

ประสิทธิผลของโปรแกรมการปรับเปลี่ยนพฤติกรรมร่วมกับการดูแลสุขภาพช่องปาก ต่อระดับน้ำตาลในเลือดและสภาวะปริทันต์ในผู้สูงอายุที่เป็นเบาหวานชนิดที่ 2 กรุงเทพมหานคร ประเทศไทย



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ลิขสิทธิ์ของจุฬาลงกรณ์มหาวิทยาลัย

EFFECTIVENESS OF LIFESTYLE CHANGE PLUS DENTAL CARE (LCDC) PROGRAM ON  
IMPROVING GLYCEMIC AND PERIODONTAL STATUS IN ELDERLY WITH TYPE 2  
DIABETES BANGKOK THAILAND

Miss Saruta Saengtibovorn



A Dissertation Submitted in Partial Fulfillment of the Requirements  
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## CONTENTS

	Page
THAI ABSTRACT .....	iv
ENGLISH ABSTRACT .....	v
ACKNOWLEDGEMENTS .....	vi
CONTENTS .....	vii
LIST OF TABLES .....	xiv
LIST OF FIGURES .....	xx
LIST OF ABBREVIATION.....	xxii
CHAPTER I.....	1
INTRODUCTION.....	1
1.1 Background & rationale.....	1
1.2 Statement of problems.....	2
1.3 Research questions.....	7
1.4 Research hypothesis.....	7
1.5 Research objectives .....	8
1.5.1 General objective.....	8
1.5.2 Specific objective.....	8
1.6 Conceptual framework.....	9
1.7 Operational definitions.....	10
CHAPTER II.....	14
REVIEW OF LITERATURE .....	14
2.1 Diabetes Mellitus (DM) .....	16
2.1.1 Classification of diabetes mellitus.....	17
2.1.2 Clinical complications of diabetes mellitus.....	24
2.1.3 Categories of increase risk for diabetes (pre-diabetes) [34] .....	25
2.1.4 Diagnostic criteria for diabetes mellitus [34].....	26
2.1.5 Factors associated with type 2 diabetes .....	26
2.1.6 Controlling of diabetes mellitus.....	29
2.2 Oral manifestations and complications of diabetes mellitus .....	33

	Page
2.2.1 Periodontal disease .....	33
2.2.2 Salivary and Taste dysfunction .....	44
2.2.3 Oral infection .....	45
2.2.4 Poor oral wound healing.....	46
2.2.5 Non-candidal oral soft tissue lesion .....	46
2.2.6 Oral mucosal disease .....	46
2.2.7 Neuro-sensory oral disorder .....	46
2.2.8 Dental caries and tooth loss .....	47
2.3 Program to prevent and control diabetes mellitus .....	47
2.3.1 Lifestyle change program .....	47
2.3.2 Periodontal treatment program.....	49
2.4 Inter-professional relationships in patient's care .....	51
2.5 Oral health problems in the elderly people.....	52
2.6 The relationship between systemic disease and oral health in elderly people	53
2.7 Theory to support health promotion .....	53
CHAPTER III .....	58
RESEARCH METHODOLOGY .....	58
3.1 Research design .....	58
3.2 Study area .....	58
3.3 Study population.....	58
3.4 Study period.....	59
3.5 Sample size .....	59
3.6 Sampling technique .....	60
3.7 Measurement tools.....	63
3.8 Data collection.....	67
3.9 Outcome measurement.....	83
3.10 Data analysis .....	84
3.11 Ethical consideration .....	86
3.12 Limitation .....	86





4.5.1.1 Overall score of knowledge toward DM and oral health	124
4.5.1.2 Score of knowledge toward DM.....	124
4.5.1.3 Score of knowledge toward oral health .....	124
4.5.2 The differences of knowledge toward DM and oral health score between the intervention and the control groups at baseline, 3 month, and 6 month follow up by Repeated measure ANOVA .....	125
4.5.2.1 Knowledge toward DM and oral health .....	125
4.5.2.2 Knowledge toward DM.....	129
4.5.2.3 Knowledge toward oral health .....	132
4.5.3 Distribution of knowledge toward DM and oral health at 3 month follow up between the intervention and the control groups.....	136
4.5.4 Distribution of knowledge toward DM and oral health at 6 month follow up between the intervention and the control groups.....	143
4.6 Attitude toward DM and oral health at baseline, 3 month, and 6 month follow up.....	151
4.6.1 Score of attitude toward DM and oral health at baseline, 3 month, and 6 month follow up.....	151
4.6.1.1 Overall score of attitude toward DM and oral health.....	151
4.6.1.2 Score of attitude toward DM.....	151
4.6.1.3 Score of attitude toward oral health.....	151
4.6.2 The differences of attitude toward DM and oral health score between the intervention and control groups at baseline, 3 month, and 6 month follow up by Repeated measure ANOVA.....	152
4.6.2.1 Attitude toward DM and oral health.....	152
4.6.2.2 Attitude toward DM.....	156
4.6.2.3 Attitude toward oral health.....	159
4.6.3 Distribution of attitude toward DM and oral health at 3 month follow up between the intervention and the control groups.....	163

4.6.4 Distribution of attitude toward DM and oral health at 6 month follow up .....	167
4.7 Practice toward DM and oral health at 3 and 6 month follow up between the intervention and the control groups .....	171
4.7.1 Practice toward DM at 3 month follow up .....	171
4.7.2 Practice toward oral health at 3 month follow up between the intervention and the control groups.....	175
4.7.2.1 Utilization of dental services between the intervention and the control groups.....	175
4.7.2.2 Oral health behaviors between the intervention and the control groups .....	176
4.7.3 Practice toward DM at 6 month follow up between the intervention and the control groups .....	178
4.7.4 Practice toward oral health at 6 month follow up between the intervention and the control groups.....	182
4.7.4.1 Utilization of dental services between the intervention and the control groups.....	182
4.7.4.2 Oral health behaviors between the intervention and the control groups .....	183
4.8 Biological parameters at baseline, 3 month, and 6 month follow up in the intervention and the control groups .....	186
4.8.1 Descriptive statistics of biological parameters at baseline, 3 month, and 6 month follow up in the intervention and the control groups .....	186
4.8.1.1 Fasting plasma glucose (FPG) .....	186
4.8.1.2 Glycated Hemoglobin (HbA1c) .....	186
4.8.1.3 Triglyceride (TG).....	186
4.8.1.4 High density lipoprotein (HDL).....	187
4.8.1.5 Low density lipoprotein (LDL) .....	187
4.8.1.6 Body Mass Index (BMI) .....	187

4.8.2 The differences of biological parameters (TG, HDL, LDL, and BMI) between the intervention and control groups at baseline, 3 month, and 6 month follow up by Repeated measure ANOVA .....	188
4.8.2.1 Triglyceride (TG).....	188
4.8.2.2 High density lipoprotein (HDL).....	190
4.8.2.3 Low density lipoprotein (LDL) .....	192
4.8.2.4 Body Mass Index (BMI) .....	194
4.9 The effectiveness of LCDC program on glycemic status by Repeated measure ANOVA.....	196
4.9.1 Fasting plasma glucose (FPG).....	196
4.9.2 Glycated hemoglobin (HbA1c) .....	200
4.10 Periodontal status at baseline, 3 month, and 6 month follow up in the intervention and the control groups .....	204
4.10.1 Descriptive statistics of periodontal status at baseline, 3 month, and 6 month follow up in the intervention and the control groups.....	204
4.10.1.1 Plaque index score .....	204
4.10.1.2 Gingival index score.....	205
4.10.1.3 Pocket depth .....	205
4.10.1.4 Clinical attachment loss (CAL) .....	205
4.11 The effectiveness of LCDC program on periodontal status by Repeated measure ANOVA.....	207
4.11.1 Plaque index score.....	207
4.11.2 Gingival index score .....	211
4.11.3 Pocket depth .....	215
4.11.4 Clinical attachment loss (CAL).....	219
CHAPTER V .....	224
DISCUSSION, CONCLUSION, AND RECOMMENDATION .....	224
5.1 Discussion.....	224
5.1.1 Baseline characteristics .....	224

5.1.2 Difference of knowledge and attitude score between pre and post education .....	225
5.1.3 The relationship between blood glucose level and periodontal status	225
5.1.4 Knowledge toward DM and oral health at baseline, 3 month, and 6 month follow up .....	226
5.1.5 Attitude toward DM and oral health at baseline, 3 month, and 6 month follow up.....	228
5.1.6 Practice toward DM and oral health at baseline, 3 month, and 6 month follow up.....	228
5.1.6.1 Practice toward DM .....	228
5.1.6.2 Practice toward oral health .....	232
5.1.7 Biological parameters (triglyceride, HDL, LDL, and BMI) at baseline, 3 month, and 6 month follow up.....	233
5.1.8 The LCDC program .....	234
5.1.8.1 The effectiveness of LCDC program on glycemic status .	235
5.1.8.2 The effectiveness of LCDC program on periodontal status .....	236
5.2 Strength and weakness .....	238
5.3 Conclusion .....	239
5.4 Recommendations .....	242
REFERENCES .....	245
VITA.....	314

## LIST OF TABLES

Table 1: Distribution of socio-demographic between Health Centers 54 and 59.....	62
Table 2: The criteria of Plaque Index (PI) .....	65
Table 3: The criteria of Gingival Index (GI).....	66
Table 4: Distribution of general characteristics (n=132) .....	93
Table 5: Distribution of biological parameters (n=132) .....	98
Table 6: Score of knowledge toward DM and oral health at baseline (n=132).....	99
Table 7: Distribution of knowledge toward DM at baseline between the intervention and the control groups (n=132) .....	103
Table 8: Distribution of knowledge toward oral health at baseline between the intervention and the control groups (n=132) .....	107
Table 9: Score of attitude toward DM and oral health at baseline (n=132) .....	109
Table 10: Distribution of attitude toward DM at baseline by Mann-Whitney U test (n=132, 66 participants per group).....	111
Table 11: Distribution of attitude toward oral health at baseline by Mann-Whitney U test (n=132, 66 participants per group).....	112
Table 12: Practice toward DM at baseline (n=132) .....	114
Table 13: Utilization of dental services at baseline between the intervention and the control groups (n=132).....	116
Table 14: Oral health behaviors at baseline between the intervention and the control groups (n=132) .....	118
Table 15: Periodontal status at baseline between the intervention and the control groups (n=132) .....	120
Table 16: Difference of knowledge and attitude score between pre and post education of the intervention group at baseline by paired t test ( $p < 0.05$ ) (n=66) ....	122
Table 17: Relationship between blood glucose level and periodontal status at baseline (n=132) .....	123
Table 18: Descriptive statistics of score of knowledge toward DM and oral health at baseline, 3 month, and 6 month follow up in the intervention and the control groups .....	125

Table 19: Repeated measure ANOVA of knowledge toward DM and oral health between the intervention and the control groups (n=130) .....	126
Table 20: Pairwise comparisons of the different measurements of knowledge toward DM and oral health between the intervention and the control groups (n=130) .....	127
Table 21: Pairwise comparisons of the different measurements of knowledge toward DM and oral health, in the time of measurements in the intervention and the control groups (n=130) .....	128
Table 22: Repeated measure ANOVA of knowledge toward DM between the intervention and the control groups (n=130) .....	129
Table 23: Pairwise comparisons of the different measurements of knowledge toward DM between the intervention and the control groups (n=130) .....	131
Table 24: Pairwise comparisons of the different measurements of knowledge toward DM, in the time of measurements of the intervention and the control groups (n=130) .....	132
Table 25: Repeated measure ANOVA of knowledge toward oral health between the intervention and the control groups (n=130) .....	133
Table 26: Pairwise comparisons of the different measurements of knowledge toward oral health between the intervention and the control groups (n=130) .....	135
Table 27: Pairwise comparisons of the different measurements of knowledge toward oral health, in the time of measurements of the intervention and the control groups (n=130) .....	136
Table 28: Distribution of knowledge toward DM and oral health at 3 month follow up in the intervention and the control groups (n=130) .....	138
Table 29: Distribution of knowledge toward oral health at 3 month follow up in the intervention and the control groups (n=130) .....	142
Table 30: Distribution of knowledge toward DM at 6 month follow up between the intervention and the control groups (n=130) .....	146
Table 31: Distribution of knowledge toward oral health at 6 month follow up between the intervention and the control groups (n=130) .....	150

Table 32: Descriptive statistics of score of attitude toward DM and oral health at baseline, 3 month, and 6 month follow up in the intervention and the control groups (n=130).....	152
Table 33: Repeated measure ANOVA of attitude toward DM and oral health between the intervention and the control groups (n=130).....	153
Table 34: Pairwise comparisons of the different measurements of attitude toward DM and oral health between the intervention and the control groups (n=130).....	154
Table 35: Pairwise comparisons of the different measurements of attitude toward DM and oral health, in the time of measurements of the intervention and the control groups (n=130) .....	155
Table 36: Repeated measure ANOVA of attitude toward DM between the intervention and the control groups (n=130) .....	156
Table 37: Pairwise comparisons of the different measurements of attitude toward DM between the intervention and the control groups (n=130) .....	158
Table 38: Pairwise comparisons of the different measurements of attitude toward DM, in the time of measurements of the intervention and the control groups (n=130) .....	159
Table 39: Repeated measure ANOVA of attitude toward oral health between the intervention and the control groups (n=130).....	160
Table 40: Pairwise comparisons of the different measurements of attitude toward oral health between the intervention and the control groups (n=130).....	162
Table 41: Pairwise comparisons of the different measurements of attitude toward oral health, in the time of measurements of the intervention and the control groups (n=130).....	163
Table 42: Distribution of attitude toward DM at 3 month follow up between the intervention and the control groups by Mann-Whitney U test (n=130, 65 participants per group).....	165
Table 43: Distribution of attitude toward oral health at 3 month follow up between the intervention and the control groups by Mann-Whitney U test (n=130, 65 participants per group) .....	166



Table 44: Distribution of attitude toward DM at 6 month follow up between the intervention and the control groups by Mann-Whitney U test (n=130, 65 participants per group).....	169
Table 45: Distribution of attitude toward oral health at 6 month follow up between the intervention and the control groups by Mann-Whitney U test (n=130, 65 participants per group) .....	170
Table 46: Practice toward DM at 3 month follow up between the intervention and the control groups (n=130).....	173
Table 47: Utilization of dental services at 3 month follow up between the intervention and the control groups (n=130).....	176
Table 48: Oral health behaviors at 3 month follow up between the intervention and the control groups (n=130).....	177
Table 49: Practice toward DM at 6 month follow up between the intervention and the control groups (n=130).....	180
Table 50: Utilization of dental services at 6 month follow up between the intervention and the control groups (n=130).....	183
Table 51: Oral health behaviors at 6 month follow up between the intervention and the control groups (n=130).....	184
Table 52: Descriptive statistics of biological parameters (FPG, HbA1c, TG, HDL, LDL, and BMI) at baseline, 3 month, and 6 month follow up in the intervention and the control groups.....	188
Table 53: Repeated measure ANOVA of triglyceride (TG) between the intervention and the control groups (n=130) .....	189
Table 54: Repeated measure ANOVA of HDL between the intervention and the control groups (n=130).....	191
Table 55: Repeated measure ANOVA of LDL between the intervention and the control groups (n=130).....	193
Table 56: Repeated measure ANOVA of BMI between the intervention and the control groups (n=130).....	195
Table 57: The effectiveness of LCDC program on FPG between the intervention and the control groups (n=130).....	197

Table 58: Pairwise comparisons of the different measurements of FPG between the intervention and the control groups in the intervention and the control groups (n=130).....	199
Table 59: Pairwise comparisons of the different measurements of FPG in the time of measurements in the intervention and the control groups (n=130).....	200
Table 60: The effectiveness of LCDC program on HbA1c between the intervention and the control groups (n=130) .....	201
Table 61: Pairwise comparisons of the different measurements of HbA1c between the intervention and the control groups (n=130).....	203
Table 62: Pairwise comparisons of the different measurements of glycated hemoglobin (HbA1c) in the time of measurements of the intervention and the control groups (n=130).....	204
Table 63: Descriptive statistics of periodontal status at baseline, 3 month, and 6 month follow up in the intervention and the control groups.....	207
Table 64: The effectiveness of LCDC program on plaque index score between the intervention and the control groups (n=130).....	208
Table 65: Pairwise comparisons of the different measurements of plaque index score between the intervention and the control groups (n=130) .....	210
Table 66: Pairwise comparisons of the different measurements of plaque index score in the time of measurements of the intervention and the control groups (n=130)..	211
Table 67: The effectiveness of LCDC program on gingival index score between the intervention and the control groups (n=130).....	212
Table 68: Pairwise comparisons of the different measurements of gingival index score between the intervention and the control groups (n=130) .....	214
Table 69: Pairwise comparisons of the different measurements of gingival index score in the time of measurements of the intervention and the control groups (n=130)..	215
Table 70: The effectiveness of LCDC program on pocket depth between the intervention and the control groups (n=130).....	216
Table 71: Pairwise comparisons of the different measurements of pocket depth between the intervention and the control groups (n=130) .....	218

Table 72: Pairwise comparisons of the different measurements of pocket depth in the time of measurements of the intervention and the control groups (n=130) .....	219
Table 73: The effectiveness of LCDC program on CAL between the intervention and the control groups (n=130).....	220
Table 74: Pairwise comparisons of the different measurements of CAL between the intervention and the control groups (n=130).....	222
Table 75: Pairwise comparisons of the different measurements of CAL in the time of measurements of the intervention and the control groups (n=130) .....	223



## LIST OF FIGURES

Figure 1: Conceptual framework .....	9
Figure 2: Flow chart of study allocation .....	63
Figure 3: Study procedure of the intervention and the control groups .....	75
Figure 4: Study population at baseline, 3 month, and 6 month follow up.....	90
Figure 5: Change overtime on knowledge toward DM and oral health in the intervention and the control groups .....	127
Figure 6: Change overtime on knowledge toward DM in the intervention and the control groups .....	130
Figure 7: Change overtime on knowledge toward oral health in the intervention and the control groups.....	134
Figure 8: Change overtime on attitude toward DM and oral health in the intervention and the control groups .....	154
Figure 9: Change overtime on attitude toward DM in the intervention and the control groups .....	157
Figure 10: Change overtime on attitude toward oral health in the intervention and the control groups.....	161
Figure 11: Change overtime on triglyceride (TG) in the intervention and the control groups .....	190
Figure 12: Change overtime on High Density Lipoprotein (HDL) in the intervention and the control groups.....	192
Figure 13: Change overtime on Low Density Lipoprotein (LDL) in the intervention and the control groups.....	194
Figure 14: Change overtime on Body Mass Index (BMI) in the intervention and the control groups .....	196
Figure 15: Change overtime on Fasting plasma glucose (FPG) in the intervention and the control groups.....	198
Figure 16: Change overtime on Glycated hemoglobin (HbA1c) in the intervention and the control groups.....	202

Figure 17: Change overtime on Plaque index score in the intervention and the control groups .....	209
Figure 18: Change overtime on Gingival index score in the intervention and the control groups .....	213
Figure 19: Change overtime on Pocket depth in the intervention and the control groups .....	217
Figure 20: Change overtime on Clinical attachment loss (CAL) in the intervention and the control groups.....	221



## LIST OF ABBREVIATION

AAP	American Academy of Periodontal disease
ADA	American Diabetes Association
BMA	Bangkok Metropolitan Administration
BMI	Body Mass Index
CAL	Clinical attachment level
CI	Confident Interval
DCCT	Diabetes Control and Complications Trial
DM	Diabetes Mellitus
DMFT	Decay, Missing and Filling Teeth
FPG	Fasting plasma glucose
GDM	Gestational diabetes mellitus
GI	Gingival index
HbA1c	Glycated hemoglobin
HBM	Health Belief Model
HDL	High Density lipoprotein
IGT	Impaired glucose tolerance
IFG	Impaired fasting glucose
IOC	Item-Objective Congruence Index
LCDC	Lifestyle Change plus Dental Care program
LDL	Low Density Lipoprotein
MI	Motivational Interviewing
NGSP	National Glycohemoglobin Standardization Program

OGTT	Oral Glucose Tolerance Test
OHA	Oral Hypoglycemic Agents
PI	Plaque index
POP	Posterior occluding pairs of natural teeth
SCT	Social Cognitive Theory
SD	Standard Deviation
SE	Standard Error
TG	Triglyceride
WHO	World Health Organization



## CHAPTER I

### INTRODUCTION

#### 1.1 Background & rationale

Thailand is becoming an aging society due to slow population growth and new group of births continues to dwindle. National Statistical Office Survey found proportion of the elderly in Thai population was increasing continuously from 6.8% in 1994, 9.4% in 2002, and 10.7% in 2007. Furthermore, the proportion of the elderly in Thai population has tendency to increase to 15.3% in 2020. These happen as a result of baby boomers, increased life expectancy at birth (66 years in male and 70.4 years in female) [1], and decreased birth rate from 16.4 (per 1,000 population) in 1994 to 11.8 (per 1,000 population) in 2012. [2]

Age-related change affects the elderly lifestyle. Physical age-related change included weakening vision, hearing impairment, and increased probability of arthritis. Moreover, the elderly are high risks of chronic conditions included diabetes mellitus, arthritis, congestive heart failure, and dementia. [3]

Diabetes mellitus (DM) is a chronic, systemic metabolic disorder. Currently, many countries face the problem of increasing prevalence of diabetes mellitus. Diabetes mellitus cause morbidity and mortality due to long-term complications, which affect the important organs, for example the eyes, blood vessels, heart, kidneys, and nerves. [4] Clinical complications of diabetes mellitus included



retinopathy, nephropathy, neuropathy, macro-vascular disease, delay wound healing, and periodontal disease. Periodontal disease is the sixth complication of diabetes mellitus. [5]

Periodontal disease is an inflammatory disease affecting the periodontium included gingiva, cementum, periodontal ligament, and alveolar bone. Periodontitis is also a complication of type 2 diabetes associated with health outcomes due to systemic inflammation. Periodontal disease and diabetes mellitus have a bidirectional relationship. The effect of DM on periodontal health and periodontal infection also affect glycemic control. Furthermore, periodontal infection increases the risk for developing diabetes mellitus complications. It is important to minimize the adverse effects of oral complications on glycemic control in diabetic patients, particularly periodontal disease, through prevention and management. [4]

## 1.2 Statement of problems

Prevalence of diabetes mellitus has been increasing in the Thai population from 2.3% in 1992 to 6.9% in 2009 and is highest in the population age 60-69 (16.7%). The first three order of the prevalence of diabetes mellitus were 60-69 (16.7%), 70-79 (15.8%), and above 80 years (11.5%). Bangkok had the highest prevalence of diabetes mellitus. [6] Rungsin et al., 2012 assessed the quality of care in type 2 diabetic patients and hypertension in the hospitals of ministry of public health and Bangkok Metropolitan Administration (BMA) in Thailand found 65.9% of diabetic patients had uncontrolled blood glucose and 59.4% of these group had acute

diabetes complication. [7] Furthermore, Pragosuntung et al., 2011 studied in Roi-Et Province found 73.9% of diabetic patients had uncontrolled blood glucose. [8]

From the 7<sup>th</sup> Thai National Oral Health Survey 2012, most of the elderly population had periodontal disease; 89.0% of the population aged 60-74 and 91.8% of the population aged above 80 years. Comparing to the 6<sup>th</sup> Thai National Oral Health Survey 2006-2007, the prevalence of periodontal disease of the population aged 60-74 increased from 84.2% in 2007 to 89.0% in 2012 however the prevalence of periodontal disease of the population above 80 years minor decreased from 95.7% in 2007 to 91.8% in 2012. [9, 10]

Among the population aged 60-74, 73.6% had 4 posterior occluding pairs of natural teeth (enough for mastication). Population of the elderly in Bangkok had the lowest 4 posterior occluding pairs of natural teeth (64.3%). 7.2% of the population aged 60-74 was edentulism. Population of the elderly in Bangkok had the highest percentage of edentulism (10.8%). Mean decay missing and filled teeth (DMFT) of the country was 14.9 teeth/person and Bangkok also had higher mean decay missing and filled teeth (DMFT) than the country (17.4 teeth/person). Furthermore, Bangkok (62.5%) had extremely higher prevalence of root caries than the average of the country level (37.5%). [9] Srisaphum, 2009 studied the dental health status of diabetic patient in Changhan, Roi Et Province found 91.8% of diabetic patients had periodontal disease, 72.2% of diabetic patients had dental caries, 55.5% of diabetic

patients had root caries, and age, brushing behavior, and using toothpick associated with periodontal disease. [11]

The elderly increased the prevalence of diabetes mellitus and oral manifestations of diabetes mellitus including periodontal disease, coronal caries, burning mouth syndrome, dry mouth, angular cheilitis and glossitis, and benign parotid hypertrophy. [4, 5] Oral health was associated with general health so subjective assessment of oral health was significantly related with medical expenses of community-dwelling elderly. [12] From the 4<sup>th</sup> Thai National Health Examination Survey 2008-2009 and the 7<sup>th</sup> Thai National Oral Health Survey 2012 showed the increasing of the prevalence of diabetes mellitus, periodontal disease, and dental caries in Thai elderly population. [6, 9]

Although the elderly had high prevalence of periodontal disease and dental caries, the percentage of utilization of dental services in Thailand was different in different areas and most of them were using dental services less than 50%, 48.9% in Thung Kru, Bangkok [13], 32.3% from the 6<sup>th</sup> Thai National Oral Health Survey 2006-2007 [10], and 29.0% in Chiang Dao, Chiang Mai [14]. Chaudhari et al., 2012 studied the dental care utilization in diabetes compared with non-diabetes found diabetic patients used dental care less than non-diabetes and diabetic patients more used periodontal care and extraction than preventive care consistent with Rungsin et al., 2012 who studied in Thai population also found only 35.2% of type 2 diabetes received oral health examination. [7, 15]

Ueno et al., 2010 found the prevalence of periodontal disease in diabetic Japanese adults increased with age group and higher than non-diabetics. Diabetic Japanese adults had lower number of natural teeth and functional teeth units. [16]

Kongtawelert and Wongkongkatep, 2008 evaluated oral health promotion, prevention, and curative service in Thailand found 59.7% of primary care units did not provide oral health service in chronic disease clinic. [17]

In 2009, Thailand had 19,089 doctors, 83,022 nurses, and 4,278 dentists. [18] The proportion of the physicians per Thai's population was about 1:7,000 and proportion of the dentists per Thai's population was 1:15,000. [19]

Weinspach et al., 2013 studied the level of information about the relationship between diabetes mellitus and periodontal disease in non-diabetes, type 1 diabetes, and type 2 diabetes found type 2 diabetes had the lowest information about diabetes mellitus and periodontal disease. [20]

Choowattanapakorn and Suriyawong, 2011 studied the understanding of diabetes in the elderly diabetic patients in Chiang-rai by using a qualitative method found diabetic patients had different aspect of knowledge in diabetes from health personnels. [21]

Bureau of Dental Health, Ministry of Public Health, Thailand formulated "Thailand Oral Health Goal 2020" to minimize the impact of oral diseases on health and psychosocial development which emphasis to promoting oral health and reducing oral disease, to develop an accessible oral health systems under the

national security scheme, and to develop oral health programs that will empower people and to promote social responsibility in order to control determinants of health. To achieve the goal, they also set the indicators for all ages. The indicators of the elderly age more than 60 years is “the elderly will have more than 20 functional teeth”. [22]

Oral health education and health promotion strategies were needed to prevent oral health complications of diabetes mellitus. Individualized counseling which include regular dental visits, comprehensive medical and drug use histories, dietary evaluation and counseling, smoking-cessation, assessment of salivary functions, topical fluoride application, and proper oral hygiene were needed for dental management strategy. [23]

Bangkok Metropolitan Administration (BMA) has 68 health centers located around Bangkok. Health centers have curative, health promotion, prevention and control disease and rehabilitative health service. Diabetic clinic is one of the curative services.

There were many studies about the effectiveness of the lifestyle change program to control diabetes by decrease glycated hemoglobin (HbA1c). [24-29] However, only lifestyle change could not prevent periodontal disease. Furthermore, periodontal treatment program also controlled diabetes by decrease HbA1c. [5, 30-32] Only periodontal treatment program could not prevent the other diabetic's

complications. So the study, which combines lifestyle change and periodontal care should prevent all of diabetic's complications.

### 1.3 Research questions

- What is the effectiveness of Lifestyle Change plus Dental Care (LCDC) program on improving glycemic status in the elderly with type 2 diabetes?
- What is the effectiveness of Lifestyle Change plus Dental Care (LCDC) program on improving periodontal status in the elderly with type 2 diabetes?

### 1.4 Research hypothesis

Lifestyle Change plus Dental Care (LCDC) program can improve glycemic and periodontal status in the elderly with type 2 diabetes.

## 1.5 Research objectives

### 1.5.1 General objective

- To assess the effectiveness of Lifestyle Change plus Dental Care (LCDC) program to improve glycemic and periodontal status in the elderly with type 2 diabetes.

### 1.5.2 Specific objective

- To explore the role of program on periodontal status in the elderly with type 2 diabetes.
- To explore the role of program on glycemic status in the elderly with type 2 diabetes.
- To explore the role of program on practice of the elderly with type 2 diabetes and periodontal disease.
- To assess the relationship between blood glucose level and periodontal disease in the elderly with type 2 diabetes.

## 1.6 Conceptual framework

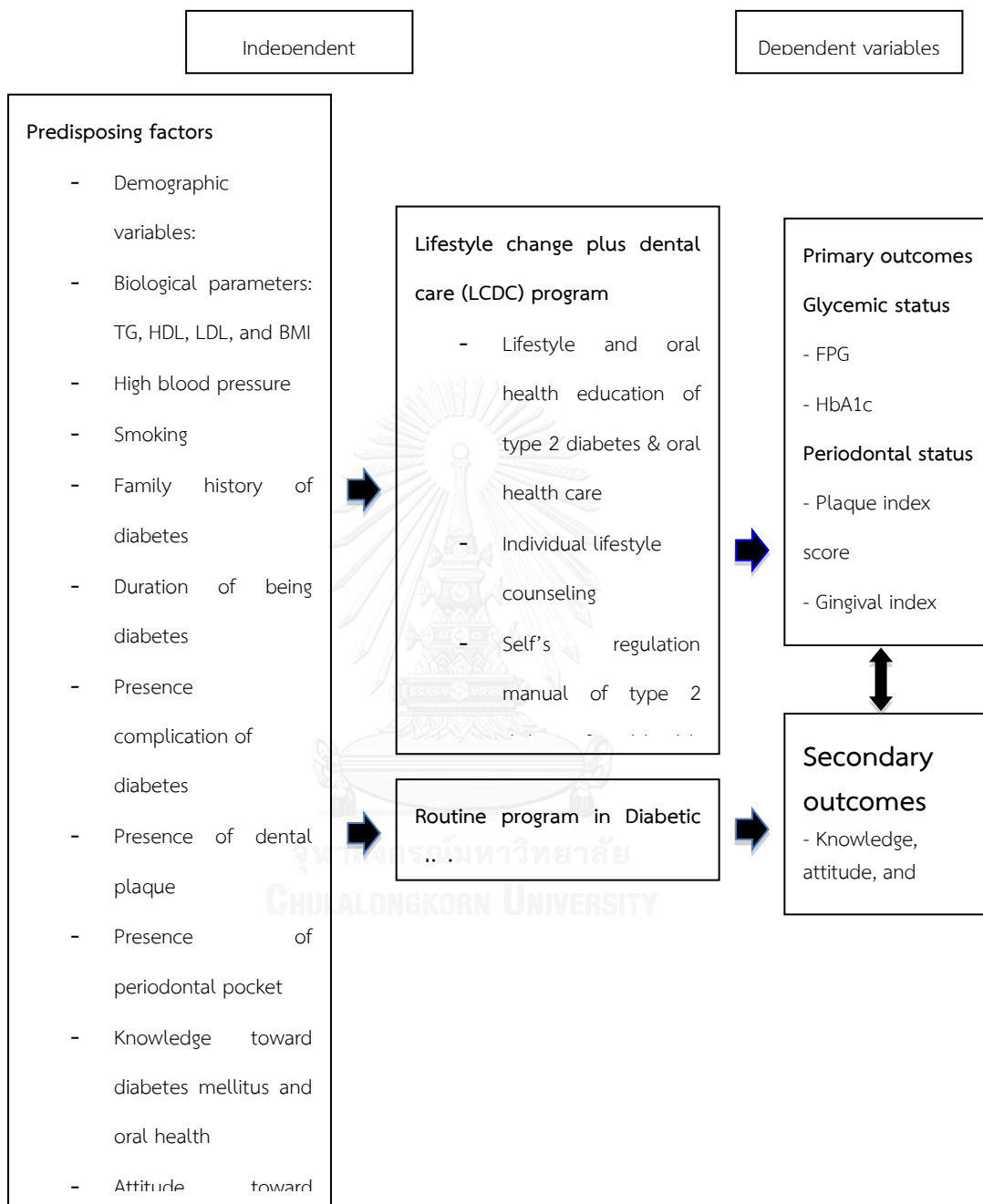


Figure 1: Conceptual framework



## 1.7 Operational definitions

- **Age:** self-reported age of the participant at the time of interview.
- **Biological parameters:** the level of TG, HDL, LDL, and BMI of the participant which retrieved from medical record at the time of interview.
- **Chronic diseases:** the diseases of long duration and generally slow progression such as heart disease, stroke, cancer, chronic respiratory diseases and diabetes. [33]
- **Complication of diabetes:** a self-report of the complication of diabetes including high blood pressure, stroke, heart disease, eye problems, kidney disease, and foot problem.
- **Dental care:** defines as intensive oral hygiene instruction including tooth brushing and using dental floss, and receiving dental services.
- **Dental service:** defines as extraction, restoration, cleaning and scaling, denture wearing, and dental examination.
- **Diabetes mellitus:** the participant who had A1C  $\geq$  6.5%, or FPG  $\geq$  126 mg/dl (7.0 mmol/l), or 2-h plasma glucose  $\geq$  200 mg/dl (11.1 mmol/l) during an OGTT, or a participant with classic symptoms of hyperglycemia or hyperglycemic crisis, a random plasma glucose  $\geq$  200 mg/dl (11.1 mmol/l).
- **Diet:** a self-report of the modified diet as doctor's/dietician's advice and

the frequency of modified diet at the time of interview.

- **Duration of being diabetes:** a self-report of the time of being diabetes at the time of interview.
- **Educational level:** the level of education that participant reported at the time of interview classified as illiteracy, primary school, secondary school, vocational school, and bachelor degree or higher.
- **Elderly:** the population aged over 60 years.
- **Family history of diabetes:** a self-report of parental, sibling or children history diabetes of the participant at the time of interview.
- **Gender:** male and female.
- **Glycemic control:** defined as HbA1c < 6.5% [34]. The HbA1c retrieved from medical record at the time of interview.
- **Healthy lifestyle:** eating lots of fruits and vegetables, reducing fat, sugar and salt intake and exercising. [35]
- **Health insurance:** a self-report of the health insurance type of the participant at the time of interview classified as universal coverage, social insurance, and government or state enterprise officer.
- **High blood pressure:** the systolic blood pressure of the participant greater than 140/90 mmHg as retrieved from medical records.

- **Income:** a self-report of the average individual total monthly income at the time of interview.
- **KAP:** refer to a self-report of knowledge, attitude, and practice of diabetic patients toward diabetes mellitus and oral health at the time of interview.
- **Marital status:** a self-report civil status of the participant at the time of interview classified as single, married, divorce/separate, and windowed.
- **Moderate physical activity:** refer to exercise from 3.5-7.0 kcal/min [36] such as yoga, light sport, physical exercise, gardening, and taking long walk measured by a self-report of physical activity
- **Occupation:** a self-report of the occupation of the participant at the time of interview classified as agricultural, employee, retired, merchant, private business, and unemployed.
- **Oral health:** the state of being free from oral disease or disorders included chronic mouth and facial pain, oral and throat cancer, oral sores, birth defects such as cleft lip and palate, periodontal disease, tooth decay and tooth loss, and other diseases and disorders that affect the oral cavity. [37]
- **Oral health behavior:** defines as tooth brushing with fluoride toothpaste and using dental floss or other services.

- **Periodontal status:** the state of periodontium measured by plaque index, gingival index, pocket depth, and clinical attachment loss.
- **Periodontal disease:** the inflammatory disease affected periodontium categorized to mild, moderate, and severe periodontitis.
- **Routine program in diabetic clinic:** refer to seeing doctor once a month, collecting diabetic medicine from pharmacist, make an appointment, measuring FPG once a month, measuring HbA1c every 6 months, and receiving oral examination once a year.
- **Smoking:** the self-report of smoking behavior from the participant classified as non-smoker, ever smoker, and smoker.
- **Systemic diseases:** the diseases that involve many organs or the whole body.
- **Utilization:** a self-report use of the above defined dental services of the participant at the time of interview.

## CHAPTER II

### REVIEW OF LITERATURE

This chapter discusses the following topics.

