoretical backgrounds are also important to perform a better public health work. I learned Leonardo da Vinci's quote "He who loves practice without theory is like the sailor who boards ship without a rudder and compass and never knows where he may cast." Therefore, the education I learned from public health program at Kansas State University and these experiences I gained through K-State Research Extension are the perfect combination that enables me to continue my career as a better public health professional both in academia, research works, and public health program administration. I would not be able to learn this much without the guidance and supports from the mentor/preceptor, major professor, faculty of the Kansas State University, Head Start program team, the participants and my friends. I am deeply thankful to everyone who have supported me in different ways to achieve a successful learning in the public health nutrition.

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Appendix A - Appendix for thesis

Table A.1 Search strategy used in PubMed database

Search	Add to builder	Query	Items found	Time
#2	Add	Search (((((((((((("diabetes mellitus, type 2"[MeSH Terms] OR "type 2 diabetes mellitus"[All Fields] OR "type 2 diabetes"[All Fields]))) OR ((niddm OR maturity-onset diabetes OR diabetes mellitus, noninsulin-dependent OR diabetes mellitus, adult-onset OR adult-onset diabetes mellitus OR diabetes mellitus, adult onset OR diabetes mellitus, ketosis-resistant OR diabetes mellitus, ketosis resistant OR ketosis-resistant diabetes mellitus OR diabetes mellitus, maturity-onset OR diabetes mellitus, maturity onset OR diabetes mellitus, non insulin dependent OR diabetes mellitus, non-insulin-dependent OR non-insulin-dependent diabetes mellitus OR diabetes mellitus, noninsulin dependent OR diabetes mellitus, slow-onset OR diabetes mellitus, slow onset OR slow-onset diabetes mellitus OR diabetes mellitus, stable OR stable diabetes mellitus OR diabetes mellitus, type ii OR maturity-onset diabetes mellitus OR maturity onset diabetes mellitus OR type 2 diabetes mellitus OR noninsulin-dependent diabetes mellitus)))) AND ((((lifestyle risk reduction[MeSH Terms] OR lifestyle, sedentary[MeSH Terms] OR sedentary lifestyle[MeSH Terms] OR behavior modification[MeSH Terms]))) OR ((((lifestyle risk reduction[MeSH Terms] OR lifestyles, sedentary[MeSH Terms] OR sedentary lifestyle[MeSH Terms] OR behavior modification[MeSH Terms]))) OR ((behavior, risk reduction OR behaviors, risk reduction OR risk reduction behaviors OR lifestyle risk reduction OR lifestyle risk reductions OR risk reduction OR lifestyle, sedentary OR lifestyles, sedentary OR sedentary lifestyles OR conditioning therapy OR therapy, conditioning OR conditioning therapies OR therapies, conditioning OR behavior modification OR behavior modifications OR modification, behavior OR modifications, behavior OR therapy, behavior OR behavior	64	12:14:21

| | | therapies OR therapies, behavior)))))) OR (((((("diabetes mellitus, type 2"[MeSH Terms] OR "type 2 diabetes mellitus"[All Fields] OR "type 2 diabetes"[All Fields]))) OR ((niddm OR maturity-onset diabetes OR diabetes mellitus, noninsulin-dependent OR diabetes mellitus, adult-onset OR adult-onset diabetes mellitus OR diabetes mellitus, adult onset OR diabetes mellitus, ketosis-resistant OR diabetes mellitus, ketosis resistant OR ketosis-resistant diabetes mellitus OR diabetes mellitus, maturity-onset OR diabetes mellitus, maturity onset OR diabetes mellitus, non insulin dependent OR diabetes mellitus, non-insulin-dependent OR non-insulin-dependent diabetes mellitus OR diabetes mellitus, noninsulin dependent OR diabetes mellitus, slow-onset OR diabetes mellitus, slow onset OR slow-onset diabetes mellitus OR diabetes mellitus, stable OR stable diabetes mellitus OR diabetes mellitus, type ii OR maturity-onset diabetes mellitus OR maturity onset diabetes mellitus OR type 2 diabetes mellitus OR noninsulin-dependent diabetes mellitus)))) AND ((((physical activit* OR physical activity OR physical activities OR motor activit* OR motor activity OR motor activities OR physical exercise))) OR (((((physical activities[MeSH Terms] OR activity, motor[MeSH Terms] OR exercise[MeSH Terms])))) OR ((activities, motor OR activity, motor OR motor activities OR physical activity OR activities, physical OR activity, physical OR physical activities OR locomotor activity OR activities, locomotor OR activity, locomotor OR locomotor activities OR exercises OR exercise, physical OR exercises, physical OR physical exercise OR physical exercises OR exercise, isometric OR exercises, isometric OR isometric exercises OR isometric exercise OR exercise, aerobic OR aerobic exercises OR exercises, aerobic OR aerobic exercise)))))) OR (((((("diabetes mellitus, type 2"[MeSH Terms] OR "type 2 diabetes mellitus"[All Fields] OR "type 2 diabetes"[All Fields]))) OR ((niddm OR maturity-onset diabetes OR diabetes mellitus, noninsulin-dependent OR diabetes mellitus, adult-onset OR adult-onset diabetes mellitus OR diabetes mellitus, adult onset OR diabetes | | |