#### 2.1 Diabetes Mellitus (DM)

##### 2.1.1 Classification of diabetes mellitus

###### - Type 1 diabetes

- Signs and symptoms of type 1 diabetes

###### - Type 2 diabetes

- Signs and symptoms of type 2 diabetes
- Risk factors of type 2 diabetes
- Prevention of type 2 diabetes

###### - Other specific types of diabetes

##### 2.1.2 Clinical complications of diabetes mellitus

##### 2.1.3 Categories of Increase risk for diabetes (pre-diabetes)

##### 2.1.4 Diagnostic criteria for diabetes mellitus

##### 2.1.5 Factors associated with type 2 diabetes

##### 2.1.6 Controlling of type 2 diabetes mellitus

#### 2.2 Oral manifestations and complications of diabetes mellitus

##### 2.2.1 Periodontal disease

- Classification of periodontal disease
- Periodontal disease and diabetes mellitus
- Role of diabetes mellitus in adversely affecting periodontal disease
- Role of periodontal infection in adversely affecting glycemic control
- Treatment and maintenance of periodontal disease

2.2.2 Salivary and taste dysfunction

2.2.3 Oral infection

2.2.4 Poor oral wound healing

2.2.5 Non-candidal oral soft tissue lesion

2.2.6 Oral mucosal disease

2.2.7 Neuro-sensory oral disorder

2.2.8 Dental caries and tooth loss

2.3 Program for prevention and control diabetes mellitus

2.3.1 Lifestyle change program

2.3.2 Periodontal treatment program

2.4 Inter-professional relationships in patient's care

2.5 Oral health problems in the elderly people

2.6 The relationship between systemic disease and oral health in elderly people

2.7 Theory to support health promotion

- Cognitive-Behavioral theory
- Health Belief Model (HBM)

- Social Cognitive Theory (SCT)
- PRECEDE-PROCEDE model
- Motivational Interviewing (MI)
- Theory to support lifestyle change plus dental care program

## 2.1 Diabetes Mellitus (DM)

Diabetes Mellitus (DM) is a chronic, systemic metabolic disorder cause hyperglycemia. Glucose was broken from food when people eat and move from bloodstream into the body cells. Insulin is used to move glucose from bloodstream into the body cells. Diabetic patients have high sugar levels due to they do not have enough insulin. [38] Hyperglycemia is associated with defective insulin secretion, insulin action, or both, so that cells of the body cannot absorb glucose in the blood. The chronic hyperglycemia of diabetes mellitus caused long-term damage, dysfunction, and failure of various organs, particularly eyes, kidneys, nerves, heart, and blood vessels. [39]

The development of diabetes mellitus affected by several pathogenic processes range from autoimmune destruction of the  $\beta$ -cells of the pancreas cause insulin deficiency to abnormalities so that resistance to insulin action. The basis of the abnormalities in carbohydrate, fat, and protein metabolism in diabetes mellitus is deficient action of insulin on target tissues. Deficient insulin action results from inadequate insulin secretion and/or diminished tissue responses to insulin at one or more points in the complex pathways of hormone action. Impairment of insulin

secretion and defects in insulin action commonly coexist in the same patient, and it is often unclear which abnormality, if either alone, is the primary cause of the hyperglycemia. [34]

Hyperglycemia had direct effect to general sign and symptoms of diabetes mellitus. [40] Polyuria, polydipsia, weight loss, polyphagia, and blur vision are the symptoms of hyperglycemia. Chronic hyperglycemia causes susceptibility to infections and impairment of growth. [34] Early diagnosis and therapy could reverse signs and symptoms. [40]

Complication of diabetes mellitus include high blood pressure, stroke, heart disease, eye problems, kidney disease, nervous system damage, foot problems, skin disorders, and dental disease. Diabetic patient has high opportunity to develop other illnesses and delay healing. [38]

### 2.1.1 Classification of diabetes mellitus

Diabetes Mellitus is divided to 3 major types in 2013 the American Diabetes Association [34]

#### 1. **Type 1 diabetes** (insulin dependent diabetes or juvenile-onset diabetes)

Type 1 diabetes is the absolute deficiency of insulin secretion, found only 5-10% of diabetes, and most common in infants and children.  $\beta$ -cells of the pancreas are destroyed by cellular-mediated autoimmune.  $\beta$ -cells include islet cell autoantibodies, autoantibodies to insulin, autoantibodies to glutamic acid decarboxylase (GAD65), and autoantibodies to the tyrosine phosphatases. IA-2 and IA-



$2\beta$  are the markers of the immune destruction. When patient has hyperglycemia, these autoantibodies are usually detected. This type of diabetes has strong human leukocyte antigen (HLA) associations, with linkage to the DQA and DQB genes, and influenced by the DRB genes. These HLA-DR/DQ alleles can be either predisposing or protective. [34] Due to the damage of  $\beta$ -cells of the pancreas from immune system, patient in this type need to take insulin everyday. [38]

Ketoacidosis is the first manifestation of this type. When the patient has infection or stress, hyperglycemia can rapidly change to severe hyperglycemia and/or ketoacidosis. [34]

#### Signs and symptoms of type 1 diabetes [41]

- Frequent urination
- Unusual thirst
- Extreme hunger
- Unusual weight loss
- Extreme fatigue and Irritability

#### 2. Type 2 diabetes (non-insulin dependent diabetes or adult-onset diabetes)

Type 2 diabetes is the most common form of diabetes ranging from predominantly insulin resistance with relative insulin deficiency to predominantly an insulin secretory defect with insulin resistance. 90-95% of diabetes had this type. Type 2 diabetes caused by patient have insulin resistance and commonly related to

insulin deficiency. Autoimmune destruction of  $\beta$ -cells does not occur in this type. [34]

Obese patients are usually found in this type because obesity causes insulin resistance. Ketoacidosis also occur spontaneously when patient has stress or infection. Patient usually undiagnosed for many years due to hyperglycemia gradually develop and at the earlier stages, patient does not have any symptoms. However in the earlier stages, patients develop macro-vascular and micro-vascular complications. Type 2 diabetic patients may have normal or elevated insulin levels, the higher blood glucose levels of type 2 diabetes patients would be expected to result in higher insulin values had their  $\beta$ -cell function been normal. So, insulin secretion of these patients is defective and insufficient to compensate for insulin resistance. Weight reduction and/or pharmacological treatment of hyperglycemia may improve insulin resistance but is seldom restored to normal. [34]

The risk factors of developing type 2 diabetes are age, obesity, and lack of physical activity. It occurs more commonly in women with experience gestational diabetes mellitus (GDM) and in patients with hypertension or dyslipidemia, and its frequency varies in different racial/ethnic subgroups. It is often associated with a strong genetic pre-disposition, more than the autoimmune form of type 1 diabetes. [34] Healthful diet, exercise, and weight control were the treatment of diabetes however some patients need to take insulin or other medicine. [38]

### Signs and symptoms of type 2 diabetes [41]

- Frequent urination
- Unusual thirst
- Extreme hunger
- Unusual weight loss
- Extreme fatigue and Irritability
- Any of the type 1 symptoms
- Frequent infections
- Blurred vision
- Cuts/bruises that are slow to heal
- Tingling/numbness in the hands/feet
- Recurring skin, gum, or bladder infections

### Risk factors of type 2 diabetes

Patients have a higher risk for diabetes if they have any of the following [42]:

- Age greater than 45 years
- Diabetes during a previous pregnancy
- Excess body weight
- Family history of diabetes
- Given birth to a baby weighing more than 9 pounds
- High density lipoprotein (HDL) cholesterol under 35 mg/dl
- Low density lipoprotein (LDL) cholesterol <100 mg/dl

- High blood levels of triglycerides, a type of fat molecule (250 mg/dl or more)
- High blood pressure (greater than or equal to 140/90 mmHg)
- Impaired glucose tolerance
- Low activity level (exercising less than 3 times a week)
- Metabolic syndrome
- Polycystic ovarian syndrome: a condition called acanthosisnigricans, which causes dark, thickened skin around the neck or armpits

### Prevention of type 2 diabetes

Type 2 diabetes can be delayed or prevented by assessment of the risk for developing diabetes mellitus, if the patient has high risk, routinely check of blood sugar levels and lifestyle changes by [38]

- **Loss of body weight:** small amounts of weight loss in the range of 5-10% can prevent or delay the development of type 2 diabetes among high-risk adults.

- **Healthy diet:** 4 dietary changes can decrease the risk of type 2 diabetes.

[43]

1. Choose whole grains and whole grain products instead of highly processed carbohydrates.

Whole grains have bran and fiber, which make more difficult for digestive enzymes to break down the starches into glucose. This leads to slower increases in blood sugar and insulin, and a lower glycemic index. So, they stress the body's insulin-making machinery less, and so help to prevent type 2 diabetes. Furthermore,

essential vitamins, minerals, and phytochemicals in whole grains can help to reduce the risk of diabetes. Whereas, the high glycemic index and glycemic load include white bread, white rice, and donuts cause sustained glucose in blood sugar, which lead to increased diabetes risk.

2. Choose water instead of sugary drinks

Water is an excellent choice. Weight gain, chronic inflammation, high triglycerides, decreased (HDL) cholesterol, and increased insulin resistance from sugary drinks are increase risk factors for diabetes.

3. Choose good fats instead of bad fats.

The development of diabetes affected by types of fats in diet. Good fats, such as the polyunsaturated fats found in liquid vegetable oils, nuts, and seeds can help to prevent type 2 diabetes. Trans fats, bad fats, or partially hydrogenated vegetable oil are found in many margarines, packaged baked goods, fried foods in most fast-food restaurants.

4. Limit red meat and avoid processed meat; choose nuts, whole grains, poultry, or fish instead.

Choosing a healthier protein source instead of red meat or processed red meat such as nuts, low-fat dairy, poultry, fish, or whole grains can decrease diabetes risk up to 35 percent. Red meat has a high iron component, which decrease insulin's effectiveness or damages the cells that produce insulin.

- **Physical activity:** Physical activity could control blood glucose and loss of body weight. Regular physical activity could prevent heart and blood flow complication. Walking 10-20 minutes every day was recommend for diabetic patients. [44]

- **Quit smoking:** Smoking increased the opportunity to develop type 2 diabetes and made diabetes to difficult control. Furthermore, smoking also increased risk of periodontal disease with related to diabetes mellitus. Smoking increased risks for diabetic complication included heart and kidney disease, poor blood flow, retinopathy, and neuropathy. [45]

### 3. Other specific types of diabetes consists of [34]

- Genetic defects of the  $\beta$ -cell
- Genetic defects in insulin action
- Disease of the exocrine pancreas such as pancreatitis, trauma, infection, pancreatectomy, and pancreatic carcinoma
- Endocrinopathies: several hormone such as growth hormone, cortisol, glucagon, and epinephrine antagonize insulin action
- Drug-or chemical-induced diabetes: Toxics such as Vacor (a rat poison) and intravenous pentamide
- Drug such as nicotinic acid and glucocorticoids
- Infections: some virus infections related with  $\beta$ -cell destruction such

as congenital rubella, coxsackievirus B, cytomegalovirus, adenovirus, and mumps.

- Uncommon forms of immune-mediated diabetes such as Stiff-man syndrome
- Other genetic syndromes sometimes associated with diabetes such as Down's syndrome, Klinefelter's syndrome, and Turner's syndrome
- Gestational diabetes mellitus (GDM): glucose intolerance with onset or first recognition during pregnancy

### **2.1.2 Clinical complications of diabetes mellitus**

Retinopathy, nephropathy, neuropathy, macro-vascular disease, delay wound healing, and periodontal disease are the clinical complications of diabetes mellitus. [5]

Retinopathy is the most common micro-vascular complication of diabetes, which is an ocular manifestation caused by persistent damage to the retina of eye from continuous inflammation or vascular remodeling. [46]

Nephropathy is a progressive kidney disease caused by angiopathy of capillaries in the kidney glomeruli due to longstanding diabetes mellitus. It is characterized by nephrotic syndrome and diffuse glomerulosclerosis. [46]

Neuropathy is a symptom of damage to nerves of the peripheral nervous system due to long-term diabetes mellitus. [46]

Macro-vascular disease caused by atherosclerosis leads to narrowing of arterial walls throughout the body. Atherosclerosis resulted from chronic inflammation and injury to the arterial wall in the peripheral or coronary vascular system. Macro-vascular disease is associated with the development of coronary artery disease, peripheral vascular disease, brain attack (stroke), and increased risk of infection. [46]

Delay wound healing caused by macro and micro-vascular disease from long-term diabetes mellitus. [46]

Periodontal disease is an inflammatory disease that affects the periodontium, including gingiva, cementum, periodontal ligament, and alveolar bone. [4]

### **2.1.3 Categories of increase risk for diabetes (pre-diabetes) [34]**

Impaired glucose tolerance (IGT) and impaired fasting glucose (IFG): patient who has glucose levels less than criteria however more than normal. Patient who has IGT and/or IFG are defined as pre-diabetes and has high risk for developing diabetes mellitus. Pre-diabetes is the patient who has

- Fasting plasma glucose (FPG) 100 mg/dl (5.6mmol/l) to 125mg/dl (6.9 mmol/l) [IFG] or
- 2-h PG in the 75-g oral glucose tolerance test (OGTT) 140 mg/dl (7.8 mmol/l) to 199 mg/dl (11.0 mmol/l) [IGT] or
- A1C 5.7–6.4%



#### 2.1.4 Diagnostic criteria for diabetes mellitus [34]

There are four ways to diagnostic of diabetes mellitus as follow

1. A1C  $\geq$  6.5%. The test should be performed in a laboratory using a method that is NGSP certified and standardized to the DCCT assay. Or
2. FPG  $\geq$  126 mg/dl (7.0 mmol/l). Fasting is defined as no caloric intake for at least 8 h. or
3. 2-h plasma glucose  $\geq$  200 mg/dl (11.1mmol/l) during an OGTT. The test should be performed as described by the World Health Organization, using a glucose load containing the equivalent of 75 g anhydrous glucose dissolved in water. Or
4. In a patient with classic symptoms of hyperglycemia or hyperglycemic crisis, a random plasma glucose  $\geq$  200 mg/dl (11.1 mmol/l).

#### 2.1.5 Factors associated with type 2 diabetes

**Obesity:** Prevalence of type 2 diabetes associated with obesity. Obesity increased the resistance to insulin action and the need for insulin production due to a limited number of beta cells from fat accumulation and beta cell dysfunction. [4] Obese patients with type 2 diabetes who treated with metformin and sulphonylureas/DPP-IV inhibitors to reduce liver fat for 6 months had reduce weight loss and mean HbA1c. [47] Women who had overweight (BMI: 25-30 kg/m<sup>2</sup>) and obese (BMI>30 kg/m<sup>2</sup>) had more incidence of type 2 diabetes. And the magnitude of

association of BMI and type 2 diabetes was greater than physical activity. [48] Severe weight gain between age 25 and 40 years was associated with a higher onset of type 2 diabetes in men (1.5 times) and women (4.3 times) than stable weight. [49] Kamath et al., 2011 found that more than 50% of type 2 diabetic patients were obesity (male: 68.1%, female: 59.9%) [50] However, Carnethon et al., 2012 studied the association of weight status in adults with diabetes found adults with normal weight had higher ratio of cardiovascular and non-cardiovascular cause of mortality than overweight or obese. [51] Lim et al., 2012 studied by using risk score for predicting type 2 diabetes in 4 years found the participant who had higher BMI, FPG, TG, and HbA1C had higher prevalence of type 2 diabetes. [52] Pragosuntung et al., 2011 studied in Roi-Et province, Thailand found 42.7% of diabetic patients were obese. [8]

**Diet:** Burger et al., 2012 studied the quality and quantity of dietary fiber and carbohydrate in diabetes mellitus found high fiber intake decreased mortality risk where as high glycemic load, carbohydrate and sugar intake were associated with an increased mortality risk in normal weight individuals with diabetes. [53] Pragosuntung et al., 2011 studied in Roi-Et province, Thailand found dietary habit was associated with glycemic control. [8] Unhealthy diet was associated with the prevalence of type 2 diabetes. [54]

**Physical activity:** Physical activity (approximately 460 and 365 kJ/day in men and women, respectively) was associated with a relative reduction in the risk of type 2 diabetes in men and women. Lower levels of physical activity were associated with

an increased risk of diabetes. [55] Vahasarja et al., 2012 studied the perceived need to increase physical activity levels in adults at high risk of type 2 diabetes found 74% of men and 76% of women perceived need to increase physical activity especially in larger waist circumference patients. [56] Inadequate physical activity was associated with the prevalence of type 2 diabetes. [54]

**Family history of diabetes:** Sousa et al., 2011 found statistically significant between family history diabetes and diabetic patients. Lim et al., 2012 found the participants who had parental or sibling history of diabetes had more prevalence of type 2 diabetes than who did not have. [57] Family history of type 2 diabetes was associated with the prevalence of type 2 diabetes. [54]

**Duration of diabetes:** Duration of diabetes was associated with glycemic control. [8] Rimal and Panza, 2013 found duration of diabetes was significantly associated with microvascular complications of type 2 diabetes. [54]

**Smoking:** Smoking increased the opportunity to develop type 2 diabetes and made diabetes to difficult control. Furthermore, smoking also increased risk of periodontal disease with related to diabetes mellitus. Smoking increased risks for diabetic complication included heart and kidney disease, poor blood flow, retinopathy, and neuropathy. [45] Smoking is an independent risk factor for the development of insulin resistance and type 2 diabetes. After smoking cessation, there was the improvement in insulin sensitivity. [58] Oba et al., 2012 studied the association between smoking cessation and short-term risk of type 2 diabetes found

the increasing risk of type 2 diabetes in newly quit smoking compared with never smoker. Furthermore, new quitters who had weight gain and family history of diabetes had more risks of developing type 2 diabetes than non-smokers. [59] Gao, Wang, and Li, 2012 found smoker group had higher triglycerides, retinol-binding protein-4, and homeostatic model assessment index, which correlated with insulin resistance than non-smoker group. [60] Lim et al., 2012 found the participants were current smoker had more prevalence of type 2 diabetes than non-smoker. [52]

**High blood pressure:** Hypertension had positively associated with the presence of type 2 diabetes. [54]

**LDL cholesterol:** Rungsin et al., 2012 studied the relationship between type 2 diabetes and acute complication by using Thai national data found LDL cholesterol > 100 mg/dl was associated with acute complication type 2 diabetes. [7]

**Sleep duration:** The elderly who had sleeping time of 5 hours or less had more prevalence of diabetes mellitus and impaired glucose tolerance test than sleeping 7-8 hours per night. [61]

### 2.1.6 Controlling of diabetes mellitus

Medical nutrition therapy and lifestyle modification were the best choice of treatment. Prevention of the complications of diabetes mellitus was the goal of treatment. Blood glucose control could prevent micro-vascular complication whereas aggressive treatment to control blood pressure levels, lipid levels, and smoking cessation could prevent macro-vascular complication. Strict glycemic control

combined with intensive insulin therapy was the good choice to prevent long-term complications.

Center of disease control and prevention (CDC) recommended 4 steps for control diabetes mellitus include [44]

### 1. Keeping a balance

To control diabetes mellitus, patients should maintain healthy lifestyles and routine control healthy level include regular exercise, appropriate nutrition, controlling blood glucose level, and regular visit. The three important things to control blood glucose at a healthy level were what to eat and drink, how much physical activity to do, and what medicine to take.

### 2. Food

Healthy eating should achieve by

- Eat regular meals: eating every 4 to 5 hours
- Eat a variety of foods: to get enough nutrition, choose a variety of food to eat
- Eat less fat: Baked, broiled, grilled, boiled, and steamed were healthy to eat. Diabetic patient should avoid fried food and eat meat that had little fat.
- Eat less sugar: by
  - Eat more high-fiber foods, like vegetables, dried beans, fruit, and

whole grain breads and cereals.

- Drink water and other drinks that have no added sugar.
  - Eat fewer foods that have extra sugar, such as cookies, cakes, pastries, candy, brownies, and sugared breakfast cereals.
  - Talk with health care team about ways to sweeten food and drinks without using sugar.
- Eat healthy foods for example fruit and vegetables
  - Eat less salt: to control blood pressure
  - Avoid drinking alcohol: Alcohol increase calories, cause health problems, cause drug reactions with some medicines.

### 3. Physical activity

Regular physical activity could control blood glucose, loss of body weight, prevent heart and blood flow problems. Walking 10-20 minutes every day was recommended for diabetic patient. Three recommendations for physical activity are

- Start with little
- Regular physical activity
- Choosing enjoy activity

### 4. Diabetic medicine: Know how and when to take diabetes medicine

Beside the lifestyle modification included loss of weight, healthy diet, exercise, and quit smoking, there was medical therapy to treat diabetes mellitus. [39]

These medical treatments of diabetes mellitus consist of

- **Insulin therapy:** Every type 1 diabetic patients were used insulin for treatment. The other type of diabetic patients used as multiple doses. The activity of insulin therapy was mimic the physiological release of insulin. Insulin therapy would successful when diabetic patient could be monitor their own blood glucose level. [39]

- **Pramlintide:** Using in type 1 diabetic patient who lacked of amylin from islets. Amylin injections help glucose control. Amylin function decreased postprandial glucagon release and delay gastric emptying. Pramlintide is the trade name of amylin. [39]

- **Oral hypoglycemic agents (OHAs):** Used most frequent in type 2 diabetes. There were 3 classes of OHAs. [39]

- Insulin secretagogues: stimulate insulin from pancreatic beta cells, using in patient who had some residual pancreatic function included sulfonylureas and meglitindes.
- Insulin sensitizers: improve the action of insulin in target tissue (hepatic, skeletal muscle, and adipose tissue) in insulin resistant patients included biguanides and thiazolidine.
- **α**-Glucosidase inhibitors: decrease absorption in the gut.

- **Incretins:** Incretins were the newest group of oral agents to treat type 2 diabetic patient included dipeptidyl peptidase IV. Incretins used to prevent the rapid

breakdown of two intestinally secreted hormones (glucagon-like peptide-1 and gastric-inhibitory peptide), which released in response to meal. [39]

- **Transplantation:** Transplantation of the isolated islet cell or whole pancreas was one of the treatment choice of type 1 diabetes. [39]

## 2.2 Oral manifestations and complications of diabetes mellitus

Oral health was an integral part of nutritional well-being and systemic health. Diabetes mellitus had oral consequences that lead to compromises in oral function which important to modulate dietary intervention critical to the overall management of diabetes mellitus. [4] Micro- and macro-vascular complications from diabetes mellitus cause oral manifestations. Diabetes mellitus related with many inflammatory diseases and soft tissue pathologies in oral cavities. [62] Oral manifestations and complications of diabetes mellitus consist of

### 2.2.1 Periodontal disease

One of the common chronic inflammatory diseases is periodontal disease.

This disease is the sixth complication of diabetes mellitus.

#### Classification of periodontal disease

The American Academy of Periodontal disease (AAP) 1999 launched new periodontal disease classification as follow [63]

1. Gingival disease divided to

- Dental plaque-induces gingival disease: Systemic disease such as diabetes and leukemia endocrine change, medication (nifedipine, cyclosporine, and



phenytoin), and malnutrition (vitamin C deficiency) could exacerbate plaque-associated gingivitis.

- Non-plaque-induced gingival disease: include bacterial pathogen, viral infection, fungal infection, mucocutaneous disorder, allergic reaction, trauma, and disorder of genetic.

## 2. Chronic periodontitis

Chronic periodontitis was occurring mostly in adults. Destruction was consistent with the amount of plaque present and other local factors. Chronic periodontitis was divided to slight (1-2 mm. CAL), moderate (3-4 mm. CAL), and severe (>5 mm. CAL) due to severity and divided to localized and generalized (>30% of sites are involved)

## 3. Aggressive periodontitis

Aggressive periodontitis was the form of rapid attachment loss and bone destruction. Aggressive periodontitis was divided to slight (1-2 mm. CAL), moderate (3-4 mm. CAL), and severe (>5 mm. CAL) due to severity and divided to localized and generalized (>30% of sites are involved)

## 4. Periodontitis as a manifestation of systemic disease

- Associated with hematological disorders
- Associated with genetic disorders
- Not otherwise specified

5. Necrotizing periodontal disease: related to diminished systemic resistance to bacterial infection
  - Necrotizing ulcerative gingivitis (NUG)
  - Necrotizing ulcerative periodontitis (NUP)
6. Abscesses of the periodontium
  - Gingival abscess
  - Periodontal abscess
  - Pericoronal abscess
7. Periodontitis associated with endodontic lesions
  - Combined periodontic-endodontic lesions
8. Developmental or acquired deformities and conditions
  - Localized tooth-related factors that modify or predispose to plaque-induced gingival diseases/periodontitis
  - Mucogingival deformities and conditions around teeth
  - Mucogingival deformities and conditions on edentulous ridges
  - Occlusal trauma

Toxic from oral bacteria in dental plaque cause the inflammatory process affecting periodontium (gingiva, cementum, periodontal ligament, and alveolar bone).

Microorganisms, host defense, systemic background, and genetic makeup host influenced to the progression of periodontal disease. [40] The destruction of

periodontium starts with the lack of removing dental plaque, toxic from oral bacteria cause gingival inflammation. The gingival inflammation cause gingiva detach from the tooth surface form periodontal pocket, which filled with bacteria and its toxin. If the disease was continue, the periodontal pocket will deeper and reach alveolar bone that will finally destroy the periodontal attachment. The severe periodontal disease causes the destruction of periodontal tissue, loss of alveolar bone, and tooth loss. [62]

#### **Periodontal disease and diabetes mellitus**

Prevalence and severity of type 1 and type 2 diabetes were increased by periodontal disease. There were the bidirectional effect between periodontitis and glycemic control in diabetes patient especially in patient with poor glycemic control. [5, 62] Weinspach et al., 2013 found 90% of type 2 diabetes had periodontal disease and diabetic patients with periodontitis had significant higher BMI than without periodontitis. [20] Alveolar bone loss that is one of the sign of periodontal disease also associated with metabolic syndrome included obesity, insulin resistance, hypertension and dyslipidemia, interrelated metabolic risk factors for diabetes, and cardiovascular disease. [64] Poorly - controlled type 2 diabetes (HbA1C > 7%) had more prevalence of periodontal disease progression than well - controlled type 2 diabetes (HbA1C < 7%). [65]

### **Role of diabetes mellitus in adversely affecting periodontal disease**

Diabetes mellitus caused more persistent inflammatory response, increase severity of attachment loss, increase alveolar bone resorption, impaired bone formation, and increase net bone loss. [4] Uncontrolled diabetes destructed the periodontal disease by reduced defense mechanism and increased susceptibility to infection. Impaired defense mechanism from diabetes mellitus involved both micro- and macro-vasculatures. The altered collagen mechanism, the results from increased susceptibility to infection and delay wound healing caused the increased level of periodontal destruction. [40] Poorer diabetes mellitus was the greater risk of developing periodontal disease. [39]

In diabetic patients, the cell function of neutrophils, monocytes, and macrophages are inhibited by the progression of diabetes. The molecular and cellular mechanisms of the association between diabetes and periodontal disease cause by the formation of accumulation of advanced glycation end products (AGEs) when excessive glucose in blood circulation and gingival crevicular fluid contact with structural and other proteins. AGEs bind to the receptor for AGE (RAGE), which found on endothelial cells and monocytes. The binding of AGE and RAGE causes the pro-inflammatory response that might be self-sustaining due to this binding induce the expression of vascular cell adhesion molecule-1 that attracts monocytes to the luminal side of endothelial cells perpetuating the inflammatory response. These monocytes have a hyperresponsive phenotype with overexpression of inflammatory

mediators such as interleukin  $1\beta$  (IL- $1\beta$ ), tumor necrosis factor- $\alpha$  (TNF- $\alpha$ ), and prostaglandin  $E_2$ . All these inflammatory mediators are associated with insulin resistance. Inflammatory response enhanced apoptosis which leading to tissue destruction and diminished repair of damaged tissue such as inhibit osteoblast may contribute to periodontal tissue destruction cause periodontal disease. Furthermore, the inhibited cell function from diabetes also inhibits destruction of bacterial pathogens in periodontal tissue. So the bacterial pathogens can ultimately destruct periodontal tissue. [5]

There were 7 diabetic factors, which increased the severity of periodontitis

- 1. Effect of diabetes mellitus on periodontal flora:** Porphyromonas gingivalis, Prevotella intermedia, and Actinomyces temcomitans were subgingival flora in type 2 diabetes. Diabetic patient had high glucose level in crevicular fluid, which favor the growth of microflora. [40] Furthermore, bacteria products such as endotoxin or lipopolysaccharides (LPS) played an important role to propagate the inflammatory response. [66]

- 2. Defect in host response:** Decreased chemotaxis, phagocytosis, and intercellular bacterial activity in diabetic patient were induced by hyperglycemia. Periodontitis was increased the severity in diabetic patient who had neutrophil impairment. Diabetic patient who had severe periodontitis had impairment of polymorphonuclear cells (PMN)

chemotaxis which facilitated the development of periodontal disease. [40]

3. **Defective phagocytosis:** Poorly-control diabetic had the impairment of neutrophil phagocytosis. The defective of polymorphonuclear cell (PMN) function was the cause of bacterial infection, which increased the progression of periodontal disease. [40]
4. **Inflammatory response:** Diabetic patient with periodontal disease had more prostaglandin E<sub>2</sub>, which secreted from peripheral blood monocytes than without disease. [40]
5. **Collagen defect:** Diabetic patient had impaired production of bone matrix component by osteoblasts, decreased collagen synthesis by gingiva and periodontal ligament fibroblasts, increased collagenase activity, increased crevicular fluid collagenolytic activity, and decreased synthesis of collagen by gingival fibroblasts, which increased the progression of periodontal disease. [40]
6. **Vascular change:** Poor control of hyperglycemia, genetic predisposition, and long duration were associated with vascular change. These change included gingival capillaries of diabetic patient. [40]
7. **Impaired wound healing:** Poor wound healing caused by the decrease in the amount of wound collagen and lowered tensile strength. The non-enzymatic glycosylation of collagen and other proteins from

hyperglycemia caused defective wound healing. Furthermore, the lack of growth factor secretion might be a key mechanism for impaired wound healing in diabetics. [40]

### **Role of periodontal infection in adversely affecting glycemic control**

Periodontitis could adversely effects glycemic management. Poor periodontal status could worsen glycemic control. The systemic inflammation and infection from periodontal disease had adverse effect on glycemic control and health outcomes. [4] Periodontal disease increased risk of diabetic complications include cardiovascular disease, cardio-renal mortality, and renal disease. [4] Many studies found periodontal treatment reduced HbA1c. Long and Ru-fan, 2011 studied periodontal treatment in well-controlled and uncontrolled diabetes found glucose and HbA1c were reduced in both groups. [31]

Patients with severe periodontal disease had inflammatory response in the periodontal tissue included tumor necrosis factor- $\alpha$ , interleukin 6, interleukin 1, and antagonize insulin. The circulation system could access these mediators throw the body. These inflammatory mediators are associated with insulin resistance. [5] Periodontal therapy reduced circulating TNF- $\alpha$ , interleukin 6, interleukin 1, and antagonize insulin which reduced inflammatory response consequently reduces HbA1C level by reduce insulin resistance. [67] So the patients who had periodontal disease, particularly poor oral hygiene, poor glycemic control, longer duration of

diabetes mellitus, and smoker had high opportunity to have more severe diabetes mellitus. [62] From meta-analyses of the intervention study showed supporting evidence that non-surgical periodontal treatment improves glycemic control, especially in type 2 diabetes. [4] Antibiotics plus periodontal treatment also reduced HbA1c. [5] Periodontal infection treatment of diabetes patient was an important part of diabetes care. [4] Sun et al., 2011 studied in China found poor glycemic control was the most significant risk factor associated with severity of periodontitis and periodontal treatment improved the levels of clinical periodontal variables. [30] Demmer et al., 2010 studied in German found periodontal disease was associated with 5-year A1C progression. There were improved mean A1C after 5 years periodontal treatment. [68] Bandyopadhyay et al., 2010 studied the periodontal disease progression and glycemic control in Gullah African Americans found poorly - controlled type 2 diabetes had high prevalence of periodontal disease than well-controlled type 2 diabetes. [65] Susanto et al., 2012 found periodontitis increased infectious and inflammatory through the body by oral bacteria and their products enter to systemic circulation. This study used C-reactive protein (CRP) as a predictor for infectious and inflammatory. The level of C-reactive protein (CRP) leads to insulin resistance and bring to poor control of glycemic control in type 2 diabetes. [69]



## Treatment and maintenance of periodontal disease

### Treatment of periodontal disease

Control of the infection was the main goal of periodontal treatment. There were many types of treatment depended on the severity of the periodontal disease. Every types of treatment required the patient to keep up good daily care at home. [70]

### Scaling and root planing

Scaling and root planing was the deep-cleaning method that was one type of periodontal treatment. Scaling means scraping off the calculus from above and below the gingival line. Root planing was the way to get rid of rough spots on the root surface and helped to remove bacteria that contribute to the disease. [70]

### Medications

Medications were used to treat with scaling and root planing, however medications alone could not take the place of scaling and root planing or surgery. Prescription antimicrobial mouth-rinse, antiseptic chip, antibiotic gel, antibiotic microsphere, enzyme suppressant, and oral antibiotics were the medications that are currently used. [70]

### Surgical treatments

**Flap Surgery** used to remove calculus deposits in deep pockets or to reduce the periodontal pocket following treatment with deep cleaning and medications. This

method used to make gingiva easier for the patient, dentist, and hygienist to clean. [70]

**Bone and Tissue Grafts** used to help regenerate the bone or gingival tissue lost due to periodontitis. Bone grafting, in which natural or synthetic bone is placed in the area of bone loss, could help to promote bone growth. [70]

#### **Intensive oral hygiene instructions**

Intensive oral hygiene instructions were one of the most important to treat periodontal disease. The objective of this method was to prevent formation of new dental plaque deposits, prevent reinfection of sub-gingival tissue, and prevent recurrence of periodontal disease. Intensive oral hygiene instructions included teaching tooth brushing, flossing, and others devices, which appropriate for each patient. [71]

#### **Others**

Vitamin C and dietary rich in vegetables and fruits improved periodontal health and delayed periodontal disease progression. [72] Chapple et al., 2011 studied the relationship between dietary supplement and non-surgical periodontal treatment found adjunctive juice powder concentration reduced pocket depth. [73]

#### **Maintenance of periodontal disease**

The most important thing of treatment periodontal disease was the maintenance phase by keeping healthy gingiva. Periodontal maintenance was an integral part of periodontal treatment began after the completion of active

periodontal treatment to all life of the dentition. [74] After treatment periodontal disease, there were 4 ways to maintain healthy gingiva by [70]

- Brushing with fluoride toothpaste twice a day
- Floss regularly to remove dental plaque in proximal area or use other devices that recommend by dental personnel for example special brush, wood or plastic pick.
- Visit dentist routinely for check-up and professional cleaning
- Do not smoke

### **2.2.2 Salivary and Taste dysfunction**

#### **Salivary dysfunction**

Saliva has a major role in maintaining healthy oral cavity. The study found the relationship between hypo-salivation and xerostomia with type 1 and type 2 diabetic patients, especially in poorly controlled type 2 diabetes. Diabetes patient usually complain of xerostomia and thirsty (polydipsia and polyuria). Patient who had xerostomia had high opportunity to develop periodontal infection and tooth decay. The cause of salivary dysfunction was not fully understood however chronic complication of diabetes mellitus, which lead to micro-vascular deterioration might play an important role in decrease salivary flow rate and composition. [62] Furthermore, prescription medications and aging affected the degree of neuropathy and subjective feeling dry mouth and thirst. [5] Sousa et al., 2011 found diabetic

patients had more prevalence of decrease salivary flow rate (49%) than non-diabetic patients (34%). [57]

### **Taste dysfunction**

Salivary dysfunction could contribute to altered taste sensation or elevated detection thresholds. Patient with poorly controlled had more frequently to have taste dysfunction. Neuropathy one of chronic complications also caused taste disturbance. Taste disturbance could lead to poor glycemic control due to inhibiting the ability to maintain a good diet. [62]

### **2.2.3 Oral infection**

#### **Fungal infections**

Oral candidiasis is an opportunistic infection caused by *Candida albican* species. Smoking, xerostomia, older age, medication, the use of denture, and endocrine and metabolic diseases were the predisposing factors of fungal infections. Poor glycemic control patient also had frequently candida infection. Furthermore, salivary dysfunction can also contribute to more prevalence of candida infection. [5, 62]

#### **Bacterial infections**

Diabetes patient had more opportunity to develop oral bacterial infections due to an impaired defense mechanism from immune-compromised. Patient who had diabetic complications and poor metabolic control was more tendency for spreading and recurrent bacterial infection. [62]

#### **2.2.4 Poor oral wound healing**

Poor oral wound healing of diabetes patients caused by delay vascularization, reduced blood flow, a decline innate immunity, decreased growth factor production, and psychological stress. (Al-Maskari et al., 2011) Impaired healing was an important aspect of diabetes caused by increase the production of pro-inflammatory mediators. The penetration of bacteria into connective tissue elevated inflammatory response in diabetic patients. Bacterial perturbation inhibited tumor necrosis factors (TNF). [4]

#### **2.2.5 Non-candidal oral soft tissue lesion**

Fissured tongue, irritation fibroma, and traumatic ulcer were high prevalence in diabetes patients. Moreover, delayed wound healing also play a role in traumatic ulcer. [62]

#### **2.2.6 Oral mucosal disease**

Oral lichen planus (OLP) and recurrent aphthous stomatitis were found in diabetes patient and more frequent in type 1 than type 2 diabetes. Oral mucosal disease caused by a prolong state of chronic immune suppression particularly in type 1 diabetes. [62]

#### **2.2.7 Neuro-sensory oral disorder**

Oral dysesthsia or burning mouth syndrome (BMS) attributed to several conditions for example dry mouth, menopause, candida infection, diabetes mellitus, cancer therapy, psychological problems, and acid influx. Diabetic neuropathy caused BMS in diabetic patient due to nerve damage from diabetic neuropathy increase

Langerhans cells which related with immune disturbance. [62] Diabetic patient who received hemodialysis have been reported alter taste. This symptom might be associated with salivary flow and change in food intake due to disease management. [5]

### **2.2.8 Dental caries and tooth loss**

Obesity and intake of high-calorie and high carbohydrate food could be increased the exposure to cariogenic foods. [5] Salivary dysfunction, periodontal disease, and sensory disorder were increase the opportunity to develop new and recurrent dental caries and tooth loss. Salivary dysfunction in diabetic patient decreased the ability of saliva to clean and buffer which increased incidence of dental caries. [62]

## **2.3 Program to prevent and control diabetes mellitus**

### **2.3.1 Lifestyle change program**

There were many studies of intervention program to prevent and control diabetes mellitus. Vermunt et al., 2012 compared the use of lifestyle intervention for type 2 diabetes by nurse practitioners and general practitioners in Dutch primary care. They found participants were more satisfied with nurse practitioners than general practitioners. Moreover, Lack of counseling time, participant motivation, and financial reimbursement were the major problems of low-efficacy of dietary guidance from general practitioners. [24] Inoue et al., 2013 studied the impact of communicative and critical health literacy on understanding of diabetes care and

self-efficacy in diabetes management. They found the clarity of physician's explanation was associated with understanding of diabetes care and self-efficacy. [75]

Noda et al., 2012 studied the use of delivery meals and dietary counseling by dietician in patients with hypertension and diabetes mellitus found body weight was reduce in patient who received diet counseling plus ordinary diet and diet counseling plus delivered meals compared to without diet counseling. [25]

Kokubo, 2012 reviewed the weight reduction in Japan primary care found the remote support coaching for weight-loss include telephone, a study-specific web site, and email was similar to in-person visits. So he concluded that using mobile technologies to deliver behavioral weight-loss was useful in primary care. Furthermore, the combination of dietary counseling and delivered calorie-controlled meal was also effective for weight loss. [26]

Kanaya et al., 2012 also found the effective of mobile lifestyle counseling delivered by reduce diabetes risk factors. They found individualized lifestyle counseling delivered by 12 calls telephone, 2 in-person sessions, and 5 optional group workshops was significant reduce weight and triglycerides in 6 months. The frequency of lifestyle counseling also affected the control of diabetes mellitus. [27]

Morrison et al., 2012 found one or more face-to-face lifestyle counseling was more increased the control of A1C, blood pressure, and LDL cholesterol than less than once per 6 months. [28]

Moreover, lifestyle change program (dietary counseling and exercise) could reduce the proportion of metabolic syndrome. [29]

Hernandez-Tejada et al., 2012 used diabetes empowerment to increase medication adherence

and self-care behaviors found diabetes empowerment was related to increase diabetes knowledge, medication adherence, and self-care behaviors in adults with type 2 diabetes. [76] Khunti et al., 2012 studied the effectiveness of a diabetes education and self-management program for people with newly diagnosed type 2 diabetes found diabetes education and self-management program had no difference of HbA1c after 3 years but this program had sustained improvements of illness beliefs. [77] Wongrochananan et al., 2012 studied in Thai patients using Interactive Multi-Modality (IMM) intervention, which include website, email, and SMS. They found IMM intervention supported diabetic patients efforts to follow self-management plan especially the improvement of self-care food consumption. [78] Dietary education and exercise reduced diabetes risk score, weight, waist circumference, BMI, blood pressure, and fasting plasma glucose. [79]

### **2.3.2 Periodontal treatment program**

Sun et al., 2011 found periodontal intervention consist of oral hygiene instruction, full mouth scaling, root planing, periodontal flap surgery when indicated, extraction of hopeless teeth, restored of balanced occlusion, and antibiotics were associated with decreased the progression of periodontal disease and improved glycemic control. [30] Long and Fan 2011 found periodontal treatment which include teaching to control dental plaque and maintain good oral health, periodontal and subgingival scaling and root planing, placing anti-inflammatory drugs, and periodic recall every 3 months were significantly improved HbA1c in well – controlled and un



– controlled elderly type 2 diabetes. [31] Promsudthi et al., 2005 studied the effect of periodontal therapy on glycemic control in older type 2 diabetic patients found periodontal therapy by mechanical periodontal treatment plus systemic doxycycline significantly improved periodontal status. 3 months after periodontal treatment, the level of FPG and HbA1C in intervention group was lower than control group with no significant difference. In control group with no periodontal treatment and systemic doxycycline found rapid deteriorating of periodontal disease. Singh et al., 2008 studied the effect of periodontal therapy on the improvement of glycemic control in type 2 diabetes. They compared between 3 groups: group A received scaling and root planing, group B scaling and root planing follow by systemic doxycycline, and group C control group, found group A and B decreased fasting plasma glucose with no statically significant and decreased HbA1c with statistically significant after 3 months. [32] Montoya-Carralero et al., 2010 studied the effect of non-surgical periodontal treatment on blood glucose control in type 2 diabetes. They found the statistically significant improvement of HbA1c 1 month after periodontal treatment. [80] Teeuw et al., 2010 using systemic review and meta-analysis about the effect of periodontal treatment on glycemic control of type 2 diabetic patients found periodontal treatment decrease 0.4% of A1C compared with no periodontal treatment. [71]

Giannobile et al., 2013 studied the relationship between high and low risk of periodontal disease and tooth loss. They found high-risk patients such as diabetic

patient who had 2 annual preventive visits had less percentage of tooth loss than high-risk with 1 annual visit. Moreover, they found multiple risk factors such as diabetes plus smoking increased cost than single risk factor. The patient who received regular maintenance program had less opportunity to develop recurrence disease. [81] However, patient who had risk factors for example age, smoking, periodontal disease severity, and biofilm had high opportunity to develop recurrence disease. [74] Furthermore, Carvalho et al., 2010 found motivational intervention included phone call for confirmation of the next visit, and information about periodontal disease, causes of progression, important of periodontal maintenance, and consequence of noncompliance improved compliance of patients. [74]

Oral health information, which provided by health professionals including dental and medical providers improved oral health knowledge related to diabetes. [82]

Phongrapan et al., 2010 developed health promotion model for holistic care in diabetic patients, Bangkok, Thailand by using Pender's health promotion model and health empowerment found diabetic patients had increase holistic health behavior scores after intervention however dietary and exercise behavior score did not increase after intervention. [83]

#### **2.4 Inter-professional relationships in patient's care**

Comprehensive care was important for diabetic patient. Team effort, which involved patient and various health care providers were essential to accomplish

patient care. Guideline in goal setting, suggest strategy and technique to achieve the goals and overcome barriers, provide skill training, screen and management of risk and the complications were the role of health care providers. Dental professional should be a part of health care providers to educate diabetic patient about the relationship between oral and general health, the association between diabetes mellitus and periodontal disease, promote lifestyle change and promote good oral and overall health behaviors. [4] Diabetic patient who received oral health information by health professional (dental or medical) had 2.9 times oral health knowledge than patient who did not receive. So health professional (dental or medical) should educate diabetic patient about the oral manifestations and oral complication of diabetes and promote proper oral health behaviors. [82]

### **2.5 Oral health problems in the elderly people**

The aging causes changing in physical, mental and social aspect. These change included degeneration in oral and dental health due to the years of chewing, smoking, trauma, dysfunctional oral habits, and medically compromising conditions or systemic disease with oral manifestations. Oral problems of the elderly patient were an increase of difficult-to-restore, dental caries, xerostomia due to decreased salivary flow and medications, loss of natural teeth, ongoing, recognized periodontal disease, excessive tooth wear, a desire to look better and younger, impaired oral hygiene due to concomitant medical problems and loss of alveolar bone and resultant impaired use of removable prostheses. [84] Tooth loss, periodontal disease,

oral cancer, dental caries, and oral manifestations of systemic conditions were the oral conditions that were commonly found in elderly people. [85]

## **2.6 The relationship between systemic disease and oral health in elderly people**

Many of elderly people had a variety of systemic disease that would have an impact on their oral health. Diabetes, heart disease, hypertension, arthritis, stroke, head and neck cancer, chronic obstructive pulmonary disease (COPD), mental health condition, osteoporosis, Parkinson disease, and protein energy malnutrition (PEM) were the most common systemic disease seen in elder adults. [3]

Restricted manual dexterity from arthritis caused compromise the ability to maintain adequate oral hygiene. [86] Head and neck cancer caused xerostomia. [3] Chronic obstructive pulmonary disease (COPD) and periodontal disease had the same risk factor (smoking). [87] Diabetes mellitus had a bidirectional relationship with periodontal disease. [4] Cardiovascular disease (CVD) and periodontal disease share some common risk factors such as diabetes, smoking. [88] Andrade et al. (2011) found that oral health is related to inadequate intake of important nutrients among non-institutionalized elderly people. [89]

## **2.7 Theory to support health promotion**

The effectiveness of health promotion program causes when consider in multiple levels of influence on health problems include individual, interpersonal, and community levels.

**PRECEDE-PROCEDE model** [90] was developed by Green and Kreuter, 1990.

This model is a planning model, which offers a framework for identifying intervention strategies to address factors. PRECEDE-PROCEDE model used to provide a roadmap for designing health education and health promotion program. This model views health behavior as influenced by individual and environmental forces that are identified by educational diagnosis (PRECEDE) and ecological diagnosis (PROCEDE)

Educational diagnosis (PRECEDE) used to design a health promotion intervention consist of

- Predisposing factors: motivate or provide a reason for behavior such as knowledge, attitude, and readiness to change.
- Reinforcing factors: come after a behavior has been initiated, encourage repetition or persistence of behaviors by providing continuing rewards or incentives such as social support, praise, and reassurance.
- Enabling factors: enable patients to act on their predispositions such as available resources, supportive policy, and services.

Ecological diagnosis (PROCEDE) for policy regulatory and organizational constructs in educational and environmental development.

**Health Belief Model (HBM)** [90] is one of the individual level models. Individual behavior is the fundamental level of group behavior. Intrapersonal factors include knowledge, attitudes, beliefs, motivation, self-concept, developmental

history, part experience, and skill are the important factors for individual level theory. HBM states the individual's perceptions include perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cue to action, and self-efficacy.

**Social Cognitive Theory (SCT)** [90] is the interpersonal level models. Social environment affect individuals by the opinions, thoughts, behavior, advice, and support from surrounding people. Family members, coworkers, friends, and health professionals are the social environment. SCT describes the dynamic process between personal factors, environment factors, and human behavior. From SCT, the health behavior will change if the patient has self-efficacy, goals, and outcome expectancies.

**Cognitive-Behavioral theory** [90] is the contemporary theories of health behavior involve individual and interpersonal levels. This theory consists of

1. Behavior: refer to the cognitions, what patient know and think which affect how patient act,
2. Knowledge: refer to the patients understanding information, however knowledge not enough for behavior changes.
3. Perceptions, motivations, skills, and the social environment: these 4 things are the key influences on behavior.

**Motivational interviewing (MI)** is a synergistic, individual-centered model [91] to bring and strengthen motivation for change. MI is an empathic, supportive counseling style that supports the state for change. Specific strategies have been

successfully applied to work with individuals with co-occurring disorders include [91]:

- Assessing the patient's perception of the problem
- Exploring the patient's understanding of his or her condition
- Examining the patient's desire for continued treatment
- Ensuring a patient's attendance at initial sessions
- Expanding the patient's perceptions for the possibilities of successful change.

#### **Theory to support Lifestyle Change plus Dental Care (LCDC) program**

Our intervention program called Lifestyle Change plus Dental Care (LCDC) program was based on PRECEDE-PROCEDE model, health belief model (HBM), social cognitive theory (SCT), and cognitive-behavioral theory.

PRECEDE-PROCEDE model was used to address factors include predisposing, reinforcing, and enabling factors. These factors were used for identifying intervention program. Health belief model (HBM) was used to develop intervention program by consider to intrapersonal factors include knowledge, attitudes, beliefs, motivation, and skill of diabetic patients to type 2 diabetes and oral health. Social cognitive theory (SCT) was used to increase social environment factors such as health professionals, family members, and caretaker in the intervention program. Cognitive-behavioral theory was used to develop the intervention program which include individual and interpersonal levels by consider the behavior which mean what is the diabetic patient think and effect their health behavior, knowledge of type 2 diabetes

and oral health, perceptions of their conditions, motivations to change the health behavior, skills of health behavior, and the social environment include health professionals (doctor, nurse, dentist, dental hygienist, and dental assistant), family members, and caretaker. All of these factors were used to develop intervention program.





## CHAPTER III

### RESEARCH METHODOLOGY

#### 3.1 Research design

The study was a quasi-experimental study.

#### 3.2 Study area

The study was conducted in Health Centers 54 and 59 located in Bangkok, Thailand.

#### 3.3 Study population

Diabetic patients who were receiving services in Diabetes clinic at Health Centers 54 and 59, Bangkok, Thailand.

##### i. Inclusion criteria: the patients

- Age over 60 years
- Have type 2 diabetes
- Both male and female
- Have at least 16 natural teeth

##### ii. Exclusion criteria: the patients

- Have serious systemic diseases or complications
- Have blood disease, liver damage, and kidney disease
- Have severe chronic periodontitis
- Have a communicable disorders such as deaf-mute

- Could not speak Thai language such as the migrants
- Do not agree to participate

### 3.4 Study period

Data collection was done from 1<sup>st</sup> October 2013 to 24<sup>th</sup> April 2014.

### 3.5 Sample size

The sample size was calculated by formula below

$$n = \frac{2(Z_{\alpha/2} + Z_{\beta})^2 \sigma^2}{(\bar{X}_1 - \bar{X}_2)^2}$$

$$n = 55$$

This formula developed by Cochran, 1963 [92]

Where

$\bar{X}_1$  = 9.28 (mean of HbA1c of the control group from a previous study [32])

$\bar{X}_2$  = 8.78 (mean of HbA1c of the intervention group from a previous study

[32])

$\sigma^2$  = 0.88 (pooled variance of the intervention group from a previous study

[32])

$$Z_{\alpha/2} = 1.96$$

$$Z_{\beta} = 0.84$$

As a result, the sample size was calculated based on a previous study. The sample size required in each group was 55 when  $\alpha$  = 0.05 (type I error),  $\beta$  = 0.20,

and power = 0.80 and increase 20% (11) for refusal and attrition in each group so the total sample size in each group was 66 and overall sample size was 132 participants.

### 3.6 Sampling technique

**Purposive sampling** was used for choosing two health centers. Health Centers 54 and 59 were chosen because they

- Serve population with similar socio-demographic characteristics including education, occupation, and income. (table 1) Data of the socio-demographic characteristics came from the population in responsible of Health Centers 54 and 59.
- Have schedule appointments: Health centers have routinely appointments for diabetic patients once a month.
- Have enough patients in Diabetes clinic: Health centers have at least 500 diabetic patients.

Health Centers 54 and 59 were randomly assigned to the intervention and control groups by simple random sampling. Health Center 54 received the intervention program and the Health Center 59 received the routine program (control). Among 561 diabetic patients in Health Center 54 and 538 diabetic patients in Health Center 59, 185 diabetic patients in Health Center 54 and 167 diabetic patients in Health Center 59 did not meet the inclusion criteria. 376 diabetic patients in Health Center 54 and 371 diabetic patients in Health Center 59 were randomized

by systematic sampling technique to select participants in the intervention and the control groups.

**Systematic sampling** was used to select participants in each health center. The number of total diabetic patients who met the inclusion criteria in each Health center (376 diabetic patients in Health Center 54 and 371 diabetic patients in Health Center 59) was divided by the sample size (66 participants) to obtain the sample. This was used to select participants from the list of diabetic patients. After starting by selecting the first patient from the list at random, if any of the participants randomly selected met any of the exclusion criteria, the next number was chosen. Due to the exclusion criteria, 5 participants were excluded. In the intervention group (Health Center 54), 2 participants were excluded because 1 participant had a communicable disorders and the other did not agree to participate. In the control group (Health Center 59), 3 participants were excluded because 1 participant could not speak Thai language and the other 2 participants did not agree to participate.

Table 1: Distribution of socio-demographic between Health Centers 54 and 59

Variables	Health		Test of group differences
	Center 54	Center 59	
	(%)	(%)	
<b>Education</b>			
Illiteracy	5.3	6.2	$\chi^2 = 20.000,$ $p = 0.220$
Primary school	45.2	39.5	
Secondary school	32.8	33.8	
Vocational school	2.3	5.04	
Bachelor degree	14.4	15.4	
<b>Occupation</b>			
Unemployed	36.4	28.2	$\chi^2 = 30.000,$ $p = 0.224$
Studying	5.6	10.8	
Employee	41.0	43.8	
Government	5.4	5.7	
Private business	11.4	11.2	
Agriculture	0.2	0.3	
<b>Income</b>			
No income	2.6	3.9	$\chi^2 = 30.000,$ $p = 0.224$
< 5,000 baht	53.6	50.6	
5,001 – 10,000 baht	17.8	24.5	
10,001 – 15,000 baht	4.5	4.3	
15,001 – 20,000 baht	14.6	10.4	
> 20,000 baht	6.9	6.3	

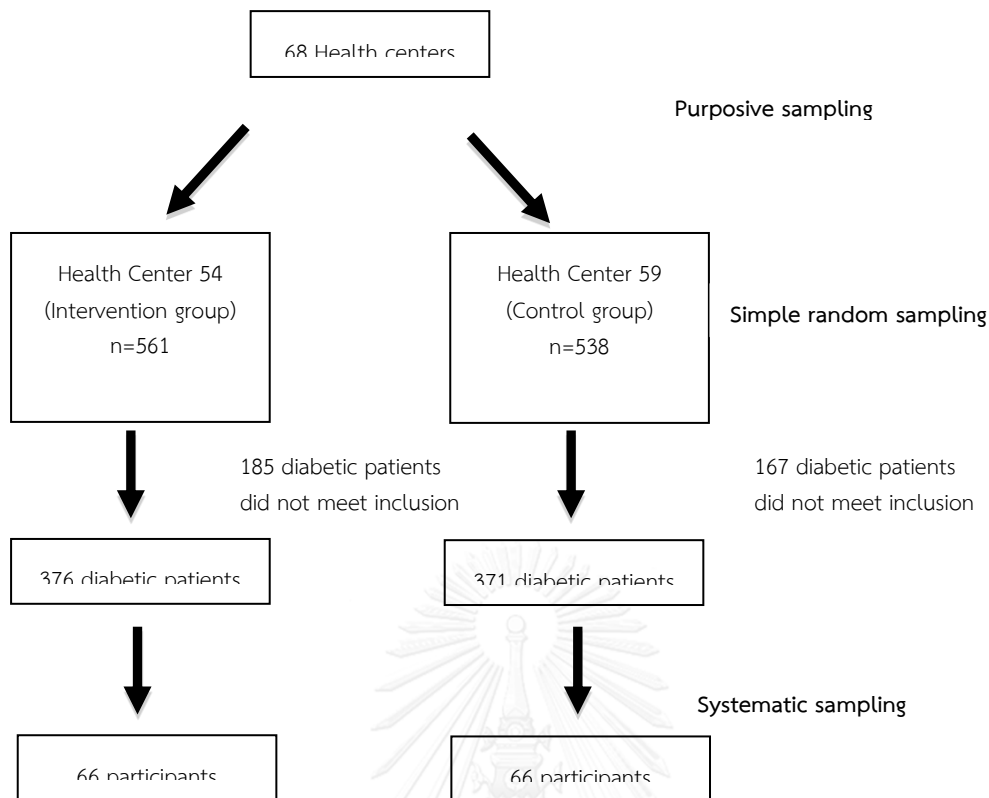


Figure 2: Flow chart of study allocation

### 3.7 Measurement tools

**1. Structured questionnaires:** two structured questionnaires were used for baseline, and 3 and 6 month follow up, respectively.

The structured questionnaire for baseline (appendix B and H) consists of 7 parts as follow;

Part 1: Biological parameters: consist of 5 questions included fasting plasma glucose (FPG), glycated hemoglobin (HbA1c), triglyceride (TG), high-density lipoprotein (HDL), and low-density lipoprotein (LDL).

Part 2: General characteristics: consist of 20 questions

Part 3: Utilization of dental services: consist of 3 questions

Part 4: Knowledge toward DM and oral health: consist of 11 questions, divided to knowledge toward DM 5 questions and 1 sub-question, and knowledge toward oral health 5 questions.

Part 5: Attitude toward DM and oral health: consist of 10 questions, divided to attitude toward DM 5 questions and attitude toward oral health 5 questions.

Part 6: Oral health behaviors: consist of 3 questions

Part 7: Practice toward DM: consist of 10 questions

The structured shorter questionnaire for 3 month and 6 month follow up (appendix C and I) consist of 7 parts as follow;

Part 1: Biological parameters: consist of 5 questions included FPG, HbA1c, TG, HDL, and LDL.

Part 2: General characteristics: consist of 5 questions

Part 3: Utilization of dental services: consist of 2 questions

Part 4: Knowledge toward DM and oral health: consist of 11 questions, divided to knowledge toward DM 5 questions and 1 sub-question, and knowledge toward oral health 5 questions.

Part 5: Attitude toward DM and oral health: consist of 10 questions, divided to attitude toward DM 5 questions and attitude toward oral health 5 questions.

Part 6: Oral health behaviors: consist of 3 questions

Part 7: Practice toward DM: consist of 10 questions

**2. Plaque index:** by using Silness-Löe Index (Silness and Löe, 1964) [93] (appendix D), The plaque index used to measure the thickness of plaque on the gingival one third of six teeth include #16, #12, #24, #36, #32, and #44 with no substitution for any missing teeth. The criteria of this index are in table below.

*Table 2: The criteria of Plaque Index (PI)*

Score	Criteria
0	No plaque
1	A film of plaque adhering to the free gingival margin and adjacent area of the tooth, which cannot be seen with the naked eye. But only by using disclosing solution or by using probe.
2	Moderate accumulation of deposits within the gingival pocket, on the gingival margin and/or adjacent tooth surface, which can be seen in the naked eye.
3	Abundance of soft matter within the gingival pocket and/or on the tooth and gingival margin.



**3. Gingival index:** by using Loe and Silness Index (Löe and Silness, 1963) [93] (appendix E). Gingival index used to examine by blunt probe of six teeth include #16, #12, #24, #36, #32, and #44 with no substitution for any missing teeth. The criteria of this index are in table below.

*Table 3: The criteria of Gingival Index (GI)*

Score	Criteria
0	No inflammation.
1	Mild inflammation, slight change in color, slight edema, no bleeding on probing.
2	Moderate inflammation, moderate glazing, redness, bleeding on probing.
3	Severe inflammation, marked redness and hypertrophy, ulceration, tendency to spontaneous bleeding.

**4. Clinical attachment level (CAL):** recorded in periodontal chart (appendix F) adapted from faculty of dentistry, Chulalongkorn University. The pocket depth and gingival recession of the six surfaces (mesiobuccal, midbuccal, distobuccal, mesiolingual, midlingual, and distobuccal) of every tooth in the diabetic patient's

mouth were recorded in periodontal chart by using a periodontal probe. CAL was calculated by measuring pocket depth plus gingival margin.

**5. Blood samples** included FPG, HbA1C, TG, HDL, and LDL. The blood samples were tested by nurse practitioner and the result of blood samples were retrieved from the medical record of the centre.

### 3.8 Data collection

The process of data collection as follow

#### Preparation stage

1. Research team approached the director of Health Centers 54 and 59 for permission to collect data, which included using data from medical record.
2. Validated questionnaires: The structured questionnaires were validated by three experts in public health. The three experts consisted of expert in diabetes, research methodology and dentistry. The Item-Objective Congruence Index (IOC) was 0.83.
3. Test the reliability of questionnaire: A pilot study was carried out to test the reliability of questionnaire. Another 30 diabetic patients who were receiving service in Health Center 42 were interviewed. Cronbach's coefficient alpha was used to test the internal consistency reliability of questionnaire. The cronbach's coefficient alpha was divided to 5 parts as follow

- Utilization of dental services: the cronbach's coefficient alpha of utilization of dental services was 0.74.

- Knowledge toward DM and oral health: the cronbach's coefficient alpha of knowledge toward DM and oral health was 0.84

- Attitude toward DM and oral health: the cronbach's coefficient alpha of attitude toward DM and oral health was 0.87.

- Oral health behaviors: the cronbach's coefficient alpha of oral health behaviors was 0.77.

- Practice toward DM: the cronbach's coefficient alpha of practice toward DM was 0.89.

The cronbach's coefficient alphas of structured questionnaire were between 0.7 and 0.9, indicated that the reliabilities were good.

4. Standardize interviewers: To avoid bias, the two interviewers were the health personnel who do not work in the intervention or the control health center. The interviewers were blinded to the group assignments. The interviewers attended a 2-days training program. The interviewers were trained to understand the questionnaires the way for data collection. The researcher explained the statement of problem, objective, data collection tools, sampling procedures, plan for data collection, and plan for data analysis of this study to the interviewers and explain the topic of questionnaire step by step. Then in-depth discussion was carried

out. The interviewers were taught basic interview techniques such as asking questions in a natural manner, not showing by words or expression what answers one expects, not showing agreement, disagreement or surprise and recording answers to open questions precisely as they are provided, without sifting or interpreting them. Furthermore, clear instructions, how interviewers introduce themselves to the interviewee, what to say concerning the purpose of the study, how to ask for consent and how to close the interview also taught. Then practical training was trained by role-play and pre-test.

5. The internal reliability of diagnosis periodontal disease by recheck diabetic patient's oral cavity 10% of sample size.
  - a. The cronbach's coefficient alpha of dentist A was 0.98.
  - b. The cronbach's coefficient alpha of dentist B was 0.95.

The cronbach's coefficient alpha of dentist A and B were more than 0.9, indicated that internal reliability was excellent.

6. Standardize dentists: Two dentists were the same throughout the baseline and follow-up examination. One dentist measured the intervention group and the other measured the control group. Both dentists knew that they measured the intervention or the control group because the researcher measured one health center. Inter-examiner reliability between examiners was tested by using cronbach's coefficient alpha. Another 5 diabetic

patients were examined periodontal status (plaque index, gingival index, pocket depth, and gingival margin) by three dentists included one expert in periodontal (gold standard) and the other two dentists who conducted the present study to measure the agreement between examiners. The cronbach's coefficient alpha was 0.85, indicated that inter-examiner reliability was good.

7. Develop self's regulation manual for self-based learning of DM and oral complications. The contents in the manual included
  - a. Lifestyle modification for type 2 diabetes such as loss weight, diet modification, physical activity, smoking, and oral health care.
  - b. Prevention of type 2 diabetes from general and oral health complications such as wearing covered shoes.
  - c. Management of diabetes signs and symptoms such as hypoglycemia.

The text in self's regulation manual was designed in a way that have it easy to read by presenting short sentences and short paragraphs, broken up with visuals aids to emphasize key points (using bullets, titles or subtitles to reinforce important points), written in the active voice, clarified with the use of examples, and avoided technical language.

The graphic in self's regulation manual was simple and uncluttered, immediate identifiable, relevant to the subject matter and reader, and

used to reinforce the text. Small type, too long or too short line of type, using all capital letters, justified right margins, photographs that won't reproduce well, and technical diagrams were avoided.

Self's regulation manual was developed by brainstorm ideas from doctors, nurse practitioners, dentists, dental assistants, and representative of diabetic patients using focus group discussion. The researcher was the facilitator of focus group discussion, which was carried out in meeting room of Health Center 54 and took about 60 minutes.

To increase the diabetic patients realization of the importance of self's regulation manual, the glycemic record, and goal for lifestyle change were included in this manual.

8. Individual counseling by motivational interviewing (MI) for lifestyle change and dental care included dietary counseling, physical activity, quit smoking, and oral health care were trained by the experts in this field.

Nurse practitioner who conducted individual counseling, had experience in individual counseling by MI and attended one day training from the experts in this field. The following is the guide for MI

- Assessing the patient's perception of their problem from diabetes and oral complications.
- Exploring the patient's understanding of their conditions.
- Examining the patient's desire for continued treatment.

- Ensuring a patient's attendance at initial sessions.
- Expanding the patient's perceptions for the possibilities of successful change.

Nurse practitioners who conducted lifestyle and oral health education and MI are working at the intervention health center.

9. Develop educational video for DM and oral complications: Contents in the video included pathogenesis of type 2 diabetes, signs and symptoms, risk factors, diabetic complications, the prevention of type 2 diabetes from its complications, oral complications of type 2 diabetes, the relationship between type 2 diabetes and oral complications.

The contents in the educational video were designed in a way that has it easy to understand. The graphics in educational video were simple and uncluttered, immediate identifiable, and relevant to the subject matter and listener. Photographs that won't reproduce well, and technical diagram were avoided. The narrative sound was clear and not too fast. The educational video was not too long so diabetic patients were not bored and it took 15 minutes.

Educational video was also developed by brainstorm ideas from doctors, nurse practitioners, dentists, dental assistants, and a representative of diabetic patients using focus group discussion. The

researcher was the facilitator of focus group discussion, which carried out in meeting room of Health Center 54 and took about 60 minutes.

10. Develop the slide presentation for lifestyle change and oral health education: the content of education included pathogenesis of type 2 diabetes, signs and symptoms, risk factors, diabetic complications, the prevention of type 2 diabetes from its complications, oral complications of type 2 diabetes, the relationship between type 2 diabetes and oral complications, and oral health care.

The slide presentation for lifestyle change and oral health education were developed by brainstorm ideas from doctors, nurse practitioners, dentists, dental assistants, and representative of diabetic patients using focus group discussion. The researcher was the facilitator of focus group discussion, which carried out in meeting room of Health Center 54 and took about 60 minutes.

11. Standardize nurse practitioners to help the patient in setting the goal and fill in the relevant sections of self's regulation manual and oral health education. The nurse practitioners were attended one day training program for the contents of education and teaching technique by the expert in education, diabetes, and dentistry.
12. Standardize dental assistants who conducted individual oral hygiene instruction. The dental assistants attended one day training program for



the contents of education and teaching technique by the expert in education, diabetes, and dentistry.

13. The self's regulation manual, educational video, and slide presentation were validated by three experts in education, diabetes, and dentistry, respectively. (appendix J-O)

The total scores of self's regulation manual was 50 point. The average score from 3 experts was 44.33 (2.08) point. (appendix P)

The total scores of educational video was 55 point. The average score from 3 experts was 51.33 (1.15) point. (appendix Q)

The total scores of slide presentation was 45 point. The average score from 3 experts was 43.33 (1.15) point. (appendix R)

14. The pretest of self's regulation manual, educational video, and lifestyle change and oral health education by using slide presentation to diabetic patients were conducted by focus group discussion. The researcher was the facilitator of focus group discussion. Nurse practitioners applied self's regulation manual and lifestyle change and oral health education by using slide presentation. Educational video was opened to diabetic patients. Two to four focus groups with six to eight people of diabetic patients who were receiving service in Health Center 42 were conducted in the meeting room of the health center. The focus group discussion of self's regulation manual, educational video, and lifestyle change and oral health

education by slide presentation were separated and took about 60 minutes per each.

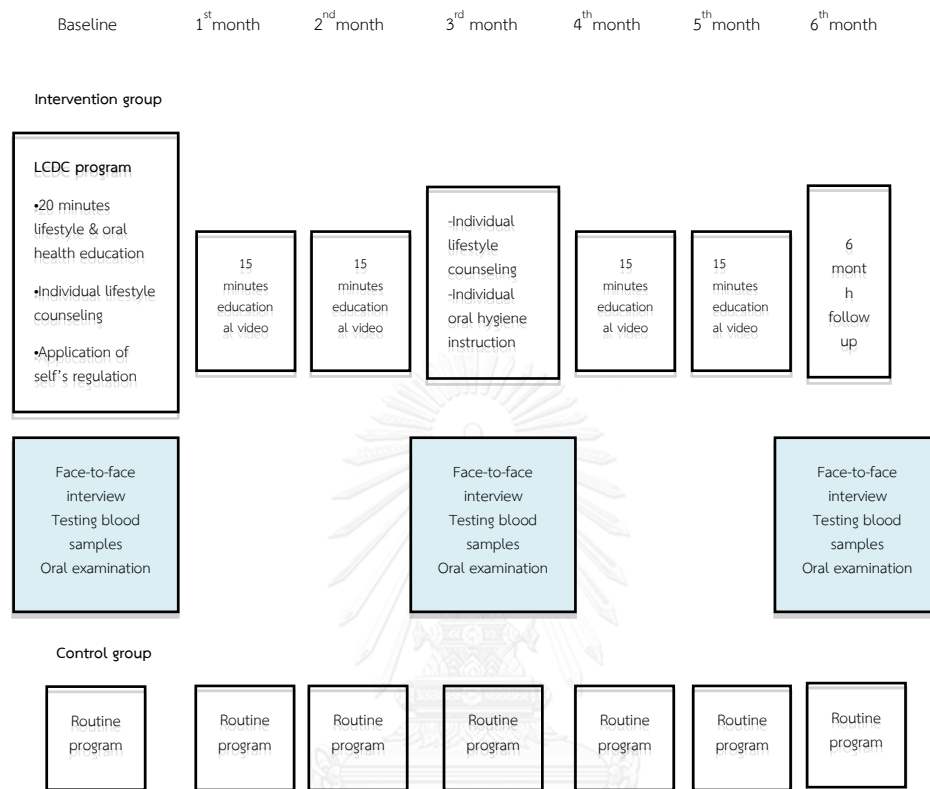


Figure 3: Study procedure of the intervention and the control groups

### Operation stage

1. Research team introduced themselves. The research assistant explained the purpose and procedures of this study to the participants who were included in the study. If they are willing to participate in the study. The participants signed inform consent before data collection.
2. At baseline: both the intervention and the control groups received

- a. Face-to-face interview by trained interviewers using a structure questionnaire to collect general characteristics, body mass index (BMI), knowledge, attitude, and practice of diabetic patient. The process of interview was recorded in tape recorder to check the quality of interview every day after interview by researcher. If the interviewers had some mistakes, the researcher advised or trained them again.
- b. Testing blood samples for FPG, HbA1c, TG, HDL, and LDL by nurse practitioners. The results of blood samples were retrieved from medical record.
- c. Oral examination by using plaque index, gingival index, pocket depth, gingival margin, and CAL of diabetic patients were conducted by experienced dentists (researcher and the other dentist). Oral examination was measured after diabetic patients tested blood sample and before eating breakfast.

Baseline interview and oral examination in the intervention and the control sites were measured at the same time.

- d. The intervention group: Research team used “Lifestyle Change plus Dental Care (LCDC) program”. This program included
  - 20 minutes lifestyle and oral health education program by trained nurse practitioners to increase knowledge and attitude of diabetic patients. The content include

pathogenesis of type 2 diabetes, signs and symptoms, risk factors, diabetic complications, the prevention of type 2 diabetes from its complications, oral complications of type 2 diabetes, the relationship between type 2 diabetes and oral complications, and oral health care. The lifestyle and oral health education was presented by slide presentation at the waiting room, which had projector and microphone. The education took 20 minutes and 10 minutes for discussion.

Lifestyle and oral health education was evaluated by the other expert in education, diabetes, and dentistry which not involve in the training and pretest. The assessment form divided to 5 parts included prevention of type 2 diabetes from its complications and the relationship between type 2 diabetes and oral complications, diet modification, exercise, foot care, and oral health care. (appendix S and T) The total scores was 100 point. The experts gave the score as follow;

- The expert in education: 93 point.
- The expert in diabetes: 96 point.

- The expert in dentistry: 95 point.

The average lifestyle and oral health education score (SD) by the experts was 94.67 (1.53) point. (appendix U)

- Individual lifestyle counseling using MI. Nurse practitioners assessed the patient's perception of their problem from diabetes and oral complications by asked the patients about their problem then explore the patient's understanding of their condition and examined the patient's desire for treatment their problem. After that ensured a patient's attendance at initial sessions and expanded the patient's perceptions for the possibilities of successful change then suggest diabetic patients to select the goal of lifestyle change which included loss of body weight, eat healthy food (fruits and vegetables), eat more high-fiber foods, eat less sugar, exercise more than 30 minutes at least 3-5 times/week, quit smoking, tooth brushing after meals, and using dental floss at least 1 time/day.

- The individual lifestyle counseling was recorded in tape recorder to check the quality of counseling by the expert. If the nurse practitioner had any mistakes, the expert advised or trained again.

- Application of self's regulation manual by nurse practitioners focus on increased physical activity, improved dietary composition, weight loss (if diabetic patient has  $BMI > 30 \text{ kg/m}^2$ ), quit smoking, and oral health care. Nurse practitioners illustrated all of the contents in the self's regulation manual in simple language.

Individual lifestyle counseling and application of self's regulation manual were used to increase knowledge, attitude, perceptions, and motivations of diabetic patients to change their behaviors.

Private room was used for individual lifestyle counseling and application of self's regulation manual by nurse practitioners. If diabetic patients had caretaker or family, they were invited to join in this process. This process took about 30 minutes.

Goal of lifestyle change and blood sugar recorded in self's regulation manual. Diabetic patients were asked to bring self's regulation manual every visit.

- Individual oral hygiene instruction by dental assistants in the dental room to increase knowledge, attitude, perceptions, and motivations of diabetic patients to change their oral health behaviors. The content in oral hygiene instruction included tooth brushing with fluoride toothpaste, using dental floss or

other devices such as inter-proximal brush, cleaning denture, and how to check oral health by themselves. The dental model was used to demonstrate tooth brushing, using dental floss, and other devices. Cleaning denture and check oral health by themselves were instructed by printed of slide presentation from oral health education. This process took about 15 minutes.

Individual lifestyle counseling, application of self's regulation manual, setting the goal of lifestyle change and blood sugar, and individual oral hygiene instruction were conducted individually because each diabetic patient has different problem. Individually apply intervention emphasized in appropriate diabetic patient's problem. Individually apply intervention provided before seeing doctor at 7:00 AM after diabetic patients tested blood samples. (the doctor began examination at 8:30 AM)

e. Control group:

- i. Routine program in diabetic clinic included seeing doctor once a month, collecting diabetic medicine from pharmacist, making an appointment for their next visit, measuring FPG once a month, measuring HbA1c every 6 months, and receiving oral examination once a year.

f. Dental treatment: Diabetic patients in both the intervention and the control groups can receive every dental treatment up to the patient self-perceived need. Dental treatment will not affect the outcome if diabetic patients do not clean their mouth well such as diabetic patients receive scaling and polishing however they did not clean their mouth well. After 3 months, their periodontal status will be the same as before receiving treatment.

3. At 1,2,4,5 months: Only the intervention group received a 15 minute educational video for diabetes and oral health education between diabetic patients waiting for seeing doctor. After the end of educational video, the facilitators (nurse practitioners who conducted education and individual lifestyle counseling) concluded the content of educational video by link to diabetic patient's life to activate diabetic patients for behavior changes. The doctor recorded blood sugar in self's regulation manual and remind diabetic patients about lifestyle change goal.
4. At 3 months: both the intervention and the control groups received
  - a. Face-to-face interview using a structured questionnaire.
  - b. Testing blood samples for FPG, HbA1c, TG, HDL, and LDL by nurse practitioners.
  - c. Oral examination by using plaque index, gingival index, pocket depth, gingival margin, and CAL of diabetic patients were conducted by



calibrated dentists (researcher and the other dentist). Oral examination was measured after diabetic patients tested blood samples and before eating breakfast.

- d. Only the intervention group: received
- i. Individual counseling with nurse practitioners to set the new goal or discuss the problem and method to solve the problem in the private room about 15 minutes.
  - ii. Individual oral hygiene instruction by dental assistants in the dental room to activate and motivate diabetic patients to change their oral health behaviors. The contents in oral hygiene instruction included tooth brushing with fluoride toothpaste, using dental floss or the use of other devices, cleaning denture, and how to check oral health by themselves. The dental model was used to demonstrate tooth brushing, using dental floss, and the use of other devices. Cleaning denture and check oral health by themselves were instructed by printed of slide presentation from oral health education. This process took about 15 minutes.

5. At 6 months follow up: Both the intervention and the control groups received
  - i. Face-to-face interviewed using a structured questionnaire.
  - ii. Testing blood samples for FPG, HbA1c, TG, HDL, and LDL by nurse practitioners.
  - iii. Oral examination by using plaque index, gingival index, pocket depth, gingival margin, and CAL of diabetic patients were conduct by calibrated dentists (researcher and the other dentist). Oral examination was measured after diabetic patients tested blood samples and before eating breakfast.

### **3.9 Outcome measurement**

The primary outcomes were glycemic status included FPG and HbA1c, and periodontal status including plaque index score, gingival index score, pocket depth, and CAL. The secondary outcomes were knowledge, attitude, and practice toward DM and oral health, TG, HDL, LDL, and BMI.

The structured questionnaires were used to compare the difference of BMI, blood pressure, oral health behavior, knowledge, attitude, and practice toward DM and oral health of diabetic patients between pre and post-intervention.

Plaque index, gingival index, pocket depth, and CAL were used to measure the efficacy of diabetic's oral health and periodontal status by measure pre and post-intervention.

Blood samples were used to measure FPG, HbA1c, TG, HDL, and LDL of diabetic patients between pre and post-intervention.

### 3.10 Data analysis

Outcome measures at follow up (glycemic and periodontal parameters) were entered as dependent variables and the intervention and the control groups as independent variables.

The glycemic control defined HbA1c < 6.5% as controlled glycemic level and HbA1c  $\geq$  6.5% as uncontrolled glycemic level. [34] The severities of periodontal disease (chronic periodontitis) were divided by used CAL (slight (1-2 mm. CAL), moderate (3-4 mm. CAL), and severe (>5 mm. CAL)). [63]

The overall knowledge score toward DM and oral health was 10 point, divided to knowledge score toward DM 5 point and knowledge score toward oral health 5 point.

The overall score of attitude score toward DM and oral health was 50 point, divided to attitude score toward DM 25 point and attitude score toward oral health 25 point. The attitude score toward DM was calculated by strongly agree = 5, agree = 4, not sure = 3, disagree = 2, and strongly disagree = 1 for question 1-4 and strongly agree = 1, agree = 2, not sure = 3, disagree = 4, and strongly disagree = 5 for question 5. The attitude score toward oral health was calculated by strongly agree = 5, agree = 4, not sure = 3, disagree = 2, and strongly disagree = 1 for question 6-10.

Data were analyzed by using descriptive statistics. Frequency distribution and percentage were used to describe general characteristics and periodontal status of diabetic patients. Mean and standard deviation were used to describe diabetic patient's knowledge, attitude, and practice, blood test, plaque index score, gingival index score, pocket depth and CAL at baseline, post-intervention, and difference between baseline and post-intervention.

T-test, Chi-square test, Fisher-exact test, and Mann-Whitney U test were used to compare the difference between the intervention and the control groups at baseline.

Pair T-test was used to evaluate the difference of diabetic patient's knowledge and attitude toward DM and oral health between pre- and post-education of the intervention group.

Chi-square test was used to compare diabetic patient's practice toward DM and oral health, and distribution of knowledge toward DM and oral health between the intervention and the control groups at baseline, 3 month and 6 month follow up.

Mann-Whitney U test was used to compare the distribution of diabetic patient's attitude toward DM and oral health between the intervention and the control groups at baseline, 3 month and 6 month follow up.

Repeated measure ANOVA was used to measure diabetic patient's knowledge and attitude toward DM and oral health, glycemic status (FPG and HbA1c), and

periodontal status (plaque index score, gingival index score, pocket depth and CAL) between baseline, 3 month, and 6 month follow up of both intervention and control groups. Post-hoc test (Bonferroni) also used to analyze the differences between groups. All analysis used a 95% confidence interval (CI), and statistically significant at p-value less than 0.05.

### **3.11 Ethical consideration**

Ethics approval was granted from the Ethics Review Committee for Research Involving Human Research Subjects, Health Science Group, Chulalongkorn University. (appendix V)

### **3.12 Limitation**

Quasi-experimental design might cause the selection bias due to lack of random assignment and true control.

This study had single blind method because only participants do not know which group they are. So this study might have measurement bias. However, the present study had double blind for interviewer.

The study was carried out only two Health centers in Bangkok, Thailand which located in urban area and more than half of the participants were female. So the finding of this study could not generalize the entire group of the elderly with type 2 diabetes patients.

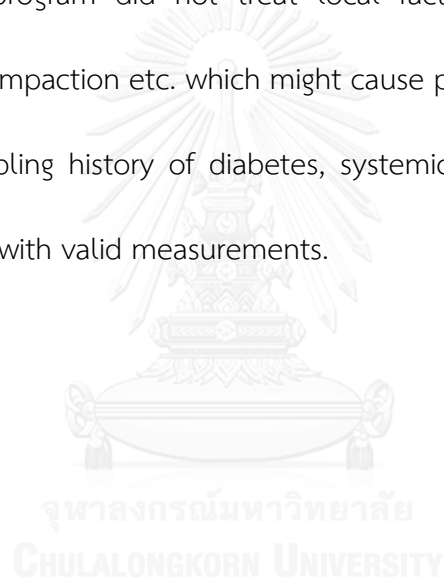
Due to limitation of time, this study lacked of long-term follow up and the change of periodontal status.

The use of participant report to estimate practice toward DM and oral health behaviors are subject to measurement error for over or under reporting due to recall bias or social desirability bias.

The outcomes of the LCDC program could not attribute the improvement of glycemic and periodontal status either to lifestyle change or to dental care due to the integration of lifestyle change and dental care in one program.

The LCDC program did not treat local factors such as calculus, tooth alignment, and food impaction etc. which might cause periodontal disease.

Parent or sibling history of diabetes, systemic disease, and diet were not investigated in detail with valid measurements.



## CHAPTER IV

### RESULTS

The study was a quasi-experimental study aim to assess the effectiveness of the Lifestyle Change plus Dental Care (LCDC) program to improve glycemic and periodontal status in the elderly with type 2 diabetes who receiving curative services in Health Centers 54 and 59, Bangkok, Thailand. Health Center 54 was an intervention group, which received the Lifestyle Change plus Dental Care (LCDC) program. Health Center 59 was a control group, which received the routine program. The Lifestyle Change plus Dental Care (LCDC) program consists of

- At baseline: 20 minutes lifestyle and oral health education, individual lifestyle counseling using MI, application of self's regulation manual and individual oral hygiene instruction.
- At 1<sup>st</sup>, 2<sup>nd</sup>, 4<sup>th</sup>, and 5<sup>th</sup> month: participants were received 15 minute educational video for diabetes and oral health education.
- At 3<sup>rd</sup> month: participants were received individual counseling and oral hygiene instruction.

Both the intervention and the control groups (132 diabetic patients, 66 diabetic patients per each health center) were interviewed by face-to-face interviewed using a structured questionnaire, tested blood samples, and received oral examination for

periodontal status at baseline, 3 month, and 6 month follow up from 1<sup>st</sup> October 2013 to 24<sup>th</sup> April 2014

#### **4.1 Study population**

Among 561 diabetic patients in Health Center 54 and 538 diabetic patients in Health Center 59, 185 diabetic patients in Health Center 54 and 167 diabetic patients in Health Center 59 did not meet the inclusion criteria. 376 diabetic patients in Health Center 54 and 371 diabetic patients in Health Center 59 were randomized by systematic sampling technique to participate in the intervention or the control groups.

Of the 132 participants who enrolled at baseline (66 intervention and 66 control), 130 (98.5%) were available for follow up at 3 months and 6 months. Among those who were not available, 1 participant in the intervention group was too ill to follow up (paralysis) and the other participant in the control group moved to live in another province (figure 4).



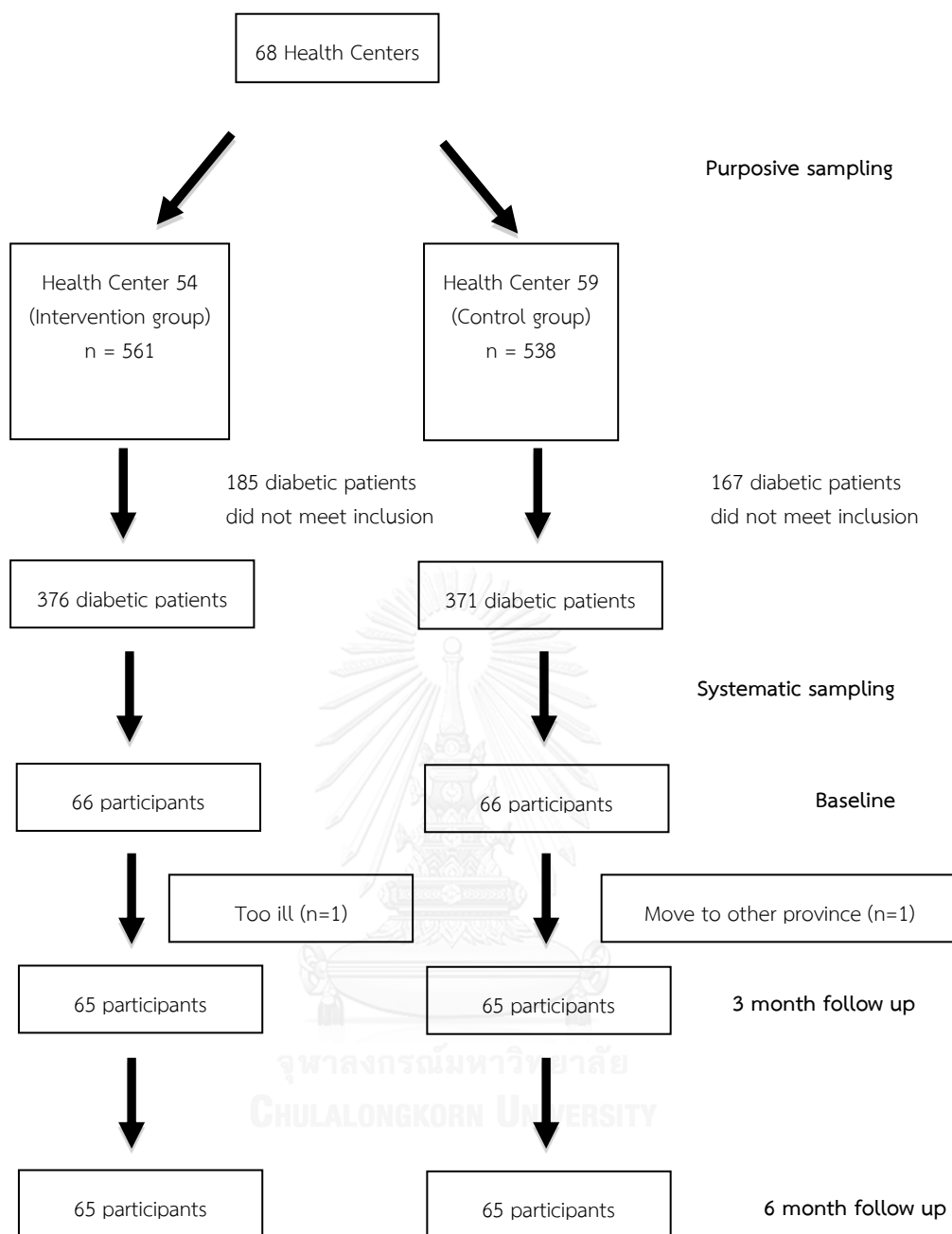


Figure 4: Study population at baseline, 3 month, and 6 month follow up

## 4.2 Baseline characteristics

### 4.2.1 General characteristics

Among 132 diabetic patients (66 diabetic patients per each group), most of the participants in each group were female (65.2% (n=43) of the intervention group and 63.6% (n=42) of the control group) with no statistically significant difference

between the intervention and the control groups ( $p=0.856$ ). The average age of the intervention and the control groups were 63.83 (4.51) and 64.06 (5.53), respectively. Most of the participants in the intervention (84.8%) and the control (83.3%) groups had age between 60-69 years. There were no statistically significant differences of age and age group between the intervention and the control groups ( $p = 0.796$  and  $0.357$ , respectively). Furthermore, there were no statistically significant differences of monthly income, educational level, marital status, living arrangement, and occupation between the intervention and the control groups. (table 4)

The average weight (SD) of the intervention and the control groups were 62.28 (9.81) and 65.29 (10.37) kg., respectively. The average height (SD) of the intervention and the control groups were 156.90 (7.80) and 156.64 (7.49) cm., respectively. The average BMI (SD) of the intervention and the control groups were 25.30 (3.57) and 26.63 (4.37)  $\text{kg}/\text{m}^2$ , respectively. The average systolic and diastolic blood pressure (SD) of the intervention and the control groups were 132.77 (18.24) / 75.42 (9.48) and 130.12 (15.26) / 77.38 (10.50) mmHg, respectively. 57.6% of the intervention group and 50.0% of the control group had hypertension. 3.0% of the intervention group and 4.5% of the control group had cardiovascular disease. 48.5% of the intervention group and 47.0% of the control group had hyper-cholesterol. There were no statistically significant differences of weight, height, BMI, blood pressure (systolic and diastolic), and the present of other systemic diseases including hypertension, cardiovascular disease, and hyper-cholesterol between the

intervention and the control groups ( $p = 0.089, 0.842, 0.057, 0.367, 0.264, 0.383, 0.648, \text{ and } 0.862$ , respectively). (table 4)

Most of the participants in the intervention (83.3%) and the control (89.4%) groups had universal coverage. Almost half of participants in the intervention (42.4%) and the control (48.5%) groups had family history of diabetes. The average time of being diabetes of the intervention and the control groups were 6.86 (5.16) and 8.42 (6.19) years, respectively. Complication of diabetes, 47.0% of the intervention and 57.6% of the control groups had hypertension. 16.7% of the intervention and 22.7% of the control groups had eye problem. 10.6% of intervention and 12.1% of the control groups had foot problem. 47.0% of the intervention and 34.8% of the control groups ever received diabetes and oral health information from health personnel. Health insurance type, family history of diabetes, duration of being diabetes, present of diabetes complications including high blood pressure, stroke, heart disease, eye problem, kidney disease, foot problem, and received diabetes and oral health information were no significant differences between the intervention and the control groups ( $p = 0.643, 0.484, 0.118, 0.223, 0.559, 0.684, 0.381, 1.000, 0.784, \text{ and } 0.157$ , respectively). (table 4)

For the smoking, most of the participants were non-smoker (86.4% of the intervention and 87.9% of the control groups). 10.6% of the intervention and 6.1% of the control groups ever smoked. The average year (SD) of stop smoking were 10.57 (7.89) years for the intervention group and 26.57 (11.09) years for the control group.

For the current smoker, the participant smoked 13.33 (12.93) rolls per day (the intervention group) and 17.88 (18.08) rolls per day (the control group). They had smoked for 25.89 (8.99) years (the intervention group) and 26.50 (8.38) years (the control group). However, there were no statistically significant differences of smoking behavior between the intervention and the control groups ( $p = 0.474, 0.131, 0.232, 0.335, 0.929, \text{ and } 0.887$ , respectively). (table 4)

Table 4: Distribution of general characteristics (n=132)

Variables	Intervention group (n=66) (%)	Control group (n=66) (%)	Test of group differences
<b>Gender</b>			
Male	23 (34.8)	24 (36.4)	$\chi^2 = 0.033,$ $p = 0.856$
Female	43 (65.2)	42 (63.6)	
<b>Age</b>			
60-69 years	56 (84.8)	55 (83.3)	$\chi^2 = 2.062,$ $p = 0.357$
70-79 years	10 (15.2)	9 (13.6)	
≥80 years	0 (0.0)	2 (3.1)	
Mean (S.D.)	63.83 (4.51)	64.06 (5.53)	$t = -0.259, p =$ $0.796$
min-max	60-75	60-82	
<b>Monthly income</b>			
< 1,500 baht	30 (45.5)	19 (28.8)	$\chi^2 = 7.007,$ $p = 0.136$
1,501-3,000 baht	9 (13.6)	5 (7.6)	
3,001-5,000 baht	5 (7.6)	9 (13.6)	
5,001-10,000 baht	14 (21.2)	22 (13.3)	
≥ 10,001 baht	8 (12.1)	11 (16.7)	
Mean (S.D.)	5,172.73 (7,188.59)	7,343.97 (9,249.81)	$t = -1.506, p = 0.135$
min-max	0-30,000	0-50,000	

Variables	Intervention group (n=66) (%)	Control group (n=66) (%)	Test of group differences
<b>Educational level</b>			
Illiteracy	2 (3.0)	3 (4.5)	$\chi^2 = 1.706,$ $p = 0.790$
Primary school	53 (80.3)	48 (72.7)	
Secondary school	8 (12.1)	9 (13.6)	
Vocational school	2 (3.0)	3 (4.5)	
Bachelor degree	1 (1.5)	3 (4.5)	
<b>Marital status</b>			
Single	5 (7.6)	7 (10.6)	$\chi^2 = 1.922,$ $p = 0.589$
Married	45 (68.2)	49 (74.2)	
Divorce/separate	7 (10.6)	4 (6.1)	
Windowed	9 (13.6)	6 (9.1)	
<b>Living arrangement</b>			
Lives alone	4 (6.1)	4 (6.1)	$\chi^2 = 0.000,$ $p = 1.000$
Lives with family member	62 (93.9)	62 (93.9)	
<b>Occupation</b>			
Employed	25	36	$\chi^2 = 3.688,$ $p = 0.055$
Unemployed	41	30	
<b>Weight (kg.)</b>			
Mean (S.D.)	62.28 (9.81)	65.29 (10.37)	$t = -1.71, p = 0.089$
min-max	43-100	48-88	
<b>Height (cm.)</b>			
Mean (S.D.)	156.90 (7.80)	156.64 (7.49)	$t = 0.199, p = 0.842$
min-max	136-175	142-172	
<b>BMI (kg/m<sup>2</sup>)</b>			
Mean (S.D.)	25.30 (3.57)	26.63 (4.37)	$t = -1.924, p = 0.057$
min-max	17.95-34.60	18.93-36.50	

Variables	Intervention group (n=66) (%)	Control group (n=66) (%)	Test of group differences
<b>Blood pressure</b>			
<b>Systolic (mmHg)</b>			
Mean (S.D.)	132.77 (18.24)	130.12 (15.26)	$t = 0.906, p = 0.367$
min-max	102-201	90-165	
<b>Diastolic (mmHg)</b>			
Mean (S.D.)	75.42 (9.48)	77.38 (10.50)	$t = -1.123, p =$
min-max	57-104	47-102	0.264
<b>Systemic disease</b>			
<b>Hypertension</b>			
Yes	38 (57.6)	50 (50.0)	$\chi^2 = 0.762,$ $p = 0.383$
No	28 (42.4)	50 (50.0)	
<b>Cardiovascular disease</b>			
Yes	2 (3.0)	3 (4.5)	$\chi^2 = 0.208,$ $p = 0.648$
No	64 (97.0)	63 (95.5)	
<b>Cholesterol</b>			
Yes	32 (48.5)	31 (47.0)	$\chi^2 = 0.030,$ $p = 0.862$
No	34 (51.5)	35 (53.0)	
<b>Health insurance</b>			
Universal coverage	55 (83.3)	59 (89.4)	$\chi^2 = 1.674,$ $p = 0.643$
Universal coverage (other)	3 (4.5)	2 (3.0)	
Government/state enterprise officer	7 (10.6)	5 (7.6)	
Do not have	1 (1.5)	0 (0.0)	
<b>Family history of diabetes</b>			
Yes	28 (42.4)	32 (48.5)	$\chi^2 = 0.489,$ $p = 0.484$
No	38 (57.6)	34 (51.5)	

Variables	Intervention group (n=66) (%)	Control group (n=66) (%)	Test of group differences
<b>Duration of being diabetes (years)</b>			
Mean (S.D.)	6.86 (5.16)	8.42 (6.19)	$t = -1.574, p = 0.118$
min-max	1-20	1-25	
<b>Complication of diabetes</b>			
<b>High blood pressure</b>			
Yes	31 (47.0)	38 (57.6)	$\chi^2 = 1.488,$ $p = 0.223$
No	35 (53.0)	28 (42.4)	
<b>Stroke</b>			
Yes	1 (1.5)	2 (3.0)	$\chi^2 = 0.341,$ $p = 0.559$
No	65 (98.5)	64 (97.0)	
<b>Heart disease</b>			
Yes	2 (3.0)	3 (4.5)	$\chi^2 = 0.208,$ $p = 0.684$
No	64 (97.0)	63 (95.5)	
<b>Eye problems</b>			
Yes	11 (16.7)	15 (22.7)	$\chi^2 = 0.766,$ $p = 0.381$
No	55 (83.3)	51 (77.3)	
<b>Kidney disease</b>			
Yes	1 (1.5)	1 (1.5)	$\chi^2 = 0.000,$ $p = 1.000$
No	65 (98.5)	65 (98.5)	
<b>Foot problem</b>			
Yes	7 (10.6)	8 (12.1)	$\chi^2 = 0.075,$ $p = 0.784$
No	59 (89.4)	58 (87.9)	
<b>Received DM &amp; oral information</b>			
Yes	31 (47.0)	23 (34.8)	$\chi^2 = 2.006,$ $p = 0.157$
No	35 (53.0)	43 (65.2)	

Variables	Intervention group (n=66) (%)	Control group (n=66) (%)	Test of group differences
<b>Smoking</b>			
Never	57 (86.4)	58 (87.9)	$\chi^2 = 1.494,$ $p = 0.474$
Ever	7 (10.6)	4 (6.1)	
Current smoker	2 (3.0)	4 (6.1)	
<b>Duration of stop smoking</b>	<b>(n=7)</b>	<b>(n=4)</b>	
Mean (S.D.)	10.57 (7.89)	17.50 (2.89)	$t = -1.661, p = 0.131$
min-max	1-22	15-20	
<b>Quantity of smoking</b>	<b>(n=9)</b>	<b>(n=8)</b>	
≤ 10 rolls	7 (77.8)	4 (50.0)	$\chi^2 = 1.431,$ $p = 0.232$
> 10 rolls	2 (22.2)	4 (50.0)	
Mean (S.D.)	13.33 (12.93)	17.88 (18.08)	$p = 0.335$
min-max	2-40	1-60	(Mann-Whitney U test)
<b>Duration of smoking</b>	<b>(n=9)</b>	<b>(n=8)</b>	
≤ 10 years	1 (11.1)	1 (12.5)	$\chi^2 = 0.008,$ $p = 0.929$
> 10 years	8 (88.9)	7 (87.5)	
Mean (S.D.)	25.89 (8.99)	26.50 (8.38)	$t = -0.144, p =$
min-max	10-40	10-38	0.887

#### 4.2.2 Biological parameters

Among 132 diabetic patients (66 diabetic patients per each groups), the average value of FPG (SD) of the intervention and the control groups were 143.65 (38.51) and 153.68 (51.34) mg/dl, respectively. The average value of HbA1c (SD) of the intervention and the control groups were 7.39 (1.18) and 7.69 (1.47) %, respectively.



The average value of TG (SD) of the intervention and the control groups were 148 (61.45) and 130.86 (46.25) mg/dl, respectively. The average value of HDL (SD) of the intervention and the control groups were 50.38 (13.62) and 52.23 (13.85) mg/dl, respectively. The average value of LDL (SD) of the intervention and the control groups were 103.44 (32.54) and 106.55 (28.56) mg/dl, respectively. There were no statistically significant differences of biological parameters (FPG, HbA1C, TG, HDL, and LDL) between the intervention and the control groups ( $p=0.206$ ,  $0.201$ ,  $0.073$ ,  $0.441$ , and  $0.561$ , respectively). (table 5)

*Table 5: Distribution of biological parameters (n=132)*

Variables	Intervention group		Control group		t	p-value
	Mean	SD	Mean	SD		
FPG	143.65	38.51	153.68	51.34	-1.270	0.206
HbA1C	7.39	1.18	7.69	1.47	-1.284	0.201
TG	148	61.45	130.86	46.25	1.810	0.073
HDL	50.38	13.62	52.23	13.85	-0.773	0.441
LDL	103.44	32.54	106.55	28.56	-0.583	0.561

### 4.2.3 Knowledge toward DM and oral health at baseline

#### 4.2.3.1 Score of knowledge toward DM and oral health at baseline

Among 132 diabetic patients (66 diabetic patients per each groups), the total score of knowledge toward DM and oral health was 10 points. The average score of knowledge toward DM and oral health (SD) of the intervention and the control groups were 7.15 (2.36) and 7.07 (2.27), respectively. The total score of knowledge

toward DM was 5 points. The average score of knowledge toward DM (SD) of the intervention and the control groups were 3.52 (1.09) and 3.59 (0.96), respectively. The total score of knowledge toward oral health was 5 points. The average score of knowledge toward oral health (SD) of the intervention and the control groups were 3.65 (1.73) and 3.53 (1.60), respectively. There were no statistically significant differences of the overall score of knowledge toward DM and oral health, knowledge toward DM, and knowledge toward oral health between the intervention and the control groups ( $p=0.893$ ,  $0.698$ , and  $0.677$ , respectively). (table 6)

*Table 6: Score of knowledge toward DM and oral health at baseline (n=132)*

Variables	Interventio n group (n=66) (%)	Control group (n=66) (%)	Test of group difference s
<b>Overall score of knowledge toward DM and oral health</b>			
Mean (S.D.)	7.15 (2.36)	7.07 (2.27)	$t = 0.203$ ,
min-max	0-10	1.2-10.0	$p = 0.893$
<b>Score of knowledge toward DM</b>			
Mean (S.D.)	3.52 (1.09)	3.59 (0.96)	$t = -0.390$ ,
min-max	0-5	1.2-5.0	$p = 0.698$
<b>Score of knowledge toward oral health</b>			
Mean (S.D.)	3.65 (1.73)	3.53 (1.60)	$t = 0.418$ ,
min-max	0-5	0-5	$p = 0.677$

#### 4.2.3.2 Distribution of knowledge toward DM and oral health at baseline

##### Distribution of knowledge toward DM

Among 132 diabetic patients (66 diabetic patients per each groups), more than half of the participants in both intervention (63.6%) and control (62.1%) groups answered high blood sugar was the best characterizes of DM. There was no statistically significant difference of the best characterizes of DM between the intervention and the control groups ( $p=0.307$ ). More than half of participants in both intervention and control groups answered weight gain or loss, frequent urination, frequent hunger, frequent thirst, and numbness were the common symptoms of DM. Most of the participants in both intervention (97.0%) and control (95.5%) groups answered asymptomatic was not the common symptoms of DM. 1.5% of the intervention and 3.0% of the control groups did not know the common symptoms of DM. There were no statistically significant differences of the common symptoms of DM included weight gain or loss, frequent urination, frequent hunger, frequent thirst, numbness, asymptomatic, and do not know between the intervention and the control groups ( $p=0.473, 0.081, 0.377, 0.148, 0.712, 0.648, \text{ and } 0.559$ , respectively). More than half of the participants in both intervention and control groups answered eye disease and foot problems were the common complications of DM. Half of participants in both intervention and control groups answered heart, kidney, and gum

disease were the common complications of DM. Whereas, one third of participants in both intervention and control groups answered stroke was the common complications of DM. 15.2% of participants in both intervention and control groups did not know the common complications of DM. There were no statistically significant differences of the common complications of DM included heart disease, kidney disease, eye disease, stroke, foot problems, gum disease, and do not know between the intervention and the control groups ( $p=0.484, 0.725, 0.340, 0.709, 0.854, 0.223, \text{ and } 1.000$ , respectively). Most of participants in both intervention and control groups answered drug, healthy diet, regular exercise, and weight control were the treatment of DM. Half of participants in both intervention and control groups answered quit smoking were the treatment of DM. 37.9% of the intervention and 43.9% of the control groups answered insulin was the treatment of DM. 3.0% of intervention and 0.0% of control groups did not know the treatment of DM. Drug was a statistically significant difference between intervention and control groups ( $p=0.023$ ). Insulin, healthy diet, regular exercise, weight control, quit smoking, and do not know were no statistically significant differences between the intervention and the control groups ( $p=0.479, 0.345, 1.000, 0.812, 0.601, 0.154$ , respectively). 97.0% of the intervention and 95.5% of the control groups answered the complications of DM can be prevented by routine investigation with no statistically significant difference ( $p=0.648$ ). Most of participants in both intervention and control groups answered testing blood sugar, monitoring blood pressure, eye examination, foot examination,

oral examination, and tested body weight were the type of routine investigations. 95.5% of the intervention and 98.5% of the control groups did not know the type of routine investigations. Monitoring blood pressure was a statistically significant difference between the intervention and the control group ( $p=0.027$ ). Testing blood sugar, eye examination, foot examination, oral examination, tested body weight, and do not know were no statistically significant differences between the intervention and the control groups ( $p=0.095, 0.170, 0.846, 0.640, 0.170, \text{ and } 0.310$ , respectively). (table 7)

#### **Distribution of knowledge toward oral health**

Among 132 diabetic patients (66 diabetic patients per each groups), 65.2% of the intervention and 63.6% of the control groups answered diabetic patients are more likely to have infection in their mouths. 69.7% of the intervention and 68.2% of the control groups answered diabetic patients are more likely to have gum disease. 72.7% of the intervention and 66.7% of the control groups answered diabetes can make teeth and gum worse. 77.3% of the intervention and 71.2% of the control groups answered bleeding gums when brushing teeth is an early sign of gum disease. 78.8% of the intervention and 81.8% of the control groups answered gum disease can lead to loss of teeth. “Diabetic patients are more likely to have infection in their mouths.”, “Diabetic patients are more likely to have gum disease.”, “Diabetes can make teeth and gum worse.”, “Bleeding gums when brushing teeth is an early sign of gum disease.”, and “Gum disease can lead to loss of teeth.” were no statistically

significant differences between the intervention and the control groups ( $p=0.982$ ,  $0.941$ ,  $0.599$ ,  $0.687$ , and  $0.721$ , respectively). (table 8)

Table 7: Distribution of knowledge toward DM at baseline between the intervention and the control groups (n=132)

Variables	Interventio n group (n=66) (%)	Control group (n=66) (%)	Test of group differences
<b>Best characterizes of disease condition</b>			
High blood sugar	42 (63.6)	41 (62.1)	$\chi^2 = 3.605$ , $p = 0.307$
Low blood sugar	5 (7.6)	1 (1.5)	
High urine sugar	8 (12.1)	8 (12.1)	
Don't know	11 (16.7)	16 (24.2)	
<b>Common symptoms of DM</b>			
<b>Weight gain/loss</b>			
Yes	39 (59.1)	43 (65.2)	$\chi^2 = 0.515$ , $p = 0.473$
No	27 (40.9)	23 (34.8)	
<b>Frequent urination</b>			
Yes	52 (78.8)	43 (65.2)	$\chi^2 = 3.042$ , $p = 0.081$
No	14 (21.2)	23 (34.8)	
<b>Frequent hunger</b>			
Yes	41 (62.1)	36 (54.5)	$\chi^2 = 0.779$ , $p = 0.377$
No	25 (37.9)	30 (45.5)	
<b>Frequent thirst</b>			
Yes	38 (57.6)	46 (69.7)	$\chi^2 = 2.095$ , $p = 0.148$
No	28 (42.4)	20 (30.3)	
<b>Numbness</b>			
Yes	45 (68.2)	43 (65.2)	$\chi^2 = 0.136$ , $p = 0.712$
No	21 (31.8)	23 (34.8)	

Variables	Interventio n group (n=66) (%)	Control group (n=66) (%)	Test of group differences
<b>Asymptomatic</b>			
Yes	2 (3.0)	3 (4.5)	$\chi^2 = 0.208,$
No	64 (97.0)	63 (95.5)	$p = 0.648$
<b>Don't know any symptom</b>			
Know none of the symptom	1 (1.5)	2 (3.0)	$\chi^2 = 0.341,$
Know at least one	65 (98.5)	64 (97.0)	$p = 0.559$
<b>Common complications of DM</b>			
<b>Heart disease</b>			
Yes	28 (42.4)	32 (48.5)	$\chi^2 = 0.489,$
No	38 (57.6)	34 (51.5)	$p = 0.484$
<b>Kidney disease</b>			
Yes	39 (59.1)	37 (56.1)	$\chi^2 = 0.124,$
No	27 (40.9)	29 (43.9)	$p = 0.725$
<b>Eye disease</b>			
Yes	44 (66.7)	49 (74.2)	$\chi^2 = 0.910,$
No	22 (33.3)	17 (25.8)	$p = 0.340$
<b>Stroke</b>			
Yes	22 (33.3)	20 (30.3)	$\chi^2 = 0.140,$
No	44 (66.7)	46 (69.7)	$p = 0.709$
<b>Foot problems</b>			
Yes	43 (65.2)	44 (66.7)	$\chi^2 = 0.034,$
No	23 (34.8)	22 (33.3)	$p = 0.854$
<b>Gum disease</b>			
Yes	35 (53.0)	28 (42.4)	$\chi^2 = 1.488,$
No	31 (47.0)	38 (57.6)	$p = 0.223$

Variables	Interventio n group (n=66) (%)	Control group (n=66) (%)	Test of group differences
<b>Don't know any complication</b>			
Know none of the complication	10 (15.2)	10 (15.2)	$\chi^2 = 0.000,$
Know at least one	56 (84.8)	56 (84.4)	$p = 1.000$
<b>Treatments of DM</b>			
<b>Drugs</b>			
Yes	61 (92.4)	66 (100.0)	$\chi^2 = 5.197,$
No	5 (7.6)	0 (0.0)	$p = 0.023$
<b>Insulin</b>			
Yes	25 (37.9)	29 (43.9)	$\chi^2 = 0.501,$
No	41 (62.1)	37 (56.1)	$p = 0.479$
<b>Healthy diet</b>			
Yes	59 (89.4)	62 (93.9)	$\chi^2 = 0.893,$
No	7 (10.6)	4 (6.1)	$p = 0.345$
<b>Regular exercise</b>			
Yes	56 (84.8)	56 (84.4)	$\chi^2 = 0.000,$
No	10 (15.2)	10 (15.2)	$p = 1.000$
<b>Weight control</b>			
Yes	55 (83.3)	56 (84.8)	$\chi^2 = 0.057,$
No	11 (16.7)	10 (15.2)	$p = 0.812$
<b>Quit smoking</b>			
Yes	36 (54.5)	33 (50.0)	$\chi^2 = 0.273,$
No	30 (45.5)	33 (50.0)	$p = 0.601$
<b>Don't know any treatment</b>			
Know none of the treatment	2 (3.0)	0 (0.0)	$\chi^2 = 2.031,$
Know at least one	64 (97.0)	66 (100.0)	$p = 0.154$



Variables	Interventio n group (n=66) (%)	Control group (n=66) (%)	Test of group differences
<b>Complications of DM can be prevented by routine investigation</b>			
Yes	64 (97.0)	63 (95.5)	$\chi^2 = 0.208,$
No	0 (0.0)	0 (0.0)	$p = 0.648$
Don't know	2 (3.0)	3 (4.5)	
<b>Which investigation should be done?</b>			
<b>Blood sugar</b>			
Yes	61 (92.4)	65 (98.5)	$\chi^2 = 2.794,$
No	5 (7.6)	1 (1.5)	$p = 0.095$
<b>Monitoring BP</b>			
Yes	57 (86.4)	64 (97.0)	$\chi^2 = 4.860,$
No	9 (13.6)	2 (3.0)	$p = 0.027$
<b>Eye examination</b>			
Yes	61 (92.4)	56 (84.8)	$\chi^2 = 1.880,$
No	5 (7.6)	10 (15.2)	$p = 0.170$
<b>Foot examination</b>			
Yes	48 (72.7)	47 (71.2)	$\chi^2 = 0.038,$
No	18 (27.3)	19 (28.8)	$p = 0.846$
<b>Oral examination</b>			
Yes	54 (81.8)	56 (84.8)	$\chi^2 = 0.218,$
No	12 (18.2)	10 (15.2)	$p = 0.640$
<b>Tested body weight</b>			
Yes	56 (84.8)	61 (92.4)	$\chi^2 = 1.880,$
No	10 (15.2)	5 (7.6)	$p = 0.170$
<b>Don't know any investigation</b>			
Know none of the investigation	3 (4.5)	1 (1.5)	$\chi^2 = 1.031,$
Know at least one	63 (95.5)	65 (98.5)	$p = 0.310$

Table 8: Distribution of knowledge toward oral health at baseline between the intervention and the control groups (n=132)

Variables	Interventio n group (n=66) (%)	Control group (n=66) (%)	Test of group differen ces
<b>Diabetic patients are more likely to have infection in their mouths.</b>			
Yes	43 (65.2)	42 (63.6)	$\chi^2=0.036$
No	3 (4.5)	3 (4.5)	, p=0.982
Don't know	20 (30.3)	21 (31.8)	
<b>Diabetic patients are more likely to have gum disease.</b>			
Yes	46 (69.7)	45 (68.2)	$\chi^2=0.122$
No	4 (6.1)	5 (7.6)	, p=0.941
Don't know	16 (24.2)	16 (24.2)	
<b>Diabetes can make teeth and gum worse.</b>			
Yes	48 (72.7)	44 (66.7)	$\chi^2=1.027$
No	4 (6.1)	7 (10.6)	, p=0.599
Don't know	14 (21.2)	15 (22.7)	
<b>Bleeding gums when brushing teeth is an early sign of gum disease.</b>			
Yes	51 (77.3)	47 (71.2)	$\chi^2=0.752$
No	8 (12.1)	9 (13.6)	, p=0.687
Don't know	7 (10.6)	10 (15.2)	

Variables	Interventio n group (n=66) (%)	Control group (n=66) (%)	Test of group differen ces
<b>Gum disease can lead to loss of teeth.</b>			
Yes	52 (78.8)	54 (81.8)	$\chi^2=0.654$
No	3 (4.5)	4 (6.1)	, p=0.721
Don't know	11 (16.7)	8 (12.1)	

#### 4.2.4 Attitude toward DM and oral health at baseline

##### 4.2.4.1 Score of attitude toward DM and oral health at baseline

The total score of attitude toward DM and oral health was 50 points. The average score of attitude toward DM and oral health (SD) of the intervention and the control groups were 43.73 (4.40) and 41.86 (6.54), respectively. The total score of attitude toward DM was 25 points. The average score of attitude toward DM (SD) of the intervention and the control groups were 22.29 (2.33) and 21.79 (2.58), respectively. The total score of attitude toward oral health was 25 points. The average score of knowledge toward oral health (SD) of the intervention and the control groups were 21.47 (2.98) and 20.79 (3.12), respectively. There were no statistically significant differences of the overall score of attitude toward DM and oral health, attitude toward DM, and attitude toward oral health between the intervention and the control groups (p=0.057, 0.244, and 0.202, respectively). (table 9)

Table 9: Score of attitude toward DM and oral health at baseline (n=132)

Variables	Intervention group (n=66) (%)	Control group (n=66) (%)	Test of group differences
<b>Overall score of attitude toward diabetes mellitus and oral health</b>			
Mean (S.D.)	43.73 (4.40)	41.86 (6.54)	$t = 1.923,$
Min-max	31-50	5-50	$p = 0.057$
<b>Score of attitude toward diabetes mellitus</b>			
Mean (S.D.)	22.29 (2.33)	21.79 (2.58)	$t = 0.381,$
Min-max	16-25	16-25	$p = 0.244$
<b>Score of attitude toward oral health</b>			
Mean (S.D.)	21.47 (2.98)	20.79 (3.12)	$t = 0.886,$
Min-max	15-25	15-25	$p = 0.202$

#### 4.2.4.2 Distribution of attitude toward DM and oral health at baseline

##### Attitude toward DM

More than half of participants of the intervention (71.2%) and the control (63.6%) groups strongly agree with “regular exercise helps in keeping diabetes under control”. 65.2% of the intervention and 62.1% of the control groups strongly agree with “People with diabetes should control their weight”. 65.2% of the intervention and 59.1% of the control groups strongly agree with “Dietary modification by control starch and sugar is useful for keeping diabetes under control”. 69.7% of the intervention and 56.1% of the control groups strongly agree with “Diabetic patient

can lead near normal life with sugar controlled”. 43.9% of the intervention and 31.8% of the control groups disagree and 30.3% of the intervention and 31.8% of the control groups strongly disagree with “If diabetic patient has well sugar controlled by drug, no need to control diet”. There were no statistically significant differences of the attitude toward DM between the intervention and the control groups. (table 10)

#### **Attitude toward oral health**

47.0% of the intervention and 42.4% of the control groups strongly agree with “Routine dental care is important to prevent diabetic complications”. 51.5% of the intervention and 43.9% of the control groups strongly agree with “Regular visits (every 3-6 months) to the dentist necessary to prevent diabetic complications”. 43.9% of the intervention and 40.9% of the control groups strongly agree with “Tooth brushing is important to prevent diabetic complications”. 42.4% of the intervention and 31.8% of the control groups strongly agree with “Using dental floss is important to prevent gum disease”. 59.1% of the intervention and 47.0% of the control groups strongly agree with “Dental treatment (scaling and root planning) is important to prevent progression of gum disease”. There were no statistically significant differences of the attitude toward oral health between the intervention and the control groups. (table 11)

Table 10: Distribution of attitude toward DM at baseline by Mann-Whitney U test (n=132, 66 participants per group)

Variables	Strongly agree n (%)	Agree n (%)	Not sure n (%)	Disagree n (%)	Strongly disagree n (%)	Test of group differences
<b>Attitude toward DM</b>						
<b>1. Regular exercise helps in keeping diabetes under control.</b>						
						<b>U =</b>
-Intervention group	47 (71.2)	16 (24.2)	3 (4.5)	0 (0.0)	0 (0.0)	2030.000,
-Control group	42 (63.6)	22 (33.3)	2 (3.0)	0 (0.0)	0 (0.0)	p = 0.410
<b>2. People with diabetes should control their weight.</b>						
						<b>U =</b>
-Intervention group	43 (65.2)	22 (33.3)	1 (1.5)	0 (0.0)	0 (0.0)	2113.000,
-Control group	41 (62.1)	24 (36.4)	1 (1.5)	0 (0.0)	0 (0.0)	p = 0.724
<b>3. Dietary modification by control starch and sugar is useful for keeping diabetes under control.</b>						
						<b>U =</b>
-Intervention group	43 (65.2)	21 (31.8)	1 (1.5)	1 (1.5)	0 (0.0)	2050.000,
-Control group	39 (59.1)	25 (37.9)	1 (1.5)	1 (1.5)	0 (0.0)	p = 0.492
<b>4. Diabetic patient can lead near normal life with sugar controlled.</b>						
						<b>U =</b>
-Intervention group	46 (69.7)	18 (27.3)	2 (3.0)	0 (0.0)	0 (0.0)	1879.000,
-Control group	37 (56.1)	26 (39.4)	2 (3.0)	1 (1.5)	0 (0.0)	p = 0.107
<b>5. If diabetic patient has well sugar controlled by drug, no need to control diet.</b>						
						<b>U =</b>
-Intervention group	7 (10.6)	8 (12.1)	2 (3.0)	29 (43.9)	20 (30.3)	2049.000,
-Control group	9 (13.6)	12 (18.2)	3 (4.5)	21 (31.8)	21 (31.8)	p = 0.538

Table 11: Distribution of attitude toward oral health at baseline by Mann-Whitney U test (n=132, 66 participants per group)

Variables	Strongly agree n (%)	Agree n (%)	Not sure n (%)	Disagree n (%)	Strongly disagree n (%)	Test of group differences
<b>Attitude toward oral health</b>						
<b>1. Routine dental care is important to prevent diabetic complications.</b>						
-Intervention group	31 (47.0)	27 (40.9)	8 (12.1)	0 (0.0)	0 (0.0)	$U = 1999.500,$ $p = 0.377$
-Control group	28 (42.4)	25 (37.9)	12 (18.2)	1 (1.5)	0 (0.0)	
<b>2. Regular visits (every 3-6 months) to the dentist necessary to prevent diabetic complications.</b>						
-Intervention group	34 (51.5)	23 (34.8)	9 (13.6)	0 (0.0)	0 (0.0)	$U = 2026.500,$ $p = 0.450$
-Control group	29 (43.9)	28 (42.4)	7 (10.6)	1 (1.5)	1 (1.5)	
<b>3. Tooth brushing is important to prevent diabetic complications.</b>						
-Intervention group	29 (43.9)	22 (33.3)	14 (21.2)	1 (1.5)	0 (0.0)	$U = 2119.500,$ $p = 0.776$
-Control group	27 (40.9)	24 (36.4)	13 (19.7)	2 (3.0)	0 (0.0)	
<b>4. Using dental floss is important to prevent gum disease.</b>						
-Intervention group	28 (42.4)	14 (21.2)	21 (31.8)	2 (3.0)	1 (1.5)	$U = 1903.500,$ $p = 0.190$
-Control group	21 (31.8)	18 (27.3)	18 (27.3)	4 (6.1)	5 (7.6)	
<b>5. Dental treatment (scaling and root planning) is important to prevent progression of gum disease.</b>						
-Intervention group	39 (59.1)	22 (33.3)	5 (7.6)	0 (0.0)	0 (0.0)	$U = 1902.000,$ $p = 0.159$
-Control group	31 (47.0)	28 (42.4)	5 (7.6)	1 (1.5)	1 (1.5)	

#### 4.2.5 Practice toward DM at baseline

Among 132 diabetic patients (66 diabetic patients per each groups), 53.0% of the intervention and 43.9% of the control groups exercised 2-5 days/week in the last month. 68.2% of the intervention and 74.2% of the control groups measured their weight once a month. 71.2% of the intervention and 74.2% of the control groups modified diet as doctor's/dietician's advice. From the participants who ever modified diet, 66.0% of the intervention and 72.0% of the control groups modified diet sometimes. 54.5% of the intervention and 47.0% of the control groups ever forgot to take any drug prescribed. From the participants who ever forgot to take drugs prescribed, 83.3% of the intervention and 96.8% of the control groups forgot 1-3 days/month. 81.8% of the intervention and 75.8% of the control groups received eye examination in the past year. 15.2% of the intervention and 7.6% of the control groups received foot examination in the past year. 42.4% of the intervention and 33.3% of the control groups always wear covered shoes when outdoors. 60.6% of the intervention and 56.1% of the control groups mostly screen foot by themselves. There were no statistically significant differences in the practice toward DM between the intervention and the control groups. (table 12)



Table 12: Practice toward DM at baseline (n=132)

Variables	Interventio n group (n=66) (%)	Control group (n=66) (%)	Test of group differences
<b>Frequency of physical activity, last month</b>			
More than 5 days/week	11 (16.7)	7 (10.6)	$\chi^2 = 4.789,$ p = 0.310
2-5 days/week	35 (53.0)	29 (43.9)	
Once a week	3 (4.5)	4 (6.1)	
2-3 times/month	0 (0.0)	2 (3.0)	
Rarely/never	17 (25.8)	24 (36.4)	
<b>Frequency of weight measurement, last month</b>			
More than once	21 (31.8)	16 (24.2)	$\chi^2 = 1.846,$ p = 0.397
Once	56 (68.2)	49 (74.2)	
Not measured	0 (0.0)	1 (1.5)	
<b>Modified diet as doctor's/dietician's advice</b>			
Yes	47 (71.2)	49 (74.2)	$\chi^2 = 0.442,$ p = 0.802
No	13 (19.7)	13 (19.7)	
Never received recommendation	6 (9.1)	4 (6.1)	
<b>Frequency of modified diet as doctor's/dietician's advice, last month</b>			
Mostly	15 (31.9)	14 (28.0)	$\chi^2 = 1.316,$ p = 0.518
Sometimes	31 (66.0)	36 (72.0)	
Rarely/never	1 (2.1)	0 (0.0)	
<b>Forgot to take any drugs prescribed</b>			
Yes	36 (54.5)	31 (47.0)	$\chi^2 = 0.758,$ p = 0.384
No	30 (45.5)	35 (53.0)	

Variables	Interventio n group (n=66) (%)	Control group (n=66) (%)	Test of group difference s
<b>Frequency to forget to take any drugs prescribed</b>			
1-3 days/month	30 (83.3)	30 (96.8)	$\chi^2 = 3.647,$ $p = 0.302$
1-2 days/week	3 (8.3)	1 (3.2)	
More than 2 days	1 (2.8)	0 (0.0)	
Don't know	2 (5.6)	0 (0.0)	
<b>Received eye examination in the past year</b>			
Yes	54 (81.8)	50 (75.8)	$\chi^2 = 0.725,$ $p = 0.394$
No	12 (18.2)	16 (24.2)	
<b>Received foot examination in the past year</b>			
Yes	10 (15.2)	5 (7.6)	$\chi^2 = 1.880,$ $p = 0.170$
No	56 (84.8)	61 (92.4)	
<b>Always wear covered shoes when outdoors</b>			
Yes	28 (42.4)	22 (33.3)	$\chi^2 = 1.159,$ $p = 0.282$
No	38 (57.6)	44 (66.7)	
<b>Frequency of screen foot by themselves</b>			
Always	40 (60.6)	37 (56.1)	$\chi^2 = 2.174,$ $p = 0.337$
Sometimes	7 (10.6)	13 (19.7)	
Rarely/never	19 (28.8)	16 (24.2)	

## 4.2.6 Practice toward oral health at baseline

### 4.2.6.1 Utilization of dental services

Among 132 diabetic patients (66 diabetic patients per each groups), 36.4% of the intervention and 30.3% of the control groups have used dental services less than 6 months. Among participants who ever used dental services, half of the intervention (43.8%) and the control (51.8%) groups received extraction last time and most of the participants in the intervention (83.3%) and the control (83.9%) groups received dental services for emergency. There were no statistically significant differences of utilization of dental services including used dental service last time, type of dental services, and reason to have had dental services between the intervention and the control groups ( $p=0.148$ ,  $0.423$ , and  $0.095$ , respectively). (table 13)

Table 13: Utilization of dental services at baseline between the intervention and the control groups ( $n=132$ )

Variables	Interventio n group ( $n=66$ ) (%)	Control group ( $n=66$ ) (%)	Test of group differences
<b>Last time dental services were used</b>			
Less than 6 months	24 (36.4)	20 (30.3)	$\chi^2 = 8.146$ , $p = 0.148$
6-12 months	13 (19.7)	9 (13.6)	
More than 1 year, but less than 2 years	11 (16.7)	13 (19.7)	
More than 2 year, but less than 5 years	8 (12.1)	10 (15.2)	
More than 5 years	8 (12.1)	4 (6.1)	
Never received dental service	2 (3.0)	10 (15.2)	

Variables	Interventio n group (n=66) (%)	Control group (n=66) (%)	Test of group differences
<b>Last time treatments were received</b>	<b>(n=64)</b>	<b>(n=56)</b>	
Extraction	28 (43.8)	29 (51.8)	$\chi^2 = 1.722,$
Restoration, cleaning & scaling	21 (32.8)	19 (33.9)	$p = 0.423$
Denture wearing & dental examination	15 (23.4)	8 (14.3)	
<b>Reason to go to received dental services</b>	<b>(n=64)</b>	<b>(n=56)</b>	
Routine/planned	9 (13.6)	9 (16.1)	$\chi^2 = 0.095,$
Emergency	55 (83.3)	47 (83.9)	$p = 0.758$

#### 4.2.6.2 Oral health behaviors

Among 132 diabetic patients (66 diabetic patients per each groups), every participant of the intervention (100%) and the control (100%) groups clean their oral cavity by tooth brushing. 34.8% of the intervention and 36.4% of the control groups use mouth rinse. 47.0% of the intervention and 37.9% of the control groups use salt solution. 15.2% of the intervention and 13.6% of the control groups use dental floss. 62.1% of the intervention and 59.1% of the control groups use toothpick. 22.7% of the intervention and 13.6% of the control groups use inter-proximal brush. 84.8% of the intervention and 77.3% of the control groups tooth brushing two times per day. There were no statistically significant differences of the oral health behaviors between the intervention and the control groups. (table 14)

Table 14: Oral health behaviors at baseline between the intervention and the control groups (n=132)

Variables	Interventio n group (n=66) (%)	Control group (n=66) (%)	Test of group differences
<b>Tooth brushing</b>			
Yes	66 (100.0)	66 (100.0)	-
No	0 (0.0)	0 (0.0)	
<b>Frequency of tooth brushing</b>			
Once a day	5 (7.6)	5 (7.6)	$\chi^2 = 3.805,$ $p = 0.283$
Two times per day	56 (84.8)	51 (77.3)	
Three times per day	4 (6.1)	10 (15.2)	
More than three times per day	1 (1.5)	0 (0.0)	
<b>Mouth rinse (n=335)</b>			
Yes	23 (34.8)	24 (36.4)	$\chi^2 = 0.033,$ $p = 0.856$
No	43 (65.2)	42 (63.6)	
Frequency: mean (SD)	1.52 (0.59)	1.75 (0.74)	
min-max	1-3	1-3	
<b>Salt solution</b>			
Yes	31 (47.0)	25 (37.9)	$\chi^2 = 1.117,$ $p = 0.291$
No	35 (53.0)	41 (62.1)	
Frequency: mean (SD)	1.23 (0.43)	1.20 (0.50)	
min-max	1-2	1-3	
<b>Dental floss</b>			
Yes	10 (15.2)	9 (13.6)	$\chi^2 = 0.061,$ $p = 0.804$
No	56 (84.8)	57 (86.4)	
Frequency: mean (SD)	1.60 (0.97)	1.56 (0.88)	
min-max	1-4	1-3	

Variables	Interventio n group (n=66) (%)	Control group (n=66) (%)	Test of group differences
<b>Tooth pick</b>			
Yes	41 (62.1)	39 (59.1)	$\chi^2 = 0.127,$
No	25 (37.9)	27 (40.9)	$p = 0.722$
Frequency: mean (SD)	2.17 (0.95)	2.13 (0.89)	
min-max	1-3	1-3	
<b>Inter-proximal brush</b>			
Yes	15 (22.7)	9 (13.6)	$\chi^2 = 1.833,$
No	51 (77.3)	57 (86.4)	$p = 0.176$
Frequency: mean (SD)	2.07 (0.59)	2.22 (0.83)	
min-max	1-3	1-3	

#### 4.2.7 Periodontal status at baseline

Among 132 diabetic patients (66 diabetic patients per each groups), the average plaque index score (SD) of the intervention and the control groups were 0.60 (0.42) and 0.63 (0.41) mm, respectively. The average gingival index score (SD) of intervention and control groups were 0.66 (0.41) and 0.76 (0.48) mm, respectively. The average pocket depth (SD) of the intervention and the control groups were 2.36 (0.55) and 2.39 (0.81) mm, respectively. The average CAL (SD) of the intervention and the control groups were 3.35 (0.88) and 3.67 (1.30) mm, respectively. Most of the participants in the intervention and the control groups had moderate periodontitis (89.4% and 86.4%, respectively). There were no statistically significant differences of the periodontal status between the intervention and the control groups. (table 15)

Table 15: Periodontal status at baseline between the intervention and the control groups (n=132)

Variables	Intervention group (n=66) (%)	Control group (n=66) (%)	Test of group differences
<b>Plaque index score</b>			
Mean (SD)	0.60 (0.42)	0.63 (0.41)	$t = -0.445,$
Min-max	0.00-1.50	0.00-2.13	$p = 0.657$
<b>Gingival index score</b>			
Mean (SD)	0.66 (0.41)	0.76 (0.48)	$t = -1.384,$
Min-max	0.00-1.81	0.00-2.00	$p = 0.169$
<b>Pocket depth</b>			
Mean (S.D.)	2.36 (0.55)	2.39 (0.81)	$t = -0.325,$
Min-max:	1.30-4.25	1.16-5.83	$p = 0.746$
<b>Clinical attachment loss (CAL)</b>			
Mean (SD)	3.35 (0.88)	3.67 (1.30)	$t = -1.643,$
Min-max:	1.89-5.71	1.36-8.82	$p = 0.103$
<b>Severity of periodontitis (%)</b>			
- Slight	2 (3.0)	2 (3.0)	$\chi^2 = 0.368,$ $p = 0.832$
- Moderate	59 (89.4)	57 (86.4)	
- Severe	5 (7.6)	7 (10.6)	

#### 4.3 Difference of knowledge and attitude score between pre and post education

After the lifestyle and oral health education at baseline, among 66 diabetic patients in the intervention group, the overall score of knowledge toward DM and oral health (SD) was increased from 7.15 (2.36) to 9.38 (0.91). The score of knowledge toward DM was increased from 3.51 (1.09) to 4.55 (0.55). The score of knowledge toward oral health was increased from 3.65 (1.73) to 4.94 (0.52). There were

statistically significant differences of the overall knowledge toward DM and oral health, knowledge toward DM, and knowledge toward oral health between pre- and post-education ( $p < 0.001$ ,  $< 0.001$ , and  $< 0.001$ , respectively). (table 16)

After the lifestyle and oral health education at baseline, among 66 diabetic patients in the intervention group, the overall score of attitude toward DM and oral health (SD) was increased from 43.73 (4.39) to 45.21 (6.60). The score of attitude toward DM was increased from 22.29 (2.33) to 22.67 (2.28). The score of attitude toward oral health was increased from 21.47 (2.98) to 23.20 (2.41). There was a statistically significant differences of the attitude toward oral health between pre- and post-education ( $p < 0.001$ ). However, there were no statistically significant differences of the overall attitude toward DM and oral health and attitude toward DM between pre- and post-education ( $p = 0.109$  and  $0.277$ , respectively). (table 16)



Table 16: Difference of knowledge and attitude score between pre and post education of the intervention group at baseline by paired t test ( $p < 0.05$ ) ( $n = 66$ )

Variables	Pre- education Mean (SD)	Post- education Mean (SD)	Mean difference (SD)	t-value	p-value
<b>Knowledge</b>					
- Overall knowledge	7.15 (2.36)	9.38(0.91)	2.22 (2.41)	7.486	<0.001
- Knowledge toward diabetes mellitus	3.51 (1.09)	4.55 (0.55)	1.03 (1.04)	8.091	<0.001
- Knowledge toward oral health	3.65 (1.73)	4.94 (0.52)	1.29 (1.73)	6.064	<0.001
<b>Attitude</b>					
- Overall attitude	43.73 (4.39)	45.21 (6.60)	1.49 (7.41)	1.627	0.109
- Attitude toward diabetes mellitus	22.29 (2.33)	22.67 (2.28)	0.38 (2.81)	1.097	0.277
- Attitude toward oral health	21.47 (2.98)	23.20 (2.41)	1.73 (7.41)	4.255	<0.001

#### 4.4 The relationship between blood glucose level and periodontal status at baseline

Of the 132 participants, 23 participants controlled diabetes (17.4%). Most of the participants in the intervention and the control groups had moderate periodontitis (89.4% and 86.4%, respectively). The uncontrolled diabetes group had higher plaque index score, pocket depth, and CAL than the controlled diabetes group. However, the uncontrolled diabetes group had lower gingival index score than the controlled diabetes group. The uncontrolled diabetes group had higher percentage of severe periodontitis than the controlled diabetes group. Although the periodontal status in the uncontrolled diabetes tended to be worse when compared with the controlled

diabetes, there were no statistically significant differences between diabetes control and periodontal status including plaque index score, gingival index score, pocket depth, CAL, and severity of periodontitis ( $p = 0.229, 0.785, 0.180, 0.084, \text{ and } 0.642$ , respectively). (table 17)

**Table 17: Relationship between blood glucose level and periodontal status at baseline (n=132)**

Variables	Glycemic control		t value / $\chi^2$	p-value
	Controlled (HbA1c<6.5) (n=23)	Uncontrolled (HbA1≥6.5) (n=109)		
<b>Plaque index score (mm.)</b>				
Mean (SD)	0.52 (0.40)	0.63 (0.41)	-1.210	0.229
<b>Gingival index score (mm.)</b>				
Mean (SD)	0.73 (0.50)	0.71 (0.44)	0.274	0.785
<b>Pocket depth (mm.)</b>				
Mean (SD)	2.20 (0.53)	2.41 (0.71)	-1.349	0.180
<b>Clinical attachment loss (CAL) (mm.)</b>				
Mean (SD)	3.15 (0.88)	3.59 (1.15)	-1.742	0.084
<b>Severity of periodontitis</b>				
- Slight	1 (4.3)	3 (2.8)	0.886	0.642
- Moderate	21 (91.4)	95 (87.1)		
- Severe	1 (4.3)	11 (10.1)		

#### **4.5 Knowledge toward DM and oral health at baseline, 3 month, and 6 month follow up**

##### **4.5.1 Score of knowledge toward DM and oral health at baseline, 3 month, and 6 month follow up**

###### **4.5.1.1 Overall score of knowledge toward DM and oral health**

The average overall score of knowledge toward DM and oral health (SD) at baseline, 3 month, and 6 month follow up in the intervention group were 7.15 (2.36), 9.48 (0.70), and 9.58 (0.62), respectively. The average overall score of knowledge toward DM and oral health (SD) at baseline, 3 month, and 6 month follow up in the control group were 7.07 (2.27), 7.29 (2.23), and 7.33 (2.31), respectively. (table 18)

###### **4.5.1.2 Score of knowledge toward DM**

The average score of knowledge toward DM (SD) at baseline, 3 month, and 6 month follow up in the intervention group were 3.52 (1.09), 4.70 (0.28), and 4.74 (0.23), respectively. The average score of knowledge toward DM (SD) at baseline, 3 month, and 6 month follow up in the control group were 3.59 (0.96), 3.66 (1.17), and 3.44 (1.32), respectively. (table 18)

###### **4.5.1.3 Score of knowledge toward oral health**

The average score of knowledge toward oral health (SD) at baseline, 3 month, and 6 month follow up in the intervention group were 3.65 (1.73), 4.77 (0.52), and 4.83 (0.52), respectively. The average score of knowledge toward oral health (SD) at baseline, 3 month, and 6 month follow up in the control group were 3.53 (1.60), 3.63 (1.36), and 3.89 (1.44), respectively. (table 18)

Table 18: Descriptive statistics of score of knowledge toward DM and oral health at baseline, 3 month, and 6 month follow up in the intervention and the control groups

Variables	Baseline (n=66)	3 month (n=65)	6 month (n=65)
<b>Overall score of knowledge toward DM and oral health</b>			
- Intervention: mean (SD)	7.15 (2.36)	9.48 (0.70)	9.58 (0.62)
- Control : mean (SD)	7.07 (2.27)	7.29 (2.23)	7.33 (2.31)
<b>Score of knowledge toward DM</b>			
- Intervention: mean (SD)	3.52 (1.09)	4.70 (0.28)	4.74 (0.23)
- Control : mean (SD)	3.59 (0.96)	3.66 (1.17)	3.44 (1.32)
<b>Score of knowledge toward oral health</b>			
- Intervention: mean (SD)	3.65 (1.73)	4.77 (0.52)	4.83 (0.52)
- Control : mean (SD)	3.53 (1.60)	3.63 (1.36)	3.89 (1.44)

#### 4.5.2 The differences of knowledge toward DM and oral health score between the intervention and the control groups at baseline, 3 month, and 6 month follow up by Repeated measure ANOVA

##### 4.5.2.1 Knowledge toward DM and oral health

There was a statistically significant difference between the intervention and the control groups ( $p < 0.001$ ). Among within subjects, there was a statistically significant difference between measurements ( $p < 0.001$ ). Interaction, there was a statistically significant difference between measurements of knowledge toward DM and oral health depending on group ( $p < 0.001$ ). (table 19 and figure 5)

Table 19: Repeated measure ANOVA of knowledge toward DM and oral health between the intervention and the control groups (n=130)

Source of variation	SS	df	MS	F-test	P-value
Between subjects					
Intervention	227.550	1	227.550	39.237	<0.001
Within group (error) (between group error)	742.324	128	5.799		
Within subjects					
Time	147.191	1.783	82.531	28.559	<0.001
Intervention x Time	92.078	1.783	51.628	17.866	<0.001
Intervention x Within group (error) (within subject error)	659.697	228.285			
Total					

SS: Sum of Squares

df: Degrees of freedom

MS: Mean Squares



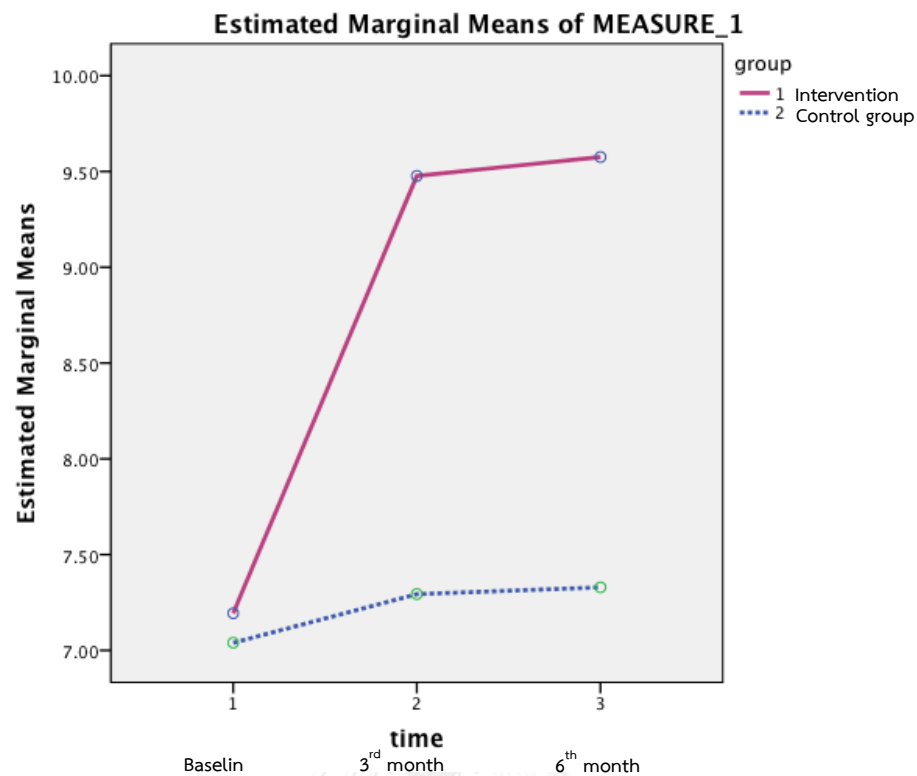


Figure 5: Change overtime on knowledge toward DM and oral health in the intervention and the control groups

There were statistically significant differences between the intervention and the control groups of knowledge toward DM and oral health at 3 and 6 month follow up ( $p < 0.001$  and  $< 0.001$ , respectively). (table 20)

Table 20: Pairwise comparisons of the different measurements of knowledge toward DM and oral health between the intervention and the control groups ( $n=130$ )

Time	Group (i)	Group (j)	Mean Differen ce (i-j)	SE	P	95% Confidence Interval <sup>b</sup>	
						Upper	Lower
Baseline	Control	Intervention	-0.154	0.406	0.705	-0.957	0.649
3 <sup>rd</sup> month	Control	Intervention	-2.183 <sup>*</sup>	0.290	<b>&lt;0.001</b>	-2.757	-1.609
6 <sup>th</sup> month	Control	Intervention	-2.246 <sup>*</sup>	0.297	<b>&lt;0.001</b>	-2.834	-1.659

Based on estimated marginal means

<sup>\*</sup>. The mean difference is significant at the 0.05 level.

<sup>b</sup>. Adjustment for multiple comparison: Bonferroni.

Knowledge toward DM and oral health, there were statistically significant differences between baseline and 3 month follow up, and baseline and 6 month follow up of the intervention group ( $p < 0.001$  and  $< 0.001$ , respectively). (table 21)



Table 21: Pairwise comparisons of the different measurements of knowledge toward DM and oral health, in the time of measurements in the intervention and the control groups (n=130)

Group	Time (i)	Time (j)	Mean Differen ce (i-j)	SE	P	95% Confidence Interval <sup>b</sup>	
						Upper	Lower

Intervention	baseline	3 <sup>rd</sup> month	-2.283	0.288	<b>&lt;0.001</b>	-2.982	-1.584
	baseline	6 <sup>th</sup> month	-2.382	0.318	<b>&lt;0.001</b>	-3.153	-1.610
	3 <sup>rd</sup> month	6 <sup>th</sup> month	-0.098	0.232	1.000	-0.661	0.464
Control	baseline	3 <sup>rd</sup> month	-0.254	0.288	1.000	-0.953	0.445
	baseline	6 <sup>th</sup> month	-0.289	0.318	1.000	-1.061	0.482
	3 <sup>rd</sup> month	6 <sup>th</sup> month	-0.035	0.232	1.000	-0.598	0.527

Based on estimated marginal means

\* . The mean difference is significant at the 0.05 level.

<sup>b</sup>. Adjustment for multiple comparison: Bonferroni.

#### 4.5.2.2 Knowledge toward DM

There was a statistically significant difference between the intervention and control groups ( $p < 0.001$ ). Among within subjects, there was a statistically significant difference between measurements ( $p < 0.001$ ). Interaction, there was a statistically significant difference between measurements of knowledge toward DM depending on group ( $p < 0.001$ ). (table 22 and figure 6)

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Table 22: Repeated measure ANOVA of knowledge toward DM between the intervention and the control groups (n=130)

Source of variation	SS	df	MS	F-test	P-value
Between subjects					
Intervention	57.462	1	57.462	45.351	<b>&lt;0.001</b>
Within group (error) (between group error)	162.183	128	1.267		



Within subjects					
Time	29.911	2	14.956	21.046	<0.001
Intervention x Time	33.440	2	16.720	23.529	<0.001
Intervention x Within group (error) (within subject error)	181.921	256	0.711		
Total					

SS: Sum of Squares

df: Degrees of freedom

MS: Mean Squares

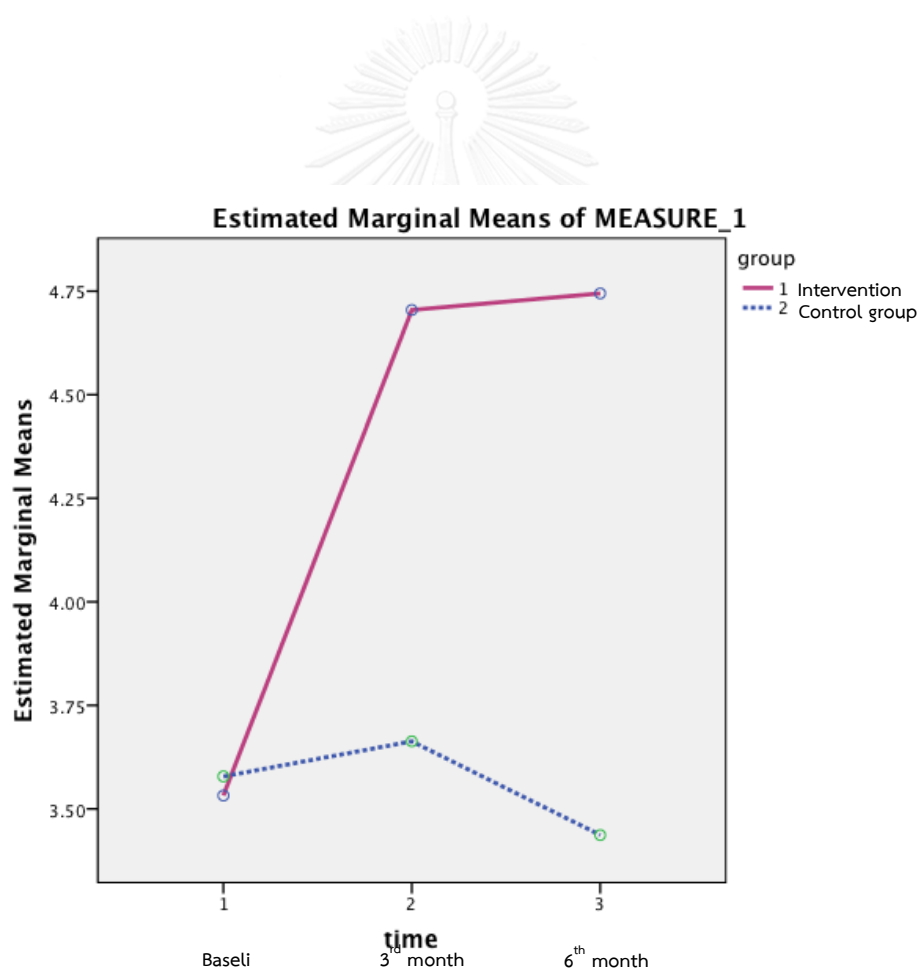


Figure 6: Change overtime on knowledge toward DM in the intervention and the control groups

There were statistically significant differences between the intervention and the

control groups of knowledge toward DM at 3 and 6 month follow up ( $p < 0.001$  and  $< 0.001$ , respectively). (table 23)

Table 23: Pairwise comparisons of the different measurements of knowledge toward DM between the intervention and the control groups (n=130)

Time	Group (i)	Group (j)	Mean Difference (i-j)	SE	P	95% Confidence Interval <sup>b</sup>	
						Upper	Lower
Baseline	Control	Intervention	0.046	0.181	0.799	-0.312	0.404
3 <sup>rd</sup> month	Control	Intervention	-1.042 <sup>*</sup>	0.149	<b>&lt;0.001</b>	-1.336	-0.747
6 <sup>th</sup> month	Control	Intervention	-1.308 <sup>*</sup>	0.167	<b>&lt;0.001</b>	-1.638	-0.978

Based on estimated marginal means

<sup>\*</sup>. The mean difference is significant at the 0.05 level.

<sup>b</sup>. Adjustment for multiple comparison: Bonferroni.

Knowledge toward DM, there were statistically significant differences between baseline and 3 month follow up, and baseline and 6 month follow up of the intervention group ( $p < 0.001$  and  $< 0.001$ , respectively). (table 24)

Table 24: Pairwise comparisons of the different measurements of knowledge toward DM, in the time of measurements of the intervention and the control groups (n=130)

Group	Time (i)	Time (j)	Mean Differenc e (i-j)	SE	P	95% Confidence Interval <sup>b</sup>	
						Upper	Lower
Intervention	baseline	3 <sup>rd</sup> month	-1.171	0.144	<0.001	-1.521	-0.824
	baseline	6 <sup>th</sup> month	-1.212	0.161	<0.001	-1.602	-0.823
	3 <sup>rd</sup> month	6 <sup>th</sup> month	-0.040	0.138	1.000	-0.376	0.296
Control	baseline	3 <sup>rd</sup> month	-0.085	0.144	1.000	-0.433	0.264
	baseline	6 <sup>th</sup> month	0.142	0.161	1.000	-0.248	0.531
	3 <sup>rd</sup> month	6 <sup>th</sup> month	0.226	0.138	0.315	-0.110	0.562

Based on estimated marginal means

\* . The mean difference is significant at the 0.05 level.

<sup>b</sup> . Adjustment for multiple comparison: Bonferroni.

#### 4.5.2.3 Knowledge toward oral health

There was a statistically significant difference between the intervention and control groups ( $p < 0.001$ ). Among within subjects, there was a statistically significant difference between measurements ( $p < 0.001$ ). Interaction, there was a statistically

significant difference between measurements of knowledge toward oral health depending on group ( $p=0.002$ ). (table 25 and figure 7)

Table 25: Repeated measure ANOVA of knowledge toward oral health between the intervention and the control groups ( $n=130$ )

Source of variation	SS	df	MS	F-test	P-value
Between subjects					
Intervention	54.656	1	54.656	20.679	<0.001
Within group (error) (between group error)	338.318	128	2.643		
Within subjects					
Time	42.774	1.707	25.059	17.998	<0.001
Intervention x Time	17.021	1.707	9.971	7.162	0.002
Intervention x Within group (error) (within subject error)	304.205	218.487	1.392		
Total					

SS: Sum of Squares

df: Degrees of freedom

MS: Mean Squares

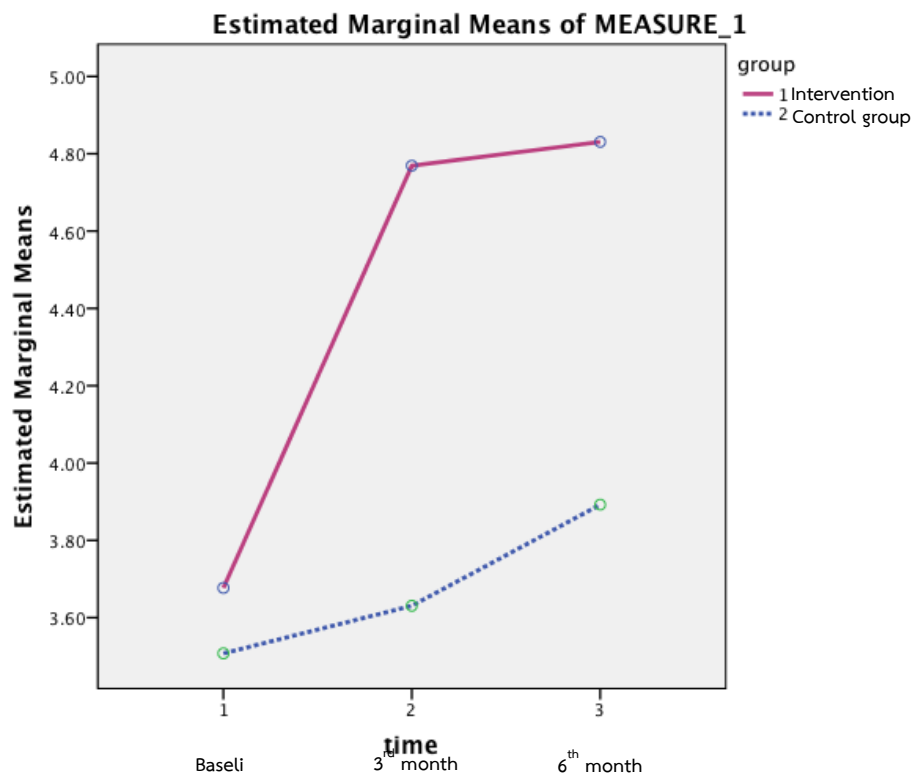


Figure 7: Change overtime on knowledge toward oral health in the intervention and the control groups

There were statistically significant differences between the intervention and the control groups of knowledge toward oral health at 3 and 6 month follow up ( $p < 0.001$  and  $< 0.001$ , respectively). (table 26)

Table 26: Pairwise comparisons of the different measurements of knowledge toward oral health between the intervention and the control groups (n=130)

Time	Group (i)	Group (j)	Mean Difference (i-j)	SE	P	95% Confidence Interval <sup>b</sup>	
						Upper	Lower
Baseline	Control	Intervention	-0.169	0.293	0.564	-0.748	0.410
3 <sup>rd</sup> month	Control	Intervention	-1.138*	0.181	<b>&lt;0.001</b>	-1.497	-0.780
6 <sup>th</sup> month	Control	Intervention	-0.938*	0.189	<b>&lt;0.001</b>	-1.313	-0.564

Based on estimated marginal means

\*. The mean difference is significant at the 0.05 level.

<sup>b</sup>. Adjustment for multiple comparison: Bonferroni.

Knowledge toward oral health, there were statistically significant differences between baseline and 3 month follow up, and baseline and 6 month follow up of the intervention group ( $p < 0.001$  and  $< 0.001$ , respectively). (table 27)

Table 27: Pairwise comparisons of the different measurements of knowledge toward oral health, in the time of measurements of the intervention and the control groups (n=130)

Group	Time (i)	Time (j)	Mean Differenc e (i-j)	SE	P	95% Confidence Interval <sup>b</sup>	
						Upper	Lower
Intervention	baseline	3 <sup>rd</sup> month	-1.092	0.199	<0.001	-1.576	-0.609
	baseline	6 <sup>th</sup> month	-1.154	0.219	<0.001	-1.684	-0.623
	3 <sup>rd</sup> month	6 <sup>th</sup> month	-0.062	0.149	1.000	-0.423	0.300
Control	baseline	3 <sup>rd</sup> month	-0.123	0.199	1.000	-0.607	0.360
	baseline	6 <sup>th</sup> month	-0.385	0.219	0.243	-0.915	0.146
	3 <sup>rd</sup> month	6 <sup>th</sup> month	-0.262	0.149	0.244	-0.623	0.100

Based on estimated marginal means

\* . The mean difference is significant at the 0.05 level.

<sup>b</sup> . Adjustment for multiple comparison: Bonferroni.

#### 4.5.3 Distribution of knowledge toward DM and oral health at 3 month follow up between the intervention and the control groups

##### Distribution of knowledge toward DM at 3 month follow up

Of the 130 diabetic patients (65 diabetic patients per each groups), most of the participants in both intervention group (90.8%) and more than half of the participants in the control group (73.8%) answered high blood sugar was the best characterizes of DM. There was a statistically significant differences of the best characterizes of DM between the intervention and the control groups ( $p=0.034$ ). There were statistically significant differences of the common symptoms of DM included weight gain or loss, frequent hunger, frequent thirst, and numbness between the intervention and the control groups ( $p=0.028$ ,  $0.001$ , and  $0.002$ ,

respectively). Common complications of DM, there were statistically significant differences of heart disease, kidney disease, eye disease, stroke, foot problems, and gum disease between the intervention and the control groups ( $p < 0.001$ ,  $< 0.001$ ,  $< 0.001$ ,  $< 0.001$ ,  $< 0.001$ , and  $< 0.001$ , respectively). Treatment of DM, drug, insulin, healthy diet, regular exercise, weight control, and quit smoking were statistically significant differences between the intervention and the control groups ( $p = 0.042$ ,  $0.031$ ,  $0.004$ ,  $< 0.001$ ,  $< 0.001$ , and  $< 0.001$ , respectively). Every participant (100.0%) in the intervention and 90.8% of the control groups answered the complications of DM can be prevented by routine investigation with a statistically significant difference ( $p = 0.043$ ). Testing blood sugar, monitoring blood pressure, eye examination, foot examination, oral examination, and tested body weight had statistically significant differences between the intervention and the control groups ( $p = 0.012$ ,  $< 0.001$ ,  $0.001$ ,  $< 0.001$ ,  $< 0.001$ , and  $0.004$ , respectively). (table 28)

#### **Distribution of knowledge toward oral health at 3 month follow up**

Among 130 diabetic patients (65 diabetic patients per each groups), 92.3% of the intervention and 72.3% of the control groups answered diabetic patients are more likely to have infection in their mouths. 96.9% of the intervention and 67.7% of the control groups answered diabetic patients are more likely to have gum disease. 96.9% of the intervention and 72.3% of the control groups answered diabetes can make teeth and gum worse. 93.8% of the intervention and 69.2% of the control groups answered bleeding gums when brushing teeth is an early sign of gum disease.



96.9% of the intervention and 81.5% of the control groups answered gum disease can lead to loss of teeth. (table 29)

Of the 130 diabetic patients (65 diabetic patients per each groups), “Diabetic patients are more likely to have infection in their mouths.”, “Diabetic patients are more likely to have gum disease.”, “Diabetes can make teeth and gum worse.”, “Bleeding gums when brushing teeth is an early sign of gum disease.”, and “Gum disease can lead to loss of teeth.” had statistically significant differences between the intervention and the control groups ( $p=0.007$ ,  $<0.001$ ,  $<0.001$ ,  $0.001$ , and  $0.013$ , respectively). (table 29)

Table 28: Distribution of knowledge toward DM and oral health at 3 month follow up in the intervention and the control groups (n=130)

Variables	Intervention group (n=65) (%)	Control group (n=65) (%)	Test of group differences
<b>Best characterizes of disease condition</b>			
High blood sugar	59 (90.8)	48 (73.8)	$\chi^2 = 8.664$ , $p = 0.034$
Low blood sugar	2 (3.1)	1 (1.5)	
High urine sugar	2 (3.1)	8 (12.3)	
Don't know	2 (3.1)	8 (12.3)	
<b>Common symptoms of DM</b>			
<b>Weight gain/loss</b>			
Yes	57 (87.7)	47 (72.3)	$\chi^2 = 4.808$ , $p = 0.028$
No	8 (12.3)	18 (27.7)	

Variables	Interventi on group (n=65) (%)	Control group (n=65) (%)	Test of group differences
<b>Frequent urination</b>			
Yes	59 (90.8)	54 (83.1)	$\chi^2 = 1.692,$
No	6 (9.2)	11 (16.9)	$p = 0.193$
<b>Frequent hunger</b>			
Yes	59 (90.8)	43 (66.2)	$\chi^2 = 11.653,$
No	6 (9.2)	22 (33.8)	$p = 0.001$
<b>Frequent thirst</b>			
Yes	58 (89.2)	50 (76.9)	$\chi^2 = 3.502,$
No	7 (10.8)	15 (23.1)	$p = 0.061$
<b>Numbness</b>			
Yes	61 (93.8)	48 (73.8)	$\chi^2 = 9.598,$
No	4 (6.2)	17 (26.2)	$p = 0.002$
<b>Asymptomatic</b>			
Yes	0 (0.0)	1 (1.5)	$\chi^2 = 1.008,$
No	65 (100.0)	64 (98.5)	$p = 0.315$
<b>Don't know any symptom</b>			
Know none of the symptom	0 (0.0)	1 (1.5)	$\chi^2 = 1.008,$
Know at least one	65 (100.0)	64 (98.5)	$p = 0.315$
<b>Common complications of DM</b>			
<b>Heart disease</b>			
Yes	58 (89.2)	37 (56.9)	$\chi^2 = 17.242,$
No	7 (10.8)	28 (43.1)	$p < 0.001$
<b>Kidney disease</b>			
Yes	62 (95.4)	42 (64.6)	$\chi^2 = 19.231,$
No	3 (4.6)	23 (35.4)	$p < 0.001$

Variables	Interventi on group (n=65) (%)	Control group (n=65) (%)	Test of group differences
<b>Eye disease</b>			
Yes	65 (100.0)	48 (73.8)	$\chi^2=19.558,$
No	0 (0.0)	17 (26.2)	$p < 0.001$
<b>Stroke</b>			
Yes	54 (83.1)	31 (47.7)	$\chi^2=17.979,$
No	11 (16.9)	34 (52.3)	$p < 0.001$
<b>Foot problems</b>			
Yes	65 (100.0)	53 (81.5)	$\chi^2=13.220,$
No	0 (0.0)	12 (18.5)	$p < 0.001$
<b>Gum disease</b>			
Yes	64 (98.5)	34 (52.3)	$\chi^2=37.309,$
No	1 (1.5)	31 (47.7)	$p < 0.001$
<b>Don't know any complication</b>			
Know none of the complication	1 (1.5)	5 (7.7)	$\chi^2 = 2.796,$
Know at least one	64 (98.5)	60 (92.3)	$p = 0.095$
<b>Treatments of DM</b>			
<b>Drugs</b>			
Yes	65 (100.0)	61 (93.8)	$\chi^2 = 4.127,$
No	0 (0.0)	4 (6.2)	$p = 0.042$
<b>Insulin</b>			
Yes	46 (70.8)	34 (52.3)	$\chi^2 = 4.680,$
No	19 (29.2)	31 (47.7)	$p = 0.031$
<b>Healthy diet</b>			
Yes	65 (100.0)	57 (87.7)	$\chi^2 = 8.525,$
No	0 (0.0)	8 (12.3)	$p = 0.004$

Variables	Interventi on group (n=65) (%)	Control group (n=65) (%)	Test of group differences
<b>Regular exercise</b>			
Yes	65 (100.0)	53 (81.5)	$\chi^2 = 13.220,$
No	0 (0.0)	12 (18.5)	$p < 0.001$
<b>Weight control</b>			
Yes	64 (98.5)	50 (76.9)	$\chi^2 = 13.969,$
No	1 (1.5)	15 (23.1)	$p < 0.001$
<b>Quit smoking</b>			
Yes	51 (78.5)	31 (47.7)	$\chi^2 = 13.211,$
No	14 (21.5)	34 (52.3)	$p < 0.001$
<b>Don't know any treatment</b>			
Know none of the treatment	0 (0.0)	1 (1.5)	$\chi^2 = 1.008,$
Know at least one	65 (100.0)	64 (98.5)	$p = 0.315$
<b>Complications of DM can be prevented by routine investigation</b>			
Yes	65 (100.0)	59 (90.8)	$\chi^2 = 6.290,$
No	0 (0.0)	1 (1.5)	$p = 0.043$
Don't know	0 (0.0)	5 (7.7)	
<b>Which investigation should be done?</b>			
<b>Blood sugar</b>			
Yes	65 (100.0)	59 (90.8)	$\chi^2 = 6.290,$
No	0 (0.0)	6 (9.2)	$p = 0.012$
<b>Monitoring BP</b>			
Yes	65 (100.0)	53 (81.5)	$\chi^2 = 13.220,$
No	0 (0.0)	12 (18.5)	$p < 0.001$
<b>Eye examination</b>			
Yes	65 (100.0)	54 (83.1)	$\chi^2 = 12.017,$
No	0 (0.0)	11 (16.9)	$p = 0.001$

Variables	Interventi on group (n=65) (%)	Control group (n=65) (%)	Test of group differences
<b>Foot examination</b>			
Yes	65 (100.0)	52 (80.0)	$\chi^2=14.444,$ $p < 0.001$
No	0 (0.0)	13 (20.0)	
<b>Oral examination</b>			
Yes	64 (98.5)	42 (64.6)	$\chi^2=24.733,$ $p < 0.001$
No	1 (1.5)	23 (35.4)	
<b>Tested body weight</b>			
Yes	65 (100.0)	57 (87.7)	$\chi^2 = 8.525,$ $p = 0.004$
No	0 (0.0)	8 (12.3)	
<b>Don't know any investigation</b>			
Know none of the investigation	0 (0.0)	0 (0.0)	-
Know at least one	65 (100.0)	65 (100.0)	

Table 29: Distribution of knowledge toward oral health at 3 month follow up in the intervention and the control groups (n=130)

Variables	Interventi on group (n=65) (%)	Control group (n=65) (%)	Test of group differences
<b>Diabetic patients are more likely to have infection in their mouths.</b>			
Yes	60 (92.3)	47 (72.3)	$\chi^2 = 9.843,$ $p = 0.007$
No	0 (0.0)	4 (6.2)	
Don't know	5 (7.7)	14 (21.5)	

Variables	Interventi on group (n=65) (%)	Control group (n=65) (%)	Test of group differences
<b>Diabetic patients are more likely to have gum disease.</b>			
Yes	63 (96.9)	44 (67.7)	$\chi^2=19.517,$ $p < 0.001$
No	0 (0.0)	9 (13.8)	
Don't know	2 (3.1)	12 (18.5)	
<b>Diabetes can make teeth and gum worse.</b>			
Yes	63 (96.9)	47 (72.3)	$\chi^2=15.394,$ $p < 0.001$
No	0 (0.0)	5 (7.7)	
Don't know	2 (3.1)	13 (20.0)	
<b>Bleeding gums when brushing teeth is an early sign of gum disease.</b>			
Yes	61 (93.8)	45 (69.2)	$\chi^2=13.548,$ $p = 0.001$
No	1 (1.5)	10 (15.4)	
Don't know	3 (4.6)	10 (15.4)	
<b>Gum disease can lead to loss of teeth.</b>			
Yes	63 (96.9)	53 (81.5)	$\chi^2 = 8.640,$ $p = 0.013$
No	0 (0.0)	5 (7.7)	
Don't know	2 (3.1)	7 (10.8)	

#### 4.5.4 Distribution of knowledge toward DM and oral health at 6 month follow up between the intervention and the control groups

##### Distribution of knowledge toward DM at 6 month follow up

Of the 130 diabetic patients (65 diabetic patients per each groups), most of the participants in the intervention group (95.4%) and more than half of the

participants in the control group (76.9%) answered high blood sugar was the best characterizes of DM. There was a statistically significant differences of the best characterizes of DM between the intervention and the control groups ( $p=0.009$ ). There were statistically significant differences of the common symptoms DM included weight gain or loss, frequent urination, frequent hunger, frequent thirst, and numbness between the intervention and the control groups ( $p=0.003$ ,  $0.001$ ,  $0.005$ ,  $0.007$  and  $<0.002$ , respectively). Common complications of DM, there were statistically significant differences of heart disease, kidney disease, eye disease, stroke, foot problems, gum disease, and do not know between the intervention and the control groups ( $p=0.001$ ,  $<0.001$ ,  $<0.001$ ,  $<0.001$ ,  $<0.001$ ,  $<0.001$ , and  $0.007$ , respectively). Treatment of DM, drug, insulin, healthy diet, regular exercise, weight control, and quit smoking were statistically significant differences between the intervention and the control groups ( $p=0.023$ ,  $0.043$ ,  $<0.001$ ,  $<0.001$ ,  $<0.001$ , and  $<0.001$ , respectively). Every participant (100.0%) in the intervention and 96.9% of the control groups answered “the complications of DM can be prevented by routine investigation” with no statistically significant difference ( $p=0.362$ ). Monitoring blood pressure, eye examination, foot examination, oral examination, and tested body weight had statistically significant differences between the intervention and the control groups ( $p<0.001$ ,  $0.001$ ,  $<0.001$ ,  $<0.001$ , and  $<0.001$ , respectively). (table 30)

### Distribution of knowledge toward oral health at 6 month follow up

Among 130 diabetic patients (65 diabetic patients per each groups), 93.8% of the intervention and 72.3% of the control groups answered diabetic patients are more likely to have infection in their mouths. 98.5% of the intervention and 72.3% of the control groups answered diabetic patients are more likely to have gum disease. 96.9% of the intervention and 78.5% of the control groups answered diabetes can make teeth and gum worse. 96.9% of the intervention and 80.0% of the control groups answered bleeding gums when brushing teeth is an early sign of gum disease. 96.9% of the intervention and 86.2% of the control groups answered gum disease can lead to loss of teeth. (table 31)

Of the 130 diabetic patients (65 diabetic patients per each groups), “Diabetic patients are more likely to have infection in their mouths.”, “Diabetic patients are more likely to have gum disease.”, “Diabetes can make teeth and gum worse.”, and “Bleeding gums when brushing teeth is an early sign of gum disease.” had statistically significant differences between the intervention and the control groups ( $p=0.004$ ,  $<0.001$ , and  $0.006$ ,  $0.010$ , respectively). (table 31)



Table 30: Distribution of knowledge toward DM at 6 month follow up between the intervention and the control groups (n=130)

Variables	Intervention group (n=65) (%)	Control group (n=65) (%)	Test of group differences
<b>Best characterizes of disease condition</b>			
High blood sugar	62 (95.4)	50 (76.9)	$\chi^2 = 9.316,$ $p = 0.009$
Low blood sugar	0 (0.0)	0 (0.0)	
High urine sugar	2 (3.1)	11 (16.9)	
Don't know	1 (1.5)	4 (6.2)	
<b>Common symptoms of DM</b>			
<b>Weight gain/loss</b>			
Yes	61 (93.8)	53 (81.5)	$\chi^2 = 4.561,$ $p = 0.033$
No	4 (6.2)	12 (18.5)	
<b>Frequent urination</b>			
Yes	62 (95.4)	48 (73.8)	$\chi^2 = 11.582,$ $p = 0.001$
No	3 (4.6)	17 (26.2)	
<b>Frequent hunger</b>			
Yes	55 (84.6)	41 (63.1)	$\chi^2 = 7.806,$ $p = 0.005$
No	10 (15.4)	24 (36.9)	
<b>Frequent thirst</b>			
Yes	59 (90.8)	47 (72.3)	$\chi^2 = 7.358,$ $p = 0.007$
No	6 (9.2)	18 (27.7)	
<b>Numbness</b>			
Yes	59 (90.8)	40 (61.5)	$\chi^2 = 15.292,$ $p < 0.001$
No	6 (9.2)	25 (38.5)	
<b>Asymptomatic</b>			
Yes	0 (0.0)	1 (1.5)	$\chi^2 = 1.008,$ $p = 0.315$
No	65 (100.0)	64 (98.5)	

Variables	Interventi on group (n=65) (%)	Control group (n=65) (%)	Test of group differences
<b>Don't know any symptom</b>			
Know none of the symptom	1 (1.5)	0 (0.0)	$\chi^2 = 1.008,$
Know at least one	64 (98.5)	65 (100.0)	$p = 0.315$
<b>Common complications of DM</b>			
<b>Heart disease</b>			
Yes	58 (89.2)	42 (64.6)	$\chi^2 = 11.093,$
No	7 (10.8)	23 (35.4)	$p = 0.001$
<b>Kidney disease</b>			
Yes	63 (96.9)	41 (63.1)	$\chi^2 = 23.269,$
No	2 (3.1)	24 (36.9)	$p < 0.001$
<b>Eye disease</b>			
Yes	65 (100.0)	46 (70.8)	$\chi^2 = 22.252,$
No	0 (0.0)	19 (29.2)	$p < 0.001$
<b>Stroke</b>			
Yes	58 (89.2)	29 (44.6)	$\chi^2 = 29.225,$
No	7 (10.8)	36 (55.4)	$p < 0.001$
<b>Foot problems</b>			
Yes	64 (98.5)	42 (64.6)	$\chi^2 = 24.733,$
No	1 (1.5)	23 (35.4)	$p < 0.001$
<b>Gum disease</b>			
Yes	65 (100.0)	28 (43.1)	$\chi^2 = 51.720,$
No	0 (0.0)	37 (55.9)	$p < 0.001$
<b>Don't know any complication</b>			
Know none of the complication	0 (0.0)	7 (10.8)	$\chi^2 = 7.398,$
Know at least one	65 (100.0)	58 (89.2)	$p = 0.007$

Variables	Interventi on group (n=65) (%)	Control group (n=65) (%)	Test of group differences
<b>Treatments of DM</b>			
<b>Drugs</b>			
Yes	65 (100.0)	60 (92.3)	$\chi^2 = 5.200,$
No	0 (0.0)	5 (7.7)	$p = 0.023$
<b>Insulin</b>			
Yes	48 (73.8)	37 (56.9)	$\chi^2 = 4.112,$
No	17 (26.2)	28 (43.1)	$p = 0.043$
<b>Healthy diet</b>			
Yes	65 (100.0)	48 (73.8)	$\chi^2 = 19.558,$
No	0 (0.0)	17 (26.2)	$p < 0.001$
<b>Regular exercise</b>			
Yes	65 (100.0)	45 (69.2)	$\chi^2 = 23.636,$
No	0 (0.0)	20 (30.8)	$p < 0.001$
<b>Weight control</b>			
Yes	65 (100.0)	46 (70.8)	$\chi^2 = 22.252,$
No	0 (0.0)	19 (29.2)	$p < 0.001$
<b>Quit smoking</b>			
Yes	48 (73.8)	22 (33.8)	$\chi^2 = 20.924,$
No	17 (26.2)	43 (66.2)	$p < 0.001$
<b>Don't know any treatment</b>			
Know none of the treatment	65 (100.0)	65 (100.0)	-
Know at least one	0 (0.0)	0 (0.0)	
<b>Complications of DM can be prevented by routine investigation</b>			
Yes	65 (100.0)	63 (96.9)	$\chi^2 = 2.031,$
No	0 (0.0)	1 (1.5)	$p = 0.362$
Don't know	0 (0.0)	1 (1.5)	

Variables	Interventi on group (n=65) (%)	Control group (n=65) (%)	Test of group differences
<b>Which investigation should be done?</b>			
<b>Blood sugar</b>			
Yes	64 (98.5)	59 (90.8)	$\chi^2 = 3.775,$
No	1 (1.5)	6 (9.2)	$p = 0.052$
<b>Monitoring BP</b>			
Yes	64 (98.5)	48 (73.8)	$\chi^2 = 16.508,$
No	1 (1.5)	17 (26.2)	$p < 0.001$
<b>Eye examination</b>			
Yes	65 (100.0)	49 (75.4)	$\chi^2 = 18.246,$
No	0 (0.0)	16 (24.6)	$p < 0.001$
<b>Foot examination</b>			
Yes	65 (100.0)	46 (70.8)	$\chi^2 = 22.252,$
No	0 (0.0)	19 (29.2)	$p < 0.001$
<b>Oral examination</b>			
Yes	64 (98.5)	39 (60.0)	$\chi^2 = 29.216,$
No	1 (1.5)	26 (40.0)	$p < 0.001$
<b>Tested body weight</b>			
Yes	65 (100.0)	46 (70.8)	$\chi^2 = 22.252,$
No	0 (0.0)	19 (29.2)	$p < 0.001$
<b>Don't know any investigation</b>			
Know none of the investigation	1 (1.5)	0 (0.0)	$\chi^2 = 1.008,$
Know at least one	64 (98.5)	65 (100.0)	$p = 0.315$

Table 31: Distribution of knowledge toward oral health at 6 month follow up between the intervention and the control groups (n=130)

Variables	Intervention group (n=65) (%)	Control group (n=65) (%)	Test of group differences
<b>Diabetic patients are more likely to have infection in their mouths.</b>			
Yes	61 (93.8)	47 (72.3)	$\chi^2 = 1.008,$ $p = 0.004$
No	1 (1.5)	7 (10.8)	
Don't know	3 (4.6)	11 (16.9)	
<b>Diabetic patients are more likely to have gum disease.</b>			
Yes	64 (98.5)	47 (72.3)	$\chi^2 = 17.934,$ $p < 0.001$
No	1 (1.5)	11 (16.9)	
Don't know	0 (0.0)	7 (10.8)	
<b>Diabetes can make teeth and gum worse.</b>			
Yes	63 (96.9)	51 (78.5)	$\chi^2 = 10.263,$ $p = 0.006$
No	1 (1.5)	7 (10.8)	
Don't know	1 (1.5)	7 (10.8)	
<b>Bleeding gums when brushing teeth is an early sign of gum disease.</b>			
Yes	63 (96.9)	52 (80.0)	$\chi^2 = 9.252,$ $p = 0.010$
No	1 (1.5)	4 (6.2)	
Don't know	1 (1.5)	9 (13.8)	
<b>Gum disease can lead to loss of teeth.</b>			
Yes	63 (96.9)	56 (86.2)	$\chi^2 = 4.983,$ $p = 0.083$
No	1 (1.5)	3 (4.6)	
Don't know	1 (1.5)	6 (9.2)	

#### **4.6 Attitude toward DM and oral health at baseline, 3 month, and 6 month follow up**

##### **4.6.1 Score of attitude toward DM and oral health at baseline, 3 month, and 6 month follow up**

###### **4.6.1.1 Overall score of attitude toward DM and oral health**

The average overall score of attitude toward DM and oral health (SD) at baseline, 3 month, and 6 month follow up in the intervention group were 43.73 (4.39), 47.82 (3.41), and 47.72 (3.879), respectively. The average overall score of attitude toward DM and oral health (SD) at baseline, 3 month, and 6 month follow up in the control group were 41.86 (6.54), 41.45 (5.27), and 41.08 (5.39), respectively. (table 32)

###### **4.6.1.2 Score of attitude toward DM**

The average score of attitude toward DM (SD) at baseline, 3 month, and 6 month follow up in the intervention group were 22.29 (2.33), 23.92 (1.81), and 23.82 (1.84), respectively. The average score of attitude toward DM (SD) at baseline, 3 month, and 6 month follow up in the control group were 21.79 (2.58), 20.86 (2.62), and 20.34 (2.46), respectively. (table 32)

###### **4.6.1.3 Score of attitude toward oral health**

The average score of attitude toward oral health (SD) at baseline, 3 month, and 6 month follow up in the intervention group were 21.47 (2.98), 23.85 (1.81), and 23.91 (2.26), respectively. The average score of attitude toward oral health (SD) at

baseline, 3 month, and 6 month follow up in the control group were 20.79 (3.12), 20.58 (3.18), and 20.74 (3.51), respectively. (table 32)

*Table 32: Descriptive statistics of score of attitude toward DM and oral health at baseline, 3 month, and 6 month follow up in the intervention and the control groups (n=130)*

Variables	Baseline (n=66)	3 month (n=65)	6 month (n=65)
<b>Overall score of attitude toward DM and oral health</b>			
- Intervention: mean (SD)	43.73 (4.39)	47.82 (3.41)	47.72 (3.879)
- Control : mean (SD)	41.86 (6.54)	41.45 (5.27)	41.08 (5.39)
<b>Score of attitude toward DM</b>			
- Intervention: mean (SD)	22.29 (2.33)	23.92 (1.81)	23.82 (1.84)
- Control : mean (SD)	21.79 (2.58)	20.86 (2.62)	20.34 (2.46)
<b>Score of attitude toward oral health</b>			
- Intervention: mean (SD)	21.47 (2.98)	23.85 (1.81)	23.91 (2.26)
- Control : mean (SD)	20.79 (3.12)	20.58 (3.18)	20.74(3.51)

#### 4.6.2 The differences of attitude toward DM and oral health score between the intervention and control groups at baseline, 3 month, and 6 month follow up by Repeated measure ANOVA

##### 4.6.2.1 Attitude toward DM and oral health

There was a statistically significant difference between the intervention and control groups ( $p < 0.001$ ). Among within subjects, there was a statistically significant difference between measurements ( $p = 0.002$ ). Interaction, there was a statistically significant difference between measurements of attitude toward DM and oral health depending on group ( $p < 0.001$ ). (table 33 and figure 8)

Table 33: Repeated measure ANOVA of attitude toward DM and oral health between the intervention and the control groups (n=130)

Source of variation	SS	df	MS	F-test	P-value
Between subjects					
Intervention	2427.510	1	2427.510	74.089	<0.001
Within group (error) (between group error)	4193.887	128	32.765		
Within subjects					
Time	265.390	1.841	144.142	6.578	0.002
Intervention x Time	450.559	1.841	244.714	11.168	<0.001
Intervention x Within group (error) (within subject error)	5164.051	235.669	21.912		
Total					

SS: Sum of Squares

df: Degrees of freedom

MS: Mean Squares



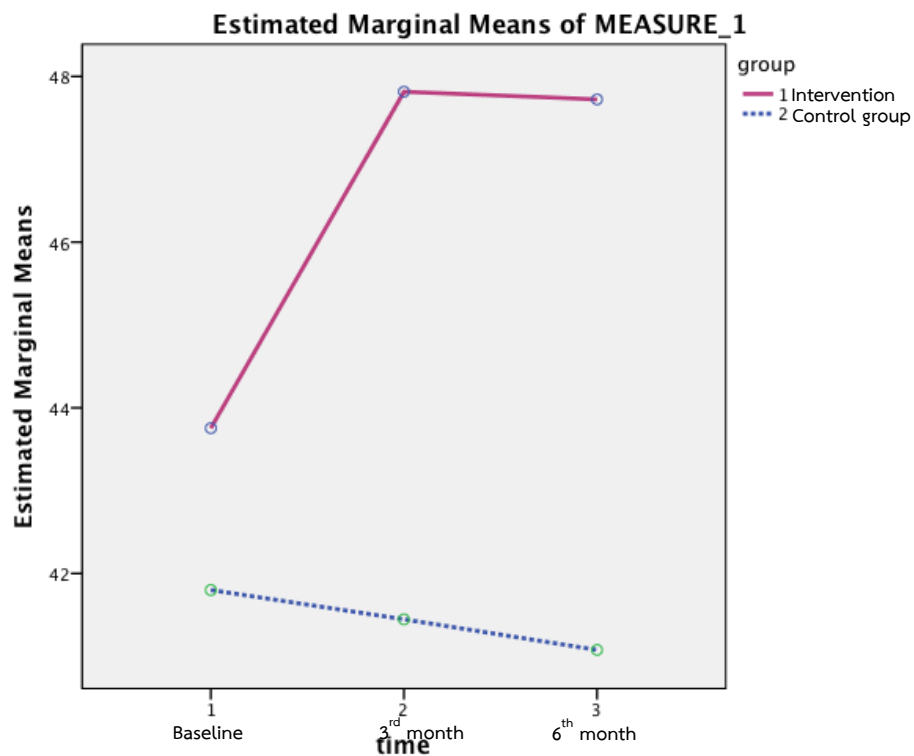


Figure 8: Change overtime on attitude toward DM and oral health in the intervention and the control groups

There were statistically significant differences between the intervention and the control groups of attitude toward DM and oral health at 3 and 6 month follow up ( $p < 0.001$  and  $< 0.001$ , respectively). (table 34)

Table 34: Pairwise comparisons of the different measurements of attitude toward DM and oral health between the intervention and the control groups (n=130)

Time	Group (i)	Group (j)	Mean Difference (i-j)	SE	P	95% Confidence Interval <sup>b</sup>	
						Upper	Lower
Baseline	Control	Intervention	-1.954	0.982	0.050	-3.897	-0.011
3 <sup>rd</sup> month	Control	Intervention	-6.369*	0.779	<0.001	-7.910	-4.828
6 <sup>th</sup> month	Control	Intervention	-6.646*	0.824	<0.001	-8.276	-5.016

Based on estimated marginal means

\*. The mean difference is significant at the 0.05 level.

<sup>b</sup>. Adjustment for multiple comparison: Bonferroni.

Attitude toward DM and oral health, there were statistically significant differences between baseline and 3 month follow up, and baseline and 6 month follow up of the intervention group ( $p < 0.001$  and  $< 0.001$ , respectively). (table 35)



Table 35: Pairwise comparisons of the different measurements of attitude toward DM and oral health, in the time of measurements of the intervention and the control groups ( $n=130$ )

Group	Time (i)	Time (j)	Mean Differenc	SE	P	95% Confidence Interval <sup>b</sup>	

			e (i-j)			Upper	Lower
Intervention	baseline	3 <sup>rd</sup> month	-4.062	0.751	<0.001	-5.885	-2.239
	baseline	6 <sup>th</sup> month	-0.396	0.894	<0.001	-6.138	-1.801
	3 <sup>rd</sup> month	6 <sup>th</sup> month	0.092	0.706	1.000	-1.620	1.805
Control	baseline	3 <sup>rd</sup> month	0.354	0.751	1.000	-1.469	2.177
	baseline	6 <sup>th</sup> month	0.723	0.894	1.000	-1.445	2.891
	3 <sup>rd</sup> month	6 <sup>th</sup> month	0.369	0.706	1.000	-1.343	2.082

Based on estimated marginal means

\* . The mean difference is significant at the 0.05 level.

<sup>b</sup> . Adjustment for multiple comparison: Bonferroni.

#### 4.6.2.2 Attitude toward DM

There was a statistically significant difference between the intervention and control groups ( $p < 0.001$ ). Among within subjects, there was no statistically significant difference between measurements ( $p = 0.268$ ). Interaction, there was a statistically significant difference between measurements of attitude toward DM depending on group ( $p < 0.001$ ). (table 36 and figure 9)

Table 36: Repeated measure ANOVA of attitude toward DM between the intervention and the control groups ( $n = 130$ )

Source of variation	SS	df	MS	F-test	P-value
Between subjects					
Intervention	537.856	1	537.856	76.418	<0.001

Within group (error)	900.913	128	7.038		
(between group error)					
Within subjects					
Time	11.554	2	5.777	1.322	0.268
Intervention x Time	168.036	2	84.018	19.231	<b>&lt;0.001</b>
Intervention x Within group	1118.410	256	4.369		
(error) (within subject error)					
Total					

SS: Sum of Squares

df: Degrees of freedom

MS: Mean Squares

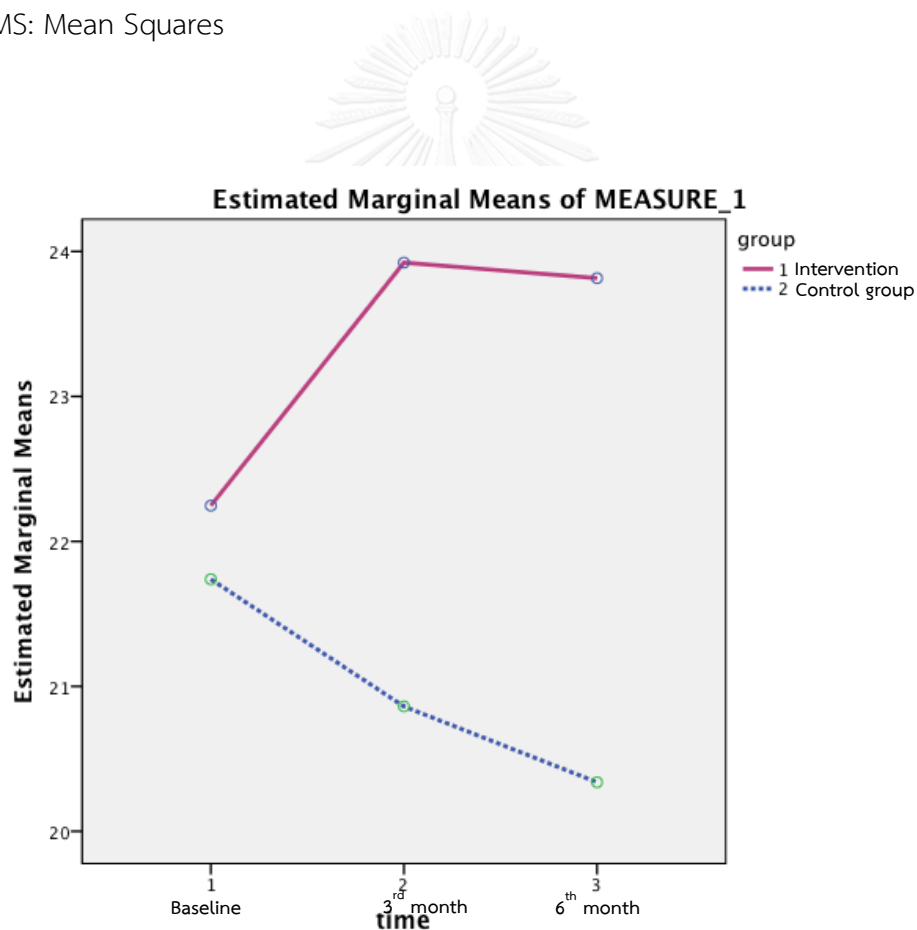


Figure 9: Change overtime on attitude toward DM in the intervention and the control groups

There were statistically significant differences between the intervention and the

control groups of attitude toward DM at 3 and 6 month follow up ( $p < 0.001$  and  $< 0.001$ , respectively). (table 37)

Table 37: Pairwise comparisons of the different measurements of attitude toward DM between the intervention and the control groups (n=130)

Time	Group (i)	Group (j)	Mean Difference (i-j)	SE	P	95% Confidence Interval <sup>b</sup>	
						Upper	Lower
Baseline	Control	Intervention	-0.508	0.429	0.239	-1.357	0.342
3 <sup>rd</sup> month	Control	Intervention	-3.062 <sup>*</sup>	0.395	<b>&lt;0.001</b>	-3.844	-2.279
6 <sup>th</sup> month	Control	Intervention	-3.477 <sup>*</sup>	0.381	<b>&lt;0.001</b>	-4.230	-2.724

Based on estimated marginal means

<sup>\*</sup>. The mean difference is significant at the 0.05 level.

<sup>b</sup>. Adjustment for multiple comparison: Bonferroni.

Attitude toward DM, there were statistically significant differences between baseline and 3 month follow up, and baseline and 6 month follow up of the intervention group ( $p < 0.001$  and  $< 0.001$ , respectively). In the control group, there were statistically significant differences between baseline and 3 month follow up, and baseline and 6 month follow up ( $p = 0.033$  and  $0.001$ , respectively). (table 38)

Table 38: Pairwise comparisons of the different measurements of attitude toward DM, in the time of measurements of the intervention and the control groups (n=130)

Group	Time (i)	Time (j)	Mean Differenc e (i-j)	SE	P	95% Confidence Interval <sup>b</sup>	
						Upper	Lower
Intervention	baseline	3 <sup>rd</sup> month	-1.677	0.340	<b>&lt;0.001</b>	-2.501	-0.852
	baseline	6 <sup>th</sup> month	-1.569	0.387	<b>&lt;0.001</b>	-2.509	-0.630
	3 <sup>rd</sup> month	6 <sup>th</sup> month	0.108	0.371	1.000	-0.793	1.008
Control	baseline	3 <sup>rd</sup> month	0.877	0.340	<b>0.033</b>	0.052	1.701
	baseline	6 <sup>th</sup> month	1.400	0.387	<b>0.001</b>	0.461	2.339
	3 <sup>rd</sup> month	6 <sup>th</sup> month	0.523	0.371	0.484	-0.377	1.424

Based on estimated marginal means

\* . The mean difference is significant at the 0.05 level.

<sup>b</sup> . Adjustment for multiple comparison: Bonferroni.

#### 4.6.2.3 Attitude toward oral health

There was a statistically significant difference between the intervention and control groups ( $p < 0.001$ ). Among within subjects, there was a statistically significant difference between measurements ( $p < 0.001$ ). Interaction, there was a statistically

significant difference between measurements of attitude toward oral health depending on group ( $p < 0.001$ ). (table 39 and figure 10)

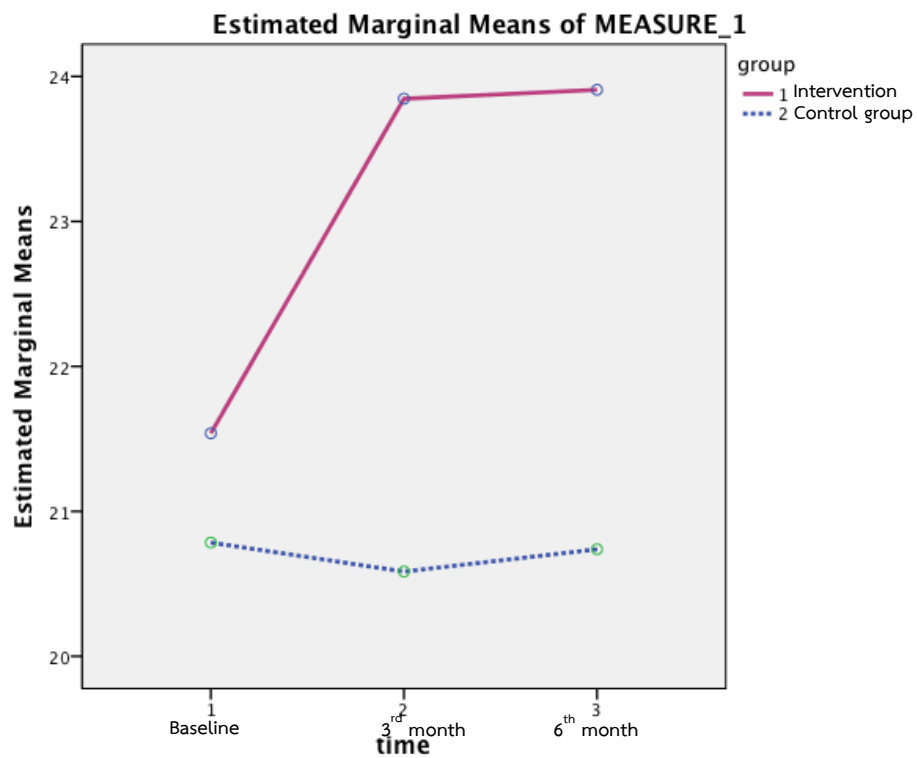
Table 39: Repeated measure ANOVA of attitude toward oral health between the intervention and the control groups (n=130)

Source of variation	SS	df	MS	F-test	P-value
Between subjects					
Intervention	559.203	1	559.203	45.536	<0.001
Within group (error) (between group error)	1571.897	128	12.280		
Within subjects					
Time	107.092	1.889	56.680	8.646	<0.001
Intervention x Time	131.421	1.889	59.556	10.610	<0.001
Intervention x Within group (error) (within subject error)	1585.487	241.844	6.556		
Total					

SS: Sum of Squares

df: Degrees of freedom

MS: Mean Squares



*Figure 10: Change overtime on attitude toward oral health in the intervention and the control groups*

There were statistically significant differences between the intervention and the control groups of attitude toward oral health at 3 and 6 month follow up ( $p < 0.001$  and  $< 0.001$ , respectively). (table 40)



Table 40: Pairwise comparisons of the different measurements of attitude toward oral health between the intervention and the control groups (n=130)

Time	Group (i)	Group (j)	Mean Difference (i-j)	SE	P	95% Confidence Interval <sup>b</sup>	
						Upper	Lower
Baseline	Control	Intervention	-0.754	0.535	0.161	-1.813	0.305
3 <sup>rd</sup> month	Control	Intervention	-3.262 <sup>*</sup>	0.453	<b>&lt;0.001</b>	-4.158	4.158
6 <sup>th</sup> month	Control	Intervention	-3.169 <sup>*</sup>	0.517	<b>&lt;0.001</b>	-4.192	-2.146

Based on estimated marginal means

<sup>\*</sup>. The mean difference is significant at the 0.05 level.

<sup>b</sup>. Adjustment for multiple comparison: Bonferroni.

Attitude toward oral health, there were statistically significant differences between baseline and 3 month follow up, and baseline and 6 month follow up of the intervention group ( $p < 0.001$  and  $< 0.001$ , respectively). (table 41)

Table 41: Pairwise comparisons of the different measurements of attitude toward oral health, in the time of measurements of the intervention and the control groups (n=130)

Group	Time (i)	Time (j)	Mean Differenc e (i-j)	SE	P	95% Confidence Interval <sup>b</sup>	
						Upper	Lower
Intervention	baseline	3 <sup>rd</sup> month	-2.308	0.397	<0.001	-3.272	-1.344
	baseline	6 <sup>th</sup> month	-2.369	0.485	<0.001	-3.545	-1.193
	3 <sup>rd</sup> month	6 <sup>th</sup> month	-0.062	0.423	1.000	-1.087	0.964
Control	baseline	3 <sup>rd</sup> month	0.200	0.397	1.000	-0.764	1.164
	baseline	6 <sup>th</sup> month	0.046	0.485	1.000	-1.130	1.222
	3 <sup>rd</sup> month	6 <sup>th</sup> month	-0.154	0.423	1.000	-1.179	0.871

Based on estimated marginal means

\* . The mean difference is significant at the 0.05 level.

<sup>b</sup> . Adjustment for multiple comparison: Bonferroni.

#### 4.6.3 Distribution of attitude toward DM and oral health at 3 month follow up between the intervention and the control groups

##### Attitude toward DM at 3 month follow up

Most of participants of the intervention (90.8%) groups strongly agree with “Regular exercise helps in keeping diabetes under control.”. Whereas, 49.2% of the control group strongly agree and 47.7% agree with “Regular exercise helps in keeping diabetes under control.”. Most of the intervention (87.7%) and half of the control groups (53.8%) strongly agree with “People with diabetes should control their weight”. More than half of participants in the intervention group (72.3%) strongly agree with “Dietary modification by control starch and sugar is useful for keeping diabetes under control”. Whereas, 47.7% of the control groups strongly agree and

46.6% of the control group agree with “Dietary modification by control starch and sugar is useful for keeping diabetes under control.”. Most of the intervention (86.2%) group strongly agree with “Diabetic patient can lead near normal life with sugar controlled.”. Whereas, 43.1% the control group strongly agree and 49.2% agree with “Diabetic patient can lead near normal life with sugar controlled.”. 70.8% of the intervention group strongly disagree and 41.5% of the control group disagree with “If diabetic patient has well sugar controlled by drug, no need to control diet.”. There were statistically significant differences of the attitude toward DM between the intervention and the control groups at 3 month follow up. (table 42)

#### **Attitude toward oral health at 3 month follow up**

75.4% of the intervention and 40.0% of the control groups strongly agree with “Routine dental care is important to prevent diabetic complications.”. 81.5% of the intervention group strongly agree and 41.5% of the control group agree with “Regular visits (every 3-6 months) to the dentist necessary to prevent diabetic complications.”. 75.4% of the intervention group strongly agree and 41.5% of the control group agree with “Tooth brushing is important to prevent diabetic complications.”. 81.5% of the intervention group strongly agree and 35.4% of the control group not sure with “Using dental floss is important to prevent gum disease.”. 76.9% of the intervention group strongly agree and 46.2% of the control group agree with “Dental treatment (scaling and root planning) is important to prevent progression of gum disease.”.

There were statistically significant differences of the attitude toward oral health between the intervention and the control groups at 3 month follow up. (table 43)

Table 42: Distribution of attitude toward DM at 3 month follow up between the intervention and the control groups by Mann-Whitney U test (n=130, 65 participants per group)

Variables	Strongly agree n (%)	Agree n (%)	Not sure n (%)	Dis agree n (%)	Strongly disagree n (%)	Test of group differences
<b>Attitude toward DM</b>						
<b>1. Regular exercise helps in keeping diabetes under control.</b>						
						<i>U</i> =
-Intervention group	59 (90.8)	6 (9.2)	0 (0.0)	0 (0.0)	0 (0.0)	1229.000,
-Control group	32 (49.2)	31 (47.7)	1 (1.5)	1 (1.5)	0 (0.0)	<b>p &lt; 0.001</b>
<b>2. People with diabetes should control their weight.</b>						
						<i>U</i> =
-Intervention group	57 (87.7)	8 (12.3)	0 (0.0)	0 (0.0)	0 (0.0)	1385.500,
-Control group	35 (53.8)	27 (41.5)	3 (4.6)	0 (0.0)	0 (0.0)	<b>p &lt; 0.001</b>
<b>3. Dietary modification by control starch and sugar is useful for keeping diabetes under control.</b>						
						<i>U</i> =
-Intervention group	47 (72.3)	17 (26.2)	1 (1.5)	0 (0.0)	0 (0.0)	1564.000,
-Control group	31 (47.7)	29 (44.6)	4 (6.2)	1 (1.5)	0 (0.0)	<b>p = 0.003</b>
<b>4. Diabetic patient can lead near normal life with sugar controlled.</b>						
						<i>U</i> =
-Intervention group	56 (86.2)	9 (13.8)	0 (0.0)	0 (0.0)	0 (0.0)	1180.000,
-Control group	28 (43.1)	32 (49.2)	5 (7.7)	0 (0.0)	0 (0.0)	<b>p &lt; 0.001</b>

Variables	Strongly agree n (%)	Agree n (%)	Not sure n (%)	Dis agree n (%)	Strongly disagree n (%)	Test of group differences
<b>5. If diabetic patient has well sugar controlled by drug, no need to control diet.</b>						
						<i>U</i> =
-Intervention group	0 (0.0)	3 (4.6)	3 (4.6)	13 (20.0)	46 (70.8)	763.500,
-Control group	11 (16.9)	11 (16.9)	7 (10.8)	27 (41.5)	9 (13.8)	<b>p &lt; 0.001</b>

Table 43: Distribution of attitude toward oral health at 3 month follow up between the intervention and the control groups by Mann-Whitney U test (n=130, 65 participants per group)

Variables	Strongly agree n (%)	Agree n (%)	Not sure n (%)	Dis agree n (%)	Strongly disagree n (%)	Test of group differences
<b>Attitude toward oral health</b>						
<b>1. Routine dental care is important to prevent diabetic complications.</b>						
						<i>U</i> =
-Intervention group	49 (75.4)	16 (24.6)	0 (0.0)	0 (0.0)	0 (0.0)	1261.000,
-Control group	26 (40.0)	26 (40.0)	13 (20.0)	0 (0.0)	0 (0.0)	<b>p &lt; 0.001</b>
<b>2. Regular visits (every 3-6 months) to the dentist necessary to prevent diabetic complications.</b>						
						<i>U</i> =
-Intervention group	53 (81.5)	11 (16.9)	1 (1.5)	0 (0.0)	0 (0.0)	1182.000,
-Control group	26 (40.0)	27 (41.5)	11 (17.0)	1 (1.5)	0 (0.0)	<b>p &lt; 0.001</b>

Variables	Strongly agree n (%)	Agree n (%)	Not sure n (%)	Disagree n (%)	Strongly disagree n (%)	Test of group differences
<b>3. Tooth brushing is important to prevent diabetic complications.</b>						
						<i>U</i> =
-Intervention group	49 (75.4)	15 (23.1)	0 (0.0)	1 (1.5)	0 (0.0)	1254.500,
-Control group	25 (38.5)	27 (41.5)	12 (18.5)	1 (1.5)	0 (0.0)	<b>p &lt; 0.001</b>
<b>4. Using dental floss is important to prevent gum disease.</b>						
						<i>U</i> =
-Intervention group	53 (81.5)	12 (18.5)	0 (0.0)	0 (0.0)	0 (0.0)	768.500,
-Control group	17 (26.2)	19 (29.2)	23 (35.4)	4 (6.2)	2 (3.1)	<b>p &lt; 0.001</b>
<b>5. Dental treatment (scaling and root planning) is important to prevent progression of gum disease.</b>						
						<i>U</i> =
-Intervention group	50 (76.9)	14 (21.5)	1 (1.5)	0 (0.0)	0 (0.0)	1323.500,
-Control group	27 (41.5)	30 (46.2)	7 (10.8)	1 (1.5)	0 (0.0)	<b>p &lt; 0.001</b>

#### 4.6.4 Distribution of attitude toward DM and oral health at 6 month follow up

##### Attitude toward diabetes mellitus at 6 month follow up

Most of participants of the intervention (83.1%) groups strongly agree and 55.4% of the control group agree with “Regular exercise helps in keeping diabetes under control.”. Most of the intervention (86.2%) strongly agree and half of the control group (56.9%) agree with “People with diabetes should control their weight.”. Most of participants in the intervention (84.6%) group strongly agree and 53.8% of the control group agree with “Dietary modification by control starch and sugar is

useful for keeping diabetes under control.”. Most of the intervention (83.1%) strongly agree and 50.8% of the control groups agree with “Diabetic patient can lead near normal life with sugar controlled.”. More than half (64.6%) of the intervention group strongly disagree and less than half (40.0%) of the control group disagree with “If diabetic patient has well sugar controlled by drug, no need to control diet.”. There were statistically significant differences of the attitude toward DM between the intervention and the control groups at 6 month follow up. (table 44)

#### **Attitude toward oral health**

Most of the participants (83.1%) in the intervention group strongly agree and half of the participants (49.2%) in the control group agree with “Routine dental care is important to prevent diabetic complications.”. 81.5% of the intervention group strongly agree and 44.6% of the control group agree with “Regular visits (every 3-6 months) to the dentist necessary to prevent diabetic complications.”. 75.4% of the intervention group strongly agree and 44.6% of the control group agree with “Tooth brushing is important to prevent diabetic complications.”. 83.1% of the intervention group strongly agree and 41.5% of the control group agree with “Using dental floss is important to prevent gum disease.”. 83.1% of the intervention group strongly agree and 55.4% of the control group agree with “Dental treatment (scaling and root planning) is important to prevent progression of gum disease.”. There were statistically significant differences of the attitude toward oral health between the intervention and the control groups at 6 month follow up. (table 45)

Table 44: Distribution of attitude toward DM at 6 month follow up between the intervention and the control groups by Mann-Whitney U test (n=130, 65 participants per group)

Variables	Strongly agree n (%)	Agree n (%)	Not sure n (%)	Dis agree n (%)	Strongly disagree n (%)	Test of group differences
<b>Attitude toward DM</b>						
<b>1. Regular exercise helps in keeping diabetes under control.</b>						
						<i>U</i> =
-Intervention group	54 (83.1)	11 (16.9)	0 (0.0)	0 (0.0)	0 (0.0)	1148.000,
-Control group	25 (38.5)	36 (55.4)	4 (6.2)	0 (0.0)	0 (0.0)	<b>p &lt; 0.001</b>
<b>2. People with diabetes should control their weight.</b>						
						<i>U</i> =
-Intervention group	56 (86.2)	9 (13.8)	0 (0.0)	0 (0.0)	0 (0.0)	1128.500,
-Control group	26 (40.0)	37 (56.9)	2 (3.1)	0 (0.0)	0 (0.0)	<b>p &lt; 0.001</b>
<b>3. Dietary modification by control starch and sugar is useful for keeping diabetes under control.</b>						
						<i>U</i> =
-Intervention group	55 (84.6)	9 (13.8)	1 (1.5)	0 (0.0)	0 (0.0)	1132.000,
-Control group	25 (38.5)	35 (53.8)	4 (6.2)	1 (1.5)	0 (0.0)	<b>p &lt; 0.001</b>
<b>4. Diabetic patient can lead near normal life with sugar controlled.</b>						
						<i>U</i> =
-Intervention group	54 (83.1)	11 (16.9)	0 (0.0)	0 (0.0)	0 (0.0)	1131.500,
-Control group	25 (38.5)	33 (50.8)	5 (7.7)	2 (3.1)	0 (0.0)	<b>p &lt; 0.001</b>



Variables	Strongly agree n (%)	Agree n (%)	Not sure n (%)	Dis agree n (%)	Strongly disagree n (%)	Test of group differences
<b>5. If diabetic patient has well sugar controlled by drug, no need to control diet.</b>						
-Intervention group	3 (4.6)	0 (0.0)	3 (4.6)	17 (26.2)	42 (64.6)	$U = 814.500,$
-Control group	12 (18.5)	12 (18.5)	7 (10.8)	26 (40.0)	8 (12.3)	$p < 0.001$

Table 45: Distribution of attitude toward oral health at 6 month follow up between the intervention and the control groups by Mann-Whitney U test (n=130, 65 participants per group)

Variables	Strongly agree n (%)	Agree n (%)	Not sure n (%)	Dis agree n (%)	Strongly disagree n (%)	Test of group differences
<b>Attitude toward oral health</b>						
<b>1. Routine dental care is important to prevent diabetic complications.</b>						
-Intervention group	54 (83.1)	9 (13.8)	2 (3.1)	0 (0.0)	0 (0.0)	$U = 1127.000,$
-Control group	24 (36.9)	32 (49.2)	7 (10.8)	2 (3.1)	0 (0.0)	$p < 0.001$
<b>2. Regular visits (every 3-6 months) to the dentist necessary to prevent diabetic complications.</b>						
-Intervention group	53 (81.5)	10 (15.4)	2 (3.1)	0 (0.0)	0 (0.0)	$U = 1174.500,$
-Control group	25 (38.5)	29 (44.6)	9 (13.8)	2 (3.1)	0 (0.0)	$p < 0.001$

Variables	Strongly agree n (%)	Agree n (%)	Not sure n (%)	Disagree n (%)	Strongly disagree n (%)	Test of group differences
<b>3. Tooth brushing is important to prevent diabetic complications.</b>						
						<i>U</i> =
-Intervention group	49 (75.4)	14 (21.5)	1 (1.5)	1 (1.5)	0 (0.0)	1286.000,
-Control group	25 (38.5)	29 (44.6)	7 (10.8)	4 (6.2)	0 (0.0)	<b>p &lt; 0.001</b>
<b>4. Using dental floss is important to prevent gum disease.</b>						
						<i>U</i> =
-Intervention group	54 (83.1)	7 (10.8)	4 (6.2)	0 (0.0)	0 (0.0)	988.500,
-Control group	20 (30.8)	27 (41.5)	13 (20.0)	4 (6.2)	1 (1.5)	<b>p &lt; 0.001</b>
<b>5. Dental treatment (scaling and root planning) is important to prevent progression of gum disease.</b>						
						<i>U</i> =
-Intervention group	54 (83.1)	10 (15.4)	1 (1.5)	0 (0.0)	0 (0.0)	1129.500,
-Control group	24 (36.9)	36 (55.4)	3 (4.6)	2 (3.1)	0 (0.0)	<b>p &lt; 0.001</b>

#### 4.7 Practice toward DM and oral health at 3 and 6 month follow up between the intervention and the control groups

##### 4.7.1 Practice toward DM at 3 month follow up

Among 130 diabetic patients (65 diabetic patients per each groups), 29.2% and 36.9% of the intervention group exercised more than 5 days per week and 2-5 days per week, respectively. Whereas, 9.2% and 33.8% of the control group exercised more than 5 days per week and 2-5 days per week, respectively. 33.8% of the intervention and 20.0% of the control groups tested their weight more than one time

within last month. 96.9% of the intervention and 70.8% of the control groups modified diet as doctor's/dietician's advice. Among the participants who ever modified diet, 36.5% of the intervention and 28.3% of the control groups mostly modified diet. 43.1% of the intervention and 46.2% of the control groups ever forgot to take drug prescribe. Among the participants who ever forgot to take drug prescribed, 75.0% of the intervention and 76.7% of the control groups forgot to take drug prescribe 1-3 days per month. 86.2% of the intervention and 76.9% of the control groups received eye examination in the past 3 month. 89.1% of the intervention and 24.6% of the control groups received foot examination in the past 3 month. 63.1% of the intervention and 29.2% of the control groups always wear covered shoes when outdoors. 76.9% of the intervention and 60.0% of the control groups always screen their feet by themselves. The frequency of physical activity, diet modification, received foot examination in the past 3 month, always wear covered shoes when outdoors, and frequency of screen feet by themselves had statistically significant differences between the intervention and control groups ( $p < 0.001$ , = 0.001,  $< 0.001$ ,  $< 0.001$ , 0.044, respectively). (table 46)

Table 46: Practice toward DM at 3 month follow up between the intervention and the control groups (n=130)

Variables	Intervention group (n=65) (%)	Control group (n=65) (%)	Test of group differences
<b>Frequency of physical activity, last month</b>			
More than 5 days/week	19 (29.2)	6 (9.2)	$\chi^2 = 22.993,$ $p < 0.001$
2-5 days/week	24 (36.9)	22 (33.8)	
Once a week	12 (18.5)	9 (13.8)	
2-3 times/month	7 (10.8)	5 (7.7)	
Rarely/never	3 (4.6)	23 (35.4)	
<b>Frequency of weight measurement, last month</b>			
More than once	22 (33.8)	13 (20.0)	$\chi^2 = 3.167,$ $p = 0.075$
Once	43 (66.2)	52 (80.0)	
<b>Modified diet as doctor's/dietician's advice</b>			
Yes	63 (96.9)	46 (70.8)	$\chi^2 = 11.885,$ $p = 0.001$
No and never received recommendation	2 (3.1)	19 (29.2)	
<b>Frequency of modified diet as doctor's/dietician's advice, last month</b>			
Mostly	n = 63 23 (36.5)	n = 46 13 (28.3)	$\chi^2 = 2.052,$ $p = 0.358$
Sometimes	38 (60.3)	29 (63.0)	
Rarely/never	2 (3.2)	4 (8.7)	
<b>Forgot to take any drugs prescribed</b>			
Yes	28 (43.1)	30 (46.2)	$\chi^2 = 0.125,$ $p = 0.724$
No	37 (56.9)	35 (53.8)	

Variables	Interventi on group (n=65) (%)	Control group (n=65) (%)	Test of group differences
<b>Frequency to forget to take any drugs prescribed</b>	n = 28	n = 30	
1-3 days/month	21 (75.0)	23 (76.7)	$\chi^2 = 3.893,$ $p = 0.273$
1-2 days/week	2 (7.1)	3 (10.0)	
More than 2 days	3 (10.7)	0 (0.0)	
Don't know	2 (7.1)	4 (13.3)	
<b>Received eye examination in the past 3 month</b>			
Yes	56 (86.2)	50 (76.9)	$\chi^2 = 1.840,$ $p = 0.175$
No	9 (13.8)	15 (23.1)	
<b>Received foot examination in the past 3 month</b>			
Yes	57 (89.1)	16 (24.6)	$\chi^2 = 54.523,$ $p < 0.001$
No	7 (10.9)	49 (75.4)	
<b>Always wear covered shoes when outdoors</b>			
Yes	41 (63.1)	19 (29.2)	$\chi^2 = 14.981,$ $p < 0.001$
No	24 (36.9)	46 (70.8)	
<b>Frequency of screen feet by themselves</b>			
Always	50 (76.9)	39 (60.0)	$\chi^2 = 6.264,$ $p = 0.044$
Sometimes	12 (18.5)	15 (23.1)	
Rarely/never	3 (4.6)	11 (16.9)	

#### 4.7.2 Practice toward oral health at 3 month follow up between the intervention and the control groups

##### 4.7.2.1 Utilization of dental services between the intervention and the control groups

Among 130 diabetic patients (65 diabetic patients per each groups), 36.9% of the intervention and 23.1% of the control groups have had dental services in the past 3 months. Among participants who ever used dental services, 9.2%, 23.1%, and 10.8% of the participants in the intervention group received extraction, filling, and scaling in the past 3 months, respectively. 10.8%, 7.7%, and 6.2% of the participants in the control group received extraction, filling, and scaling within 3 months, respectively. Filling had a statistically significant difference between the intervention and the control groups ( $p = 0.015$ ). There were no statistically significant differences of have had dental services within 3 months, extraction, and scaling between the intervention and the control groups ( $p=0.085$ ,  $0.770$ , and  $0.344$ , respectively). (table 47)

Table 47: Utilization of dental services at 3 month follow up between the intervention and the control groups (n=130)

Variables	Intervention group (n=65) (%)	Control group (n=65) (%)	Test of group differences
<b>Have had dental treatment in the past 3 months</b>			
Yes	24 (36.9)	15 (23.1)	$\chi^2 = 2.967$ , $p = 0.085$
No	41 (63.1)	50 (76.9)	
<b>Type of dental treatment</b>			
<b>Extraction</b>			
Yes	6 (9.2)	7 (10.8)	$\chi^2 = 0.085$ , $p = 0.770$
No	59 (90.8)	58 (89.2)	
<b>Filling</b>			
Yes	15 (23.1)	5 (7.7)	$\chi^2 = 5.909$ , $p = 0.015$
No	50 (76.9)	60 (92.3)	
<b>Scaling</b>			
Yes	7 (10.8)	4 (6.2)	$\chi^2 = 0.894$ , $p = 0.344$
No	58 (89.2)	61 (93.8)	

#### 4.7.2.2 Oral health behaviors between the intervention and the control groups

Among 130 diabetic patients (65 diabetic patients per each groups), every participant (100%) in the intervention and the control groups clean their oral cavity by tooth brushing. 87.7% of the participants in the intervention and 83.1% of the participants in the control groups brush their teeth 2 times per day. Almost half of the participants in the intervention group (49.2%) used mouth rinse whereas one

third of the participants in the control group (36.9%) used mouth rinse. 49.2% of the intervention group and 29.2% of the control group used salt solution. Most of the participants in the intervention group (70.8%) used dental floss whereas 7.7% of the control group used dental floss. 50.8% and 61.5% of the intervention and the control groups used toothpick. 35.4% and 30.8% of the intervention and the control groups used inter-proximal brush. Using salt solution and dental floss had statistically significant differences between the intervention and control groups at 3 month follow up ( $p = 0.020$  and  $<0.001$ , respectively). (table 48)

Table 48: Oral health behaviors at 3 month follow up between the intervention and the control groups (n=130)

Variables	Interventio n group (n=65) (%)	Control group (n=65) (%)	Test of group differences
<b>Tooth brushing</b>			
Yes	65 (100.0)	65 (100.0)	-
No	0 (0.0)	0 (0.0)	
<b>Frequency of tooth brushing</b>			
Once a day	1 (1.5)	4 (6.2)	$\chi^2 = 4.214,$ $p = 0.239$
Two times per day	57 (87.7)	54 (83.1)	
Three times per day	5 (7.7)	7 (10.8)	
More than three times per day	2 (3.1)	0 (0.0)	
<b>Mouth rinse</b>			
Yes	32 (49.2)	24 (36.9)	$\chi^2 = 2.008,$ $p = 0.157$
No	33 (50.8)	41 (63.1)	
Frequency: mean (SD)	1.31 (0.54)	1.63 (0.71)	$t = -1.804,$ $p = 0.079$



Variables	Interventio n group (n=65) (%)	Control group (n=65) (%)	Test of group differences
<b>Salt solution</b>			
Yes	32 (49.2)	19 (29.2)	$\chi^2 = 5.453,$
No	33 (50.8)	46 (80.8)	<b>p = 0.020</b>
Frequency: mean (SD)	1.31 (0.47)	1.32 (0.58)	$t = -0.22,$
<b>Dental floss</b>			
Yes	46 (70.8)	5 (7.7)	$\chi^2 = 54.239,$
No	19 (29.2)	60 (92.3)	<b>p &lt; 0.001</b>
Frequency: mean (SD)	1.30 (0.66)	1.40 (0.89)	$t = -0.297,$
<b>Tooth pick</b>			
Yes	33 (50.8)	40 (61.5)	$\chi^2 = 1.531,$
No	32 (49.2)	25 (38.5)	$p = 0.216$
Frequency: mean (SD)	1.76 (0.87)	2.00 (0.88)	$t = -1.181,$
<b>Inter-proximal brush</b>			
Yes	23 (35.4)	20 (30.8)	$\chi^2 = 0.313,$
No	42 (64.6)	45 (69.2)	$p = 0.576$
Frequency: mean (SD)	1.77 (0.61)	2.05 (0.61)	$t = -1.475,$
$p = 0.148$			

#### 4.7.3 Practice toward DM at 6 month follow up between the intervention and the control groups

Among 130 diabetic patients (65 diabetic patients per each groups), 26.2% and 38.5% of the intervention group exercised more than 5 days per week and 2-5 days per week, respectively. Whereas, 16.9% and 24.6% of the control group exercised more than 5 days per week and 2-5 days per week, respectively. 80.0% of the

intervention and 72.3% of the control groups tested their weight one time per month. 92.3% of the intervention and 78.5% of the control groups modified diet as doctor's/dietician's advice. Among the participants who ever modified diet, 36.7% of the intervention and 15.7% of the control groups mostly modified diet. 38.5% of the intervention and 41.5% of the control groups ever forgot to take drug prescribe. Among the participants who ever forgot to take drug prescribed, 84.0% of the intervention and 66.7% of the control groups forgot to take drug prescribe 1-3 days per month. 83.1% of the intervention and 75.4% of the control groups received eye examination in the past 3 month. 93.8% of the intervention and 27.7% of the control groups received foot examination in the past 3 month. 61.5% of the intervention and 26.2% of the control groups always wear covered shoes when outdoors. 80.0% of the intervention and 52.3% of the control groups always screen their feet by themselves. The frequency of physical activity, diet modification, frequency of diet modification, received foot examination in the past 3 month, always wear covered shoes when outdoors, and frequency of screen feet by themselves had statistically significant differences between the intervention and control groups ( $p = 0.016, 0.025, 0.046, < 0.001, < 0.001, 0.001$ , respectively). (table 49)

Table 49: Practice toward DM at 6 month follow up between the intervention and the control groups (n=130)

Variables	Intervention group (n=65) (%)	Control group (n=65) (%)	Test of group differences
<b>Frequency of physical activity, last month</b>			
More than 5 days/week	17 (26.2)	11 (16.9)	$\chi^2 = 12.183,$ $p = 0.016$
2-5 days/week	25 (38.5)	16 (24.6)	
Once a week	10 (15.4)	9 (13.8)	
2-3 times/month	5 (7.6)	4 (6.2)	
Rarely/never	8 (12.3)	25 (38.5)	
<b>Frequency of weight measurement, last month</b>			
More than once	13 (20.0)	17 (26.2)	$\chi^2 = 1.786,$ $p = 0.409$
Once	52 (80.0)	47 (72.3)	
Not measured	0 (0.0)	1 (1.5)	
<b>Modified diet as doctor's/dietician's advice</b>			
Yes	60 (92.3)	51 (78.5)	$\chi^2 = 4.993,$ $p = 0.025$
No and never received recommendation	5 (7.7)	14 (21.5)	
<b>Frequency of modified diet as doctor's/dietician's advice, last month</b>			
Mostly	n=60 22 (36.7)	n=51 8 (15.7)	$\chi^2 = 6.169,$ $p = 0.046$
Sometimes	36 (60.0)	41 (80.4)	
Rarely/never	2 (3.3)	2 (3.9)	