| | | mellitus, ketosis-resistant OR diabetes mellitus, ketosis resistant OR ketosis-resistant diabetes mellitus OR diabetes mellitus, maturity-onset OR diabetes mellitus, maturity onset OR diabetes mellitus, non insulin dependent OR diabetes mellitus, non-insulin-dependent OR non-insulin-dependent diabetes mellitus OR diabetes mellitus, noninsulin dependent OR diabetes mellitus, slow-onset OR diabetes mellitus, slow onset OR slow-onset diabetes mellitus OR diabetes mellitus, stable OR stable diabetes mellitus OR diabetes mellitus, type ii OR maturity-onset diabetes mellitus OR maturity onset diabetes mellitus OR type 2 diabetes mellitus OR noninsulin-dependent diabetes mellitus)))) AND (((((diet modification) OR ((diet modification[MeSH Terms] OR diet therapy[MeSH Terms] OR diet, reducing[MeSH Terms] OR diet habits[MeSH Terms] OR food habits[MeSH Terms]))) OR ((food habit OR habit, food OR habits, food OR dietary modification OR dietary modifications OR modification, dietary OR modifications, dietary OR diet modification OR diet modifications OR modification, diet OR modifications, diet OR dietary habits OR dietary habit OR habit, dietary OR habits, dietary OR diet habits OR diet habit OR habit, diet OR habits, diet OR therapy, diet OR diet therapies OR therapies, diet OR nutritional management OR dietary management OR diets, reducing OR reducing diet OR reducing diets OR weight reduction diet OR diet, weight reduction OR diets, weight reduction OR weight reduction diets OR weight loss diet OR diet, weight loss OR diets, weight loss OR weight loss diets)))) OR ((diet/exercise OR diet modification)))))) AND (((glycemic control) OR ((Hb A1c OR HbA1 OR glycosylated hemoglobin a OR Hb A1 OR glycohemoglobin a OR hemoglobin a AND (1) OR hemoglobin, glycosylated OR glycosylated hemoglobin OR glycated hemoglobins OR hemoglobins, glycated OR hemoglobin, glycosylated OR glycosylated hemoglobin OR glycated hemoglobins OR hemoglobins, glycated OR blood sugar OR sugar, blood OR glucose, blood OR blood glucose self monitoring OR glucose, blood, self-monitoring OR monitoring, | | |

| | | home blood glucose OR blood sugar self-monitoring OR blood sugar self monitoring OR blood sugar self monitoring OR self-monitoring, blood sugar OR self monitoring, blood sugar OR sugar self-monitoring, blood OR sugar self monitoring, blood OR home blood glucose monitoring OR glucose, blood, self monitoring OR self-monitoring, blood glucose OR blood glucose self monitoring OR glucose self-monitoring, blood OR glucose self monitoring, blood OR self monitoring, blood glucose OR self monitoring, blood glucose))) OR ((hemoglobin a1c OR haemoglobin a1c OR haemoglobin a1c OR glycosylated hemoglobin OR glycosylated haemoglobin OR blood glucose level OR blood sugar OR blood glucose self monitoring OR home blood glucose monitoring OR blood sugar self monitoring OR home blood sugar monitoring OR serum glucose level OR glycemic control)))))) AND (((asia, southeastern[MeSH Terms]) OR ((southeast asia OR asian OR brunei OR burma OR borneo OR cambodia OR east timor OR indonesia OR laos OR malaysia OR myanmar OR mekong valley OR philippines OR thailand OR vietnam OR singapore))) OR ((bruneian OR burmese OR cambodian OR indonesian OR laotian OR malaysian OR filipinos OR thai OR vietnamese OR singaporean)))))) AND (((((randomized controlled trial[MeSH Terms]) OR ("Randomized Controlled Trial"[Publication Type] AND "Randomized Controlled Trials as Topic"[Mesh] AND "Controlled Clinical Trial"[Publication Type])) OR ((Randomized Controlled Trial[Publication Type] OR randomized controlled trials as topic OR Controlled Clinical Trial[Publication Type]))) OR randomized controlled trial) | | |

Appendix B - Materials used for nutrition education

Figure B.1 Material used in nutrition education (Brush up on healthy teeth, Source CDC)

Brush Up on Healthy Teeth

Simple Steps for Kids' Smiles

1. Start cleaning teeth early.

As soon as the first tooth appears, begin cleaning by wiping with a clean, damp cloth every day. When more teeth come in, switch to a small, soft toothbrush. Begin using toothpaste with fluoride when the child is 2 years old. Use toothpaste with fluoride earlier if your child's doctor or dentist recommends it.

2. Use the right amount of fluoride toothpaste.

Fluoride is important for fighting cavities. But if children younger than 6 years old swallow too much fluoride, their permanent teeth may have white spots. To keep this from happening, use only a small amount of toothpaste (about the size of a pea). Teach your child to spit out the toothpaste and to rinse well after brushing.

3. Supervise brushing.

Brush your child's teeth twice a day until your child has the skill to handle the toothbrush alone. Then continue to closely watch brushing to make sure the child is doing a thorough job and using only a small amount of toothpaste.

4. Talk to your child's doctor or dentist.

Check with the doctor or dentist about your child's specific fluoride needs. After age 2, most children get the right amount of fluoride to help prevent cavities if they drink water that contains fluoride and brush their teeth with a pea-sized amount of fluoride toothpaste twice a day.

Parents of children older than 6 months should ask about the need for a fluoride supplement if drinking water does not have enough fluoride.

Do not let a child younger than 6 years old use a fluoride mouth rinse unless the child's doctor or dentist recommends it.

Early care for your children's teeth will protect their smile and their health.

Figure B.2 Material used in nutrition education (CDC)

Refresque Sus Conocimientos sobre Dientes Sanos

Pasos Sencillos para Sonrisas Infantiles

1. Empiece a limpiar los dientes desde muy temprano.
Tan pronto como aparezca el primer diente, empiece a limpiarlo con un trapo limpio y húmedo todos los días. Cuando salgan más dientes, utilice un cepillo de dientes pequeño de cerdas suaves. Inicie el uso de pasta de dientes con fluoruro cuando el niño cumpla los dos años de edad. Utilice pasta de dientes con fluoruro antes si el médico o dentista del niño lo recomienda.

2. Utilice la cantidad correcta de pasta de dientes con fluoruro.
El fluoruro es importante para prevenir las caries. Sin embargo, si un niño menor de seis años traga demasiado fluoruro sus dientes permanentes podrían desarrollar manchas blancas. Para evitar esto, utilice una cantidad pequeña de pasta de dientes (aproximadamente el tamaño de un pequeño grano de maíz). Enseñe a su hijo a escupir la pasta de dientes y a enjuagarse bien después de cepillarse.

3. Supervise el cepillado.
Cepille los dientes de su hijo dos veces al día hasta que él aprenda a utilizar el cepillo de dientes sin ayuda. Luego continúe supervisando al niño cuidadosamente hasta que esté seguro que se cepilla correctamente y que utiliza una cantidad pequeña de pasta de dientes.

4. Hable con el doctor o dentista de su hijo.
Converse con el doctor o dentista acerca de las necesidades de fluoruro de su hijo. Después de cumplir los dos años, la mayoría de los niños ingieren la cantidad necesaria de fluoruro para prevenir las caries si beben agua que contenga esta sustancia y se cepillan los dientes dos veces al día con una pequeña cantidad (del tamaño de un pequeño grano de maíz) de pasta de dientes con fluoruro.

Los padres de niños mayores de seis meses deben preguntar si es necesario administrar un suplemento de fluoruro en caso de que el agua potable no contenga cantidad suficiente.

No deje que un niño menor de seis años utilice enjuague bucal con fluoruro a menos que el doctor o dentista del niño lo haya recomendado.

Si empieza a cuidar desde muy temprano los dientes de su hijo protegerá su sonrisa y su salud.