Variables	Interventi on group (n=65) (%)	Control group (n=65) (%)	Test of group differences
<b>Forgot to take any drugs prescribed</b>			
Yes	25 (38.5)	27 (41.5)	$\chi^2 = 0.290,$
No	40 (61.5)	38 (58.5)	$p = 0.590$
<b>Frequency to forget to take any drugs prescribed</b>	n=25	n=27	
1-3 days/month	21 (84.0)	18 (66.7)	$\chi^2 = 4.093,$
1-2 days/week	1 (4.0)	4 (14.8)	$p = 0.252$
More than 2 days	2 (8.0)	1 (3.7)	
Don't know	1 (4.0)	4 (14.8)	
<b>Received eye examination in the past 3 month</b>			
Yes	54 (83.1)	49 (75.4)	$\chi^2 = 1.169,$
No	11 (16.9)	16 (24.6)	$p = 0.280$
<b>Received foot examination in the past 3 month</b>			
Yes	61 (93.8)	18 (27.7)	$\chi^2 = 59.660,$
No	4 (6.2)	47 (72.3)	$p < 0.001$
<b>Always wear covered shoes when outdoors</b>			
Yes	40 (61.5)	17 (26.2)	$\chi^2 = 16.527,$
No	25 (38.5)	48 (73.8)	$p < 0.001$
<b>Frequency of screen foot by themselves</b>			
Always	52 (80.0)	34 (52.3)	$\chi^2 = 15.082,$
Sometimes	13 (20.0)	22 (33.8)	$p = 0.001$
Rarely/never	0 (0.0)	9 (13.8)	

#### 4.7.4 Practice toward oral health at 6 month follow up between the intervention and the control groups

##### 4.7.4.1 Utilization of dental services between the intervention and the control groups

Among 130 diabetic patients (65 diabetic patients per each groups), 32.3% of the intervention and 20.0% of the control groups have had dental services in the past 3 months. Among participants who ever used dental services, 7.7%, 20.0%, and 6.2% of the participants in the intervention group received extraction, filling, and scaling in the past 3 months, respectively. 6.2%, 9.2%, and 4.6% of the participants in the control group received extraction, filling, and scaling in the past 3 months, respectively. There were no statistically significant differences of have had dental services in the past 3 months, type of dental treatment included extraction, filling, and scaling between the intervention and the control groups ( $p=0.110$ ,  $0.730$ ,  $0.082$ , and  $0.698$ , respectively). (table 50)

Table 50: Utilization of dental services at 6 month follow up between the intervention and the control groups (n=130)

Variables	Intervention group (n=65) (%)	Control group (n=65) (%)	Test of group differences
<b>Have had dental treatment in the past 3 months</b>			
Yes	21 (32.3)	13 (20.0)	$\chi^2 = 2.549$ , p = 0.110
No	44 (67.7)	52 (80.0)	
<b>Type of dental treatment</b>			
<b>Extraction</b>			
Yes	5 (7.7)	4 (6.2)	$\chi^2 = 0.119$ , p = 0.730
No	60 (92.3)	61 (93.8)	
<b>Filling</b>			
Yes	13 (20.0)	6 (9.2)	$\chi^2 = 3.020$ , p = 0.082
No	52 (80.0)	59 (90.8)	
<b>Scaling</b>			
Yes	4 (6.2)	3 (4.6)	$\chi^2 = 0.151$ , p = 0.698
No	61 (93.8)	62 (95.4)	

#### 4.7.4.2 Oral health behaviors between the intervention and the control groups

Among 130 diabetic patients (65 diabetic patients per each groups), every participant (100%) in the intervention and the control groups clean their oral cavity by tooth brushing. 86.2% of the participants in the intervention and 80.0% of the participants in the control groups brush their teeth 2 times per day. 49.2% of the intervention and 46.2% of the control group used mouth rinse. 46.2% of the

intervention group and 32.3% of the control group used salt solution. Most of the participants in the intervention group (73.8%) used dental floss whereas 16.9% of the control group used dental floss. 49.2% and 55.4% of the intervention and the control groups used toothpick. 40.0% and 16.9% of the intervention and the control groups used inter-proximal brush. Using dental floss and inter-proximal brush had statistically significant differences between the intervention and control groups at 6 month follow up ( $p < 0.001$  and  $p = 0.004$ , respectively). (table 51)

Table 51: Oral health behaviors at 6 month follow up between the intervention and the control groups (n=130)

Variables	Interventio n group (n=65) (%)	Control group (n=65) (%)	Test of group differences
<b>Tooth brushing</b>			
Yes	65 (100.0)	65 (100.0)	-
No	0 (0.0)	0 (0.0)	
<b>Frequency of tooth brushing</b>			
Once a day	2 (3.1)	6 (9.2)	$\chi^2 = 4.481,$
Two times per day	56 (86.2)	52 (80.0)	$p = 0.214$
Three times per day	5 (7.7)	7 (10.8)	
More than three times per day	2 (3.1)	0 (0.0)	
<b>Mouth rinse</b>			
Yes	32 (49.2)	30 (46.2)	$\chi^2 = 0.123,$
No	33 (50.8)	35 (53.8)	$p = 0.725$
Frequency: mean (SD)	1.34 (0.55)	1.43 (0.63)	$t = -0.602$ $p = 0.550$

Variables	Interventio n group (n=65) (%)	Control group (n=65) (%)	Test of group differences
<b>Salt solution</b>			
Yes	30 (46.2)	21 (32.3)	$\chi^2 = 2.614,$
No	35 (53.8)	44 (67.7)	$p = 0.106$
Frequency: mean (SD)	1.37 (0.62)	1.24 (0.54)	$t = 0.772,$
			$p = 0.444$
<b>Dental floss</b>			
Yes	48 (73.8)	11 (16.9)	$\chi^2 = 42.485,$
No	17 (26.2)	54 (83.1)	$p < 0.001$
Frequency: mean (SD)	1.17 (0.38)	1.36 (0.81)	$t = -1.224,$
			$p = 0.226$
<b>Tooth pick</b>			
Yes	32 (49.2)	36 (55.4)	$\chi^2 = 0.493,$
No	33 (50.8)	29 (44.6)	$p = 0.482$
Frequency: mean (SD)	1.94 (0.84)	1.92 (0.87)	$t = 0.100,$
			$p = 0.921$
<b>Inter-proximal brush</b>			
Yes	26 (40.0)	11 (16.9)	$\chi^2 = 8.500,$
No	39 (60.0)	54 (83.1)	$p = 0.004$
Frequency: mean (SD)	1.96 (0.60)	1.82 (0.60)	$t = 0.664,$
			$p = 0.511$



#### **4.8 Biological parameters at baseline, 3 month, and 6 month follow up in the intervention and the control groups**

##### **4.8.1 Descriptive statistics of biological parameters at baseline, 3 month, and 6 month follow up in the intervention and the control groups**

###### **4.8.1.1 Fasting plasma glucose (FPG)**

The average of FPG (SD) at baseline, 3 month, and 6 month follow up in the intervention group were 143.65 (38.51), 129.57 (21.24), and 137.12 (27.29) mg/dl, respectively. The average of FPG (SD) at baseline, 3 month, and 6 month follow up in the control group were 153.68 (51.34), 158.32 (47.28), and 157.75 (39.91) mg/dl, respectively. (table 52)

###### **4.8.1.2 Glycated Hemoglobin (HbA1c)**

The average of HbA1c (SD) at baseline, 3 month, and 6 month follow up in the intervention group were 7.39 (1.18), 7.10 (1.04), and 7.00 (0.93)%, respectively. The average of HbA1c (SD) at baseline, 3 month, and 6 month follow up in the control group were 7.69 (1.47), 7.77 (1.46), 7.70 (1.40) %, respectively. (table 52)

###### **4.8.1.3 Triglyceride (TG)**

The average of TG (SD) at baseline, 3 month, and 6 month follow up in the intervention group were 148.00 (61.45), 149.06 (61.72), and 138.91 (57.01) mg/dl, respectively. The average of triglyceride (SD) at baseline, 3 month, and 6 month follow up in the control group were 130.86 (46.25), 137.51 (56.94), and 139.91 (54.62) mg/dl, respectively. (table 52)

#### 4.8.1.4 High density lipoprotein (HDL)

The average of HDL (SD) at baseline, 3 month, and 6 month follow up in the intervention group were 50.38 (13.62), 51.83 (13.40), and 53.83 (13.58) mg/dl, respectively. The average of HDL (SD) at baseline, 3 month, and 6 month follow up in the control group were 52.23 (13.85), 53.52 (12.95), and 52.92 (11.95) mg/dl, respectively. (table 52)

#### 4.8.1.5 Low density lipoprotein (LDL)

The average of LDL (SD) at baseline, 3 month, and 6 month follow up in the intervention group were 103.44 (32.54), 103.74 (32.38), and 100.17 (31.07) mg/dl, respectively. The average of LDL (SD) at baseline, 3 month, and 6 month follow up in the control group were 106.55 (28.56), 104.75 (34.40), and 104.43 (28.50) mg/dl, respectively. (table 52)

#### 4.8.1.6 Body Mass Index (BMI)

The average of BMI (SD) at baseline, 3 month, and 6 month follow up in the intervention group were 25.30 (3.57), 25.57 (3.64), and 25.78 (3.65) kg/m<sup>2</sup>, respectively. The average of BMI (SD) at baseline, 3 month, and 6 month follow up in the control group were 26.63 (4.67), 26.88 (4.11), and 26.94 (4.26) kg/m<sup>2</sup>, respectively. (table 52)

Table 52: Descriptive statistics of biological parameters (FPG, HbA1c, TG, HDL, LDL, and BMI) at baseline, 3 month, and 6 month follow up in the intervention and the control groups

Variables	Baseline (n=66)	3 month (n=65)	6 month (n=65)
<b>FPG (mg/dl)</b>			
- Intervention: mean (SD)	143.65 (38.51)	129.57 (21.24)	137.12 (27.29)
- Control : mean (SD)	153.68 (51.34)	158.32 (47.28)	157.75 (39.91)
<b>HbA1C (%)</b>			
- Intervention: mean (SD)	7.39 (1.18)	7.10 (1.04)	7.00 (0.93)
- Control : mean (SD)	7.69 (1.47)	7.77 (1.46)	7.70 (1.40)
<b>TG (mg/dl)</b>			
- Intervention: mean (SD)	148.00 (61.45)	149.06 (61.72)	138.91 (57.01)
- Control : mean (SD)	130.86 (46.25)	137.51 (56.94)	139.91 (54.62)
<b>HDL (mg/dl)</b>			
- Intervention: mean (SD)	50.38 (13.62)	51.83 (13.40)	53.83 (13.58)
- Control : mean (SD)	52.23 (13.85)	53.52 (12.95)	52.92 (11.95)
<b>LDL (mg/dl)</b>			
- Intervention: mean (SD)	103.44 (32.54)	103.74 (32.38)	100.17 (31.07)
- Control : mean (SD)	106.55 (28.56)	104.75 (34.40)	104.43 (28.50)
<b>BMI (kg/m<sup>2</sup>)</b>			
- Intervention: mean (SD)	25.30 (3.57)	25.57 (3.64)	25.78 (3.65)
- Control : mean (SD)	26.63 (4.67)	26.88 (4.11)	26.94 (4.26)

#### 4.8.2 The differences of biological parameters (TG, HDL, LDL, and BMI) between the intervention and control groups at baseline, 3 month, and 6 month follow up by Repeated measure ANOVA

##### 4.8.2.1 Triglyceride (TG)

There was no statistically significant difference between the intervention and control groups ( $p=0.295$ ). Among within subjects, there was no statistically significant difference between measurements ( $p=0.535$ ). Interaction, there was no statistically

significant difference between measurements of triglyceride depending on group ( $p=0.052$ ). (table 53 and figure 11)

*Table 53: Repeated measure ANOVA of triglyceride (TG) between the intervention and the control groups (n=130)*

Source of variation	SS	df	MS	F	P-value
Between subjects					
Intervention	8521.356	1	8521.356	1.106	0.295
Within group (error) (between group error)	986418.308	128	7706.393		
Within subjects					
Time	1211.836	2	605.918	0.627	0.535
Intervention x Time	5793.990	2	2896.995	2.996	0.052
Intervention x Within group (error) (within subject error)	247511.508	256	966.842		
Total					

SS: Sum of Squares

df: Degrees of freedom

MS: Mean Squares

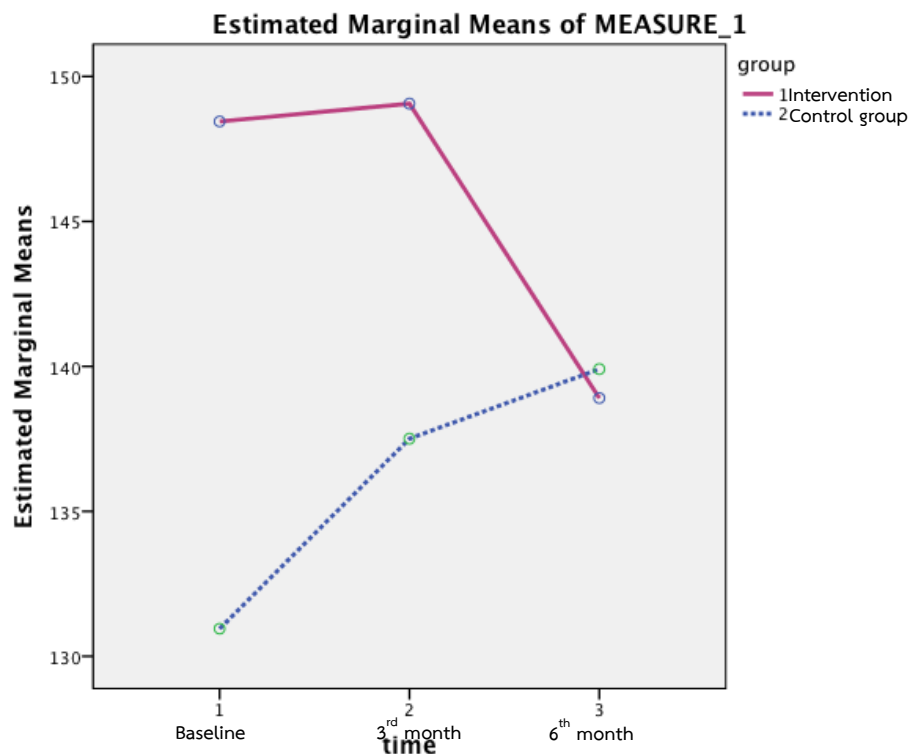


Figure 11: Change overtime on triglyceride (TG) in the intervention and the control groups

#### 4.8.2.2 High density lipoprotein (HDL)

There was no statistically significant difference between the intervention and control groups ( $p=0.688$ ). Among within subjects, there was no statistically significant difference between measurements ( $p=0.057$ ). Interaction, there was no statistically significant difference between measurements of HDL depending on group ( $p=0.132$ ).

(table 54 and figure 12)

Table 54: Repeated measure ANOVA of HDL between the intervention and the control groups (n=130)

Source of variation	SS	df	MS	F	P-value
Between subjects					
Intervention	73.233	1	73.233	0.162	0.688
Within group (error) (between group error)	57694.769	128	450.740		
Within subjects					
Time	231.882	1.659	139.738	3.083	0.057
Intervention x Time	153.728	1.659	92.641	2.044	0.132
Intervention x Within group (error) (within subject error)	9627.723	212.404	45.327		
Total					

SS: Sum of Squares

df: Degrees of freedom

MS: Mean Squares

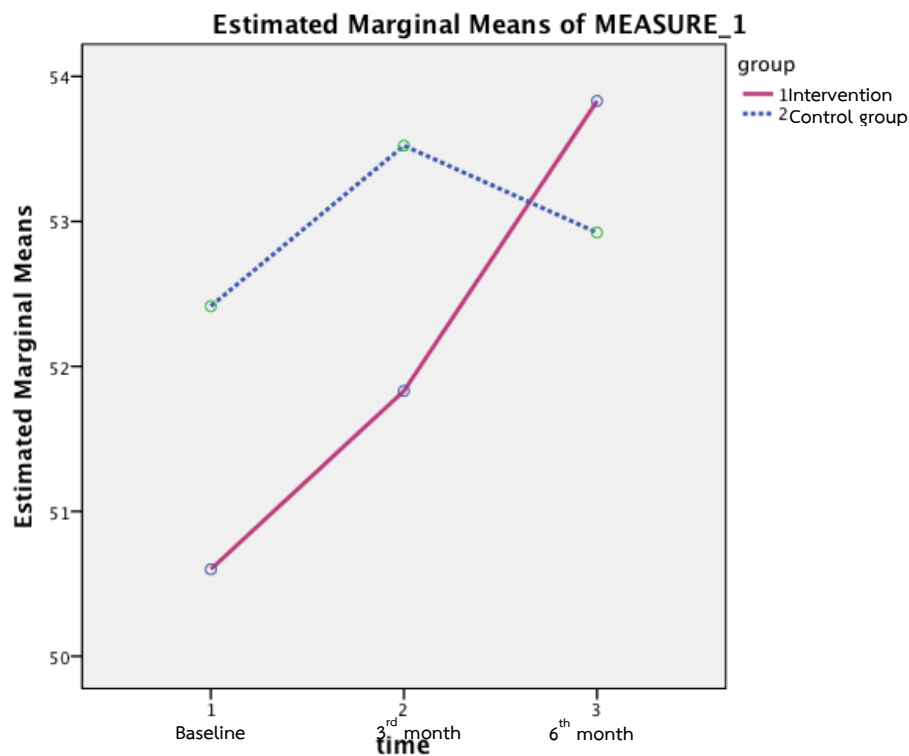


Figure 12: Change overtime on High Density Lipoprotein (HDL) in the intervention and the control groups

#### 4.8.2.3 Low density lipoprotein (LDL)

There was no statistically significant difference between the intervention and control groups ( $p=0.577$ ). Among within subjects, there was no statistically significant difference between measurements ( $p=0.412$ ). Interaction, there was no statistically significant difference between measurements of LDL depending on group ( $p=0.762$ ). (table 55 and figure 13)

Table 55: Repeated measure ANOVA of LDL between the intervention and the control groups (n=130)

Source of variation	SS	df	MS	F	P-value
Between subjects					
Intervention	725.703	1	725.703	0.313	0.577
Within group (error) (between group error)	296746.667	128	2318.333		
Within subjects					
Time	565.421	2	282.710	0.891	0.412
Intervention x Time	172.805	2	86.403	0.272	0.762
Intervention x Within group (error) (within subject error)	81262.441	256	317.431		
Total					

SS: Sum of Squares

df: Degrees of freedom

MS: Mean Squares



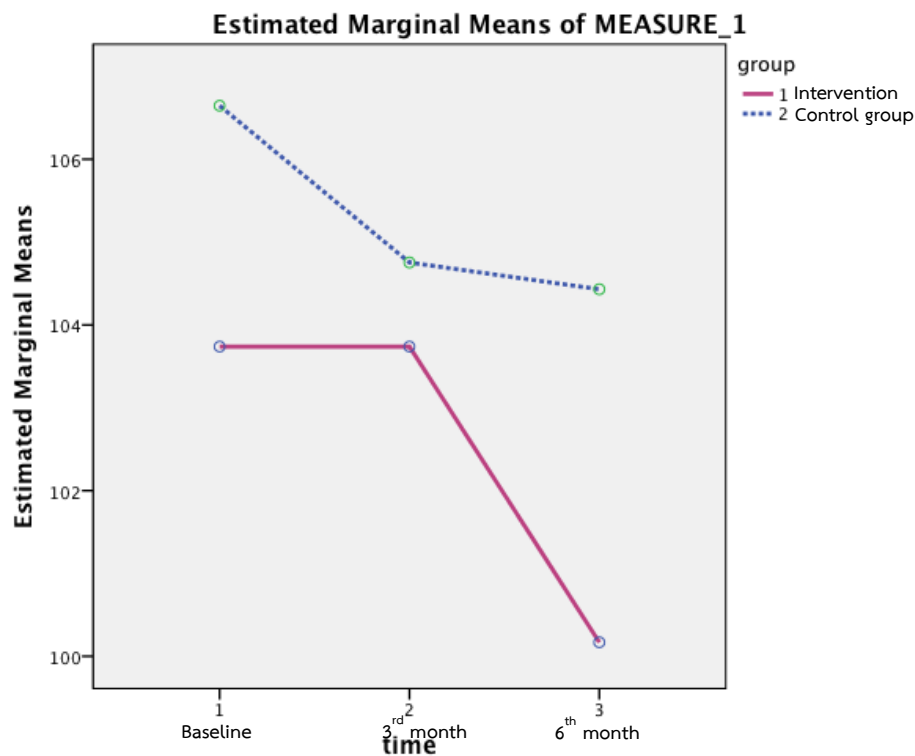


Figure 13: Change overtime on Low Density Lipoprotein (LDL) in the intervention and the control groups

#### 4.8.2.4 Body Mass Index (BMI)

There was no statistically significant difference between the intervention and control groups ( $p=0.060$ ). Among within subjects, there was no statistically significant difference between measurements ( $p=0.132$ ). Interaction, there was no statistically significant difference between measurements of LDL depending on group ( $p=0.862$ ). (table 56 and figure 14)

Table 56: Repeated measure ANOVA of BMI between the intervention and the control groups (n=130)

Source of variation	SS	df	MS	F	P-value
Between subjects					
Intervention	154.786	1	154.786	3.610	0.060
Within group (error) (between group error)	5487.953	128	42.875		
Within subjects					
Time	8.361	1.758	4.756	2.096	0.132
Intervention x Time	0.479	1.758	0.273	0.120	0.862
Intervention x Within group (error) (within subject error)	510.627	225.001	2.269		
Total					

SS: Sum of Squares

df: Degrees of freedom

MS: Mean Squares

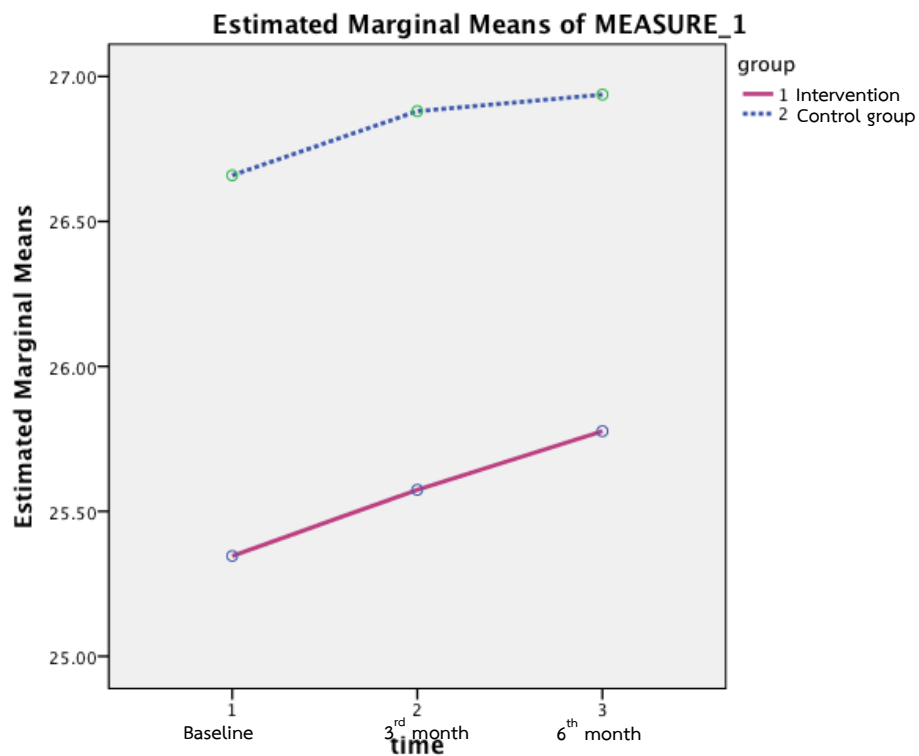


Figure 14: Change overtime on Body Mass Index (BMI) in the intervention and the control groups

#### 4.9 The effectiveness of LCDC program on glycemc status by Repeated measure ANOVA

##### 4.9.1 Fasting plasma glucose (FPG)

There was a statistically significant difference between the intervention and control groups ( $p=0.001$ ). Among within subjects, there was no statistically significant difference between measurements ( $p=0.343$ ). Interaction, there was a statistically significant difference between measurements of FPG depending on group ( $p=0.010$ ). (table 57 and figure 15)

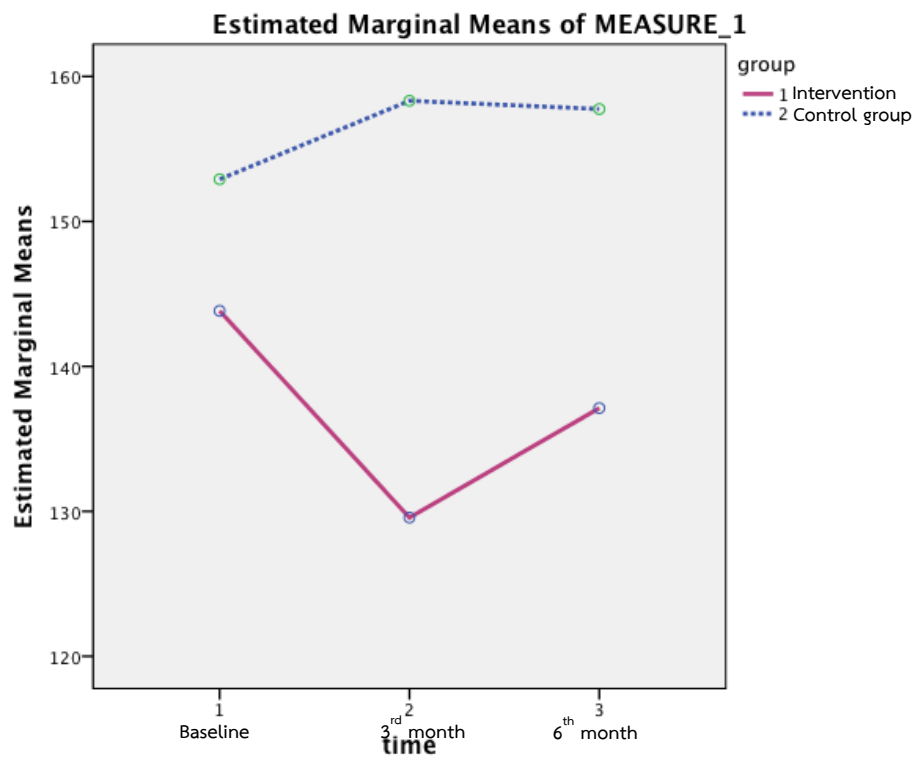
Table 57: The effectiveness of LCDC program on FPG between the intervention and the control groups (n=130)

Source of variation	SS	df	MS	F-test	P-value
Between subjects					
Intervention	37025.641	1	37025.641	11.358	<b>0.001</b>
Within group (error) (between group error)	417259.067	128	3259.836		
Within subjects					
Time	1413.800	1.909	740.482	4.806	0.343
Intervention x Time	6355.451	1.909	3328.687	4.806	<b>0.010</b>
Intervention x Within group (error) (within subject error)	169268.749	244.390	692.617		
Total					

SS: Sum of Squares

df: Degrees of freedom

MS: Mean Squares



*Figure 15: Change overtime on Fasting plasma glucose (FPG) in the intervention and the control groups*

There were statistically significant differences between the intervention and the control groups of FPG at 3 and 6 month follow up ( $p < 0.001$  and  $0.001$ , respectively). (table 58)

Table 58: Pairwise comparisons of the different measurements of FPG between the intervention and the control groups in the intervention and the control groups

(n=130)

Time	Group (i)	Group (j)	Mean Difference (i-j)	SE	P	95% Confidence Interval <sup>b</sup>	
						Upper	Lower
Baseline	Control	Intervention	9.077	7.982	0.258	-6.716	24.870
3 <sup>rd</sup> month	Control	Intervention	28.754 <sup>*</sup>	6.429	< 0.001	16.034	41.474
6 <sup>th</sup> month	Control	Intervention	20.631 <sup>*</sup>	5.996	0.001	8.766	32.496

Based on estimated marginal means

<sup>\*</sup>. The mean difference is significant at the 0.05 level.

<sup>b</sup>. Adjustment for multiple comparison: Bonferroni.

FPG, there was a statistically significant difference between baseline and 3 month follow up of the intervention group (p=0.002). (table 59)

Table 59: Pairwise comparisons of the different measurements of FPG in the time of measurements in the intervention and the control groups (n=130)

Group	Time (i)	Time (j)	Mean Differenc e (i-j)	SE	P	95% Confidence Interval <sup>b</sup>	
						Upper	Lower
Intervention	baseline	3 <sup>rd</sup> month	14.262	4.163	<b>0.002</b>	4.162	24.361
	baseline	6 <sup>th</sup> month	6.708	4.967	0.538	-5.341	18.756
	3 <sup>rd</sup> month	6 <sup>th</sup> month	-7.554	4.362	0.257	-18.137	3.029
Control	baseline	3 <sup>rd</sup> month	-5.415	4.163	0.587	-15.515	4.684
	baseline	6 <sup>th</sup> month	-4.846	4.967	0.993	-16.895	7.203
	3 <sup>rd</sup> month	6 <sup>th</sup> month	0.569	4.362	1.000	-10.013	1.152

Based on estimated marginal means

\* . The mean difference is significant at the 0.05 level.

<sup>b</sup>. Adjustment for multiple comparison: Bonferroni.

#### 4.9.2 Glycated hemoglobin (HbA1c)

There was a statistically significant difference between the intervention and control groups ( $p=0.010$ ). Among within subjects, there was a statistically significant difference between measurements ( $p=0.009$ ). Interaction, there was a statistically significant difference between measurements of HbA1c depending on group ( $p=0.001$ ). (table 60 and figure 16)

Table 60: The effectiveness of LCDC program on HbA1c between the intervention and the control groups (n=130)

Source of variation	SS	df	MS	F-test	P-value
Between subjects					
Intervention	29.908	1	29.908	6.886	<b>0.010</b>
Within group (error) (between group error)	555.919	1	4.343		
Within subjects					
Time	2.319	2	1.160	4.781	<b>0.009</b>
Intervention x Time	3.350	2	1.675	6.905	<b>0.001</b>
Intervention x Within group (error) (within subject error)	62.097	256	0.243		
Total					

SS: Sum of Squares

df: Degrees of freedom

MS: Mean Squares



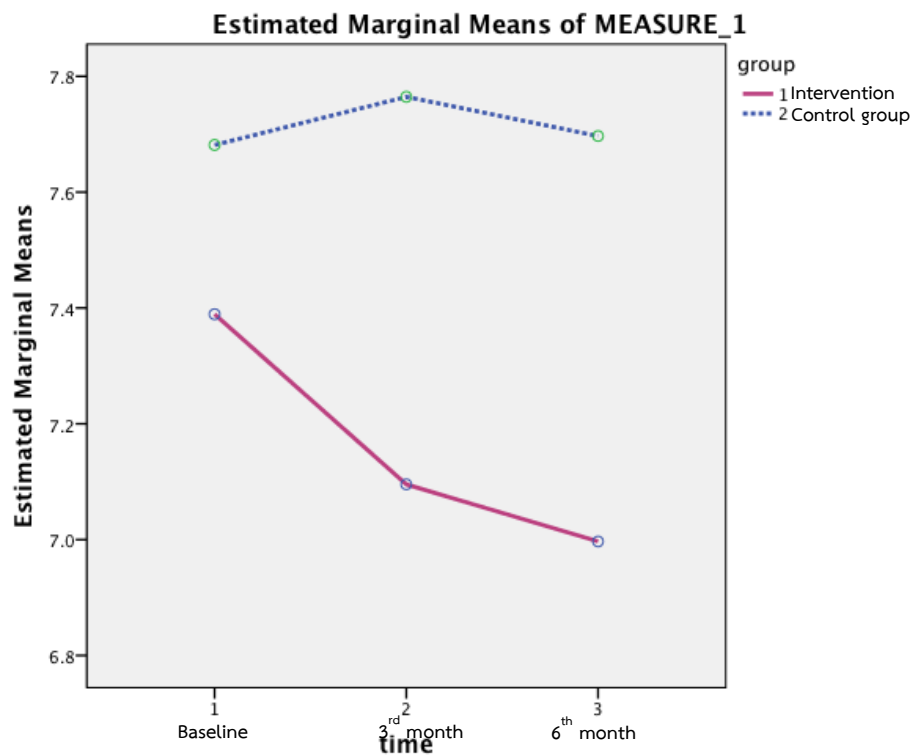


Figure 16: Change overtime on Glycated hemoglobin (HbA1c) in the intervention and the control groups

There were statistically significant differences between the intervention and the control groups of HbA1c at 3 and 6 month follow up ( $p=0.003$  and  $0.001$ , respectively). (table 61)

Table 61: Pairwise comparisons of the different measurements of HbA1c between the intervention and the control groups (n=130)

Time	Group (i)	Group (j)	Mean Difference (i-j)	SE	P	95% Confidence Interval <sup>b</sup>	
						Upper	Lower
Baseline	Control	Intervention	0.292	0.236	0.217	-0.174	0.759
3 <sup>rd</sup> month	Control	Intervention	0.669*	0.222	<b>0.003</b>	0.229	1.109
6 <sup>th</sup> month	Control	Intervention	0.700*	0.209	<b>0.001</b>	0.287	1.113

Based on estimated marginal means

\*. The mean difference is significant at the 0.05 level.

<sup>b</sup>. Adjustment for multiple comparison: Bonferroni.

HbA1c, there were statistically significant differences between baseline and 3 month follow up, and baseline and 6 month follow up of the intervention group (p=0.003 and <0.001, respectively). (table 62)

Table 62: Pairwise comparisons of the different measurements of glycated hemoglobin (HbA1c) in the time of measurements of the intervention and the control groups (n=130)

Group	Time (i)	Time (j)	Mean Differenc e (i-j)	SE	P	95% Confidence Interval <sup>b</sup>	
						Upper	Lower
Intervention	baseline	3 <sup>rd</sup> month	0.294	0.086	<b>0.003</b>	0.084	0.503
	baseline	6 <sup>th</sup> month	0.392	0.083	<b>&lt;0.001</b>	0.191	0.593
	3 <sup>rd</sup> month	6 <sup>th</sup> month	0.098	0.090	0.826	-0.120	0.317
Control	baseline	3 <sup>rd</sup> month	-0.083	0.086	1.000	-0.293	0.126
	baseline	6 <sup>th</sup> month	-0.015	0.083	1.000	-0.216	0.185
	3 <sup>rd</sup> month	6 <sup>th</sup> month	0.068	0.090	1.000	-0.150	0.286

Based on estimated marginal means

\* . The mean difference is significant at the 0.05 level.

<sup>b</sup> . Adjustment for multiple comparison: Bonferroni.

#### 4.10 Periodontal status at baseline, 3 month, and 6 month follow up in the intervention and the control groups

##### 4.10.1 Descriptive statistics of periodontal status at baseline, 3 month, and 6 month follow up in the intervention and the control groups

###### 4.10.1.1 Plaque index score

The average plaque index score (SD) at baseline, 3 month, and 6 month follow up in the intervention group were 0.60 (0.42), 0.26 (0.31), and 0.19 (0.28) mm, respectively. The average plaque index score (SD) at baseline, 3 month, and 6 month follow up in the control group were 0.63 (0.41), 0.45 (0.45), and 0.42 (0.51) mm, respectively. (table 63)

#### 4.10.1.2 Gingival index score

The average gingival index score (SD) at baseline, 3 month, and 6 month follow up in the intervention group were 0.66 (0.41), 0.27 (0.29), and 0.22 (0.27) mm, respectively. The average gingival index score (SD) at baseline, 3 month, and 6 month follow up in the control group were 0.76 (0.48), 0.48 (0.40), and 0.46 (0.46) mm, respectively. (table 63)

#### 4.10.1.3 Pocket depth

The average pocket depth (SD) at baseline, 3 month, and 6 month follow up in the intervention group were 2.36 (0.55), 2.04 (0.47), and 2.09 (0.52) mm, respectively. The average pocket depth (SD) at baseline, 3 month, and 6 month follow up in the control group were 2.40 (0.81), 2.54 (0.88), and 2.56 (0.91) mm, respectively. (table 63)

#### 4.10.1.4 Clinical attachment loss (CAL)

The average CAL (SD) at baseline, 3 month, and 6 month follow up in the intervention group were 3.35 (0.88), 2.96 (0.85), and 2.97 (0.89) mm., respectively. The average CAL (SD) at baseline, 3 month, and 6 month follow up in the control group were 3.67 (1.30), 3.64 (1.37), and 3.44 (1.29) mm. respectively. (table 63)



Table 63: Descriptive statistics of periodontal status at baseline, 3 month, and 6 month follow up in the intervention and the control groups

Variables	Baseline (n=66)	3 month (n=65)	6 month (n=65)
<b>Plaque index score (mm.)</b>			
- Intervention: mean (SD)	0.60 (0.42)	0.26 (0.31)	0.19 (0.28)
- Control