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Figure B.3 Material used in nutrition education (Brush up on healthy teeth, Spanish version, Source CDC)

Brush Up on Healthy Teeth

A Quiz for Parents About Simple Steps for Kids' Smiles

Learn more about keeping your child's teeth healthy with this true or false quiz.

1. ____ All children older than 6 months should receive a fluoride supplement every day.

2. ____ Parents should start cleaning their child's teeth as soon as the first tooth appears.

3. ____ Parents should start brushing their child's teeth with toothpaste that contains fluoride at age 3.

4. ____ Children younger than 6 years should use enough toothpaste with fluoride to cover the toothbrush.

5. ____ Parents should brush their child's teeth twice a day until the child can handle the toothbrush alone.

6. ____ Young children should always use fluoride mouth rinses after brushing.
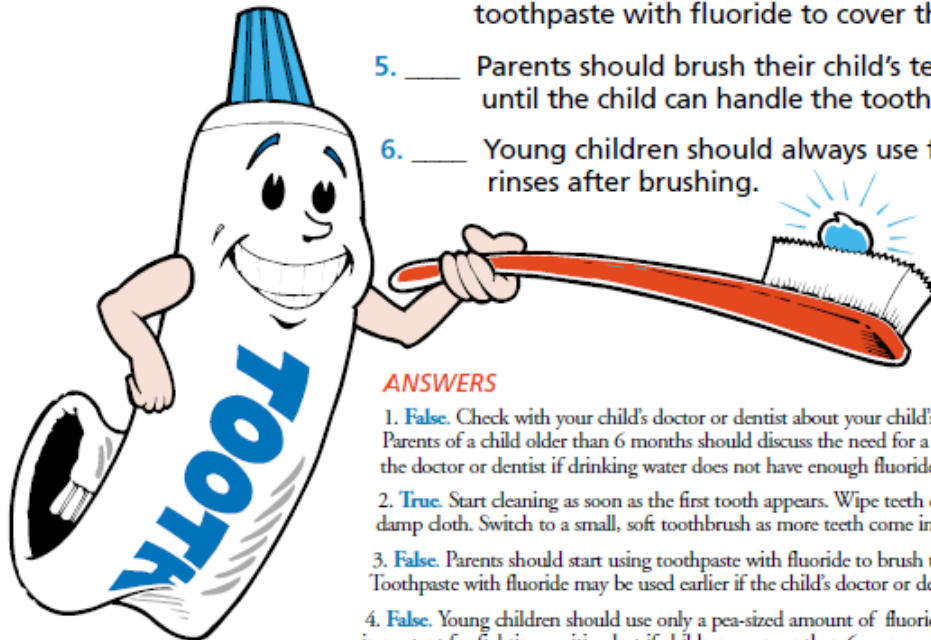
ANSWERS

1. **False.** Check with your child's doctor or dentist about your child's specific fluoride needs. Parents of a child older than 6 months should discuss the need for a fluoride supplement with the doctor or dentist if drinking water does not have enough fluoride to help prevent cavities.

2. **True.** Start cleaning as soon as the first tooth appears. Wipe teeth every day with a clean, damp cloth. Switch to a small, soft toothbrush as more teeth come in.

3. **False.** Parents should start using toothpaste with fluoride to brush their child's teeth at age 2. Toothpaste with fluoride may be used earlier if the child's doctor or dentist recommends it.

4. **False.** Young children should use only a pea-sized amount of fluoride toothpaste. Fluoride is important for fighting cavities, but if children younger than 6 years swallow too much fluoride, their permanent teeth may have white spots. Using no more than a pea-sized amount of toothpaste with fluoride can help keep this from happening.

5. **True.** Children usually do not have the skill to brush their teeth well until around age 4 or 5. Parents should brush their young child's teeth thoroughly twice a day until the child can handle the toothbrush alone.

6. **False.** Fluoride mouth rinses have a high concentration of fluoride. Children younger than 6 years should not use fluoride mouth rinses unless the child's doctor or dentist recommends it. Young children tend to swallow rather than spit, and swallowing too much fluoride before age 6 may cause the permanent teeth to have white spots.

Figure B.4 Material used in nutrition education (A quiz for parents, Source CDC)

Figure B.5 Material used in nutrition education (Healthy snacks limit acid attacks, Source REACH and Kansas Cavity Free Kids)

Figure B.6 Material used in nutrition education (Healthy snacks limit acid attacks, Spanish version, Source REACH and Kansas Cavity Free Kids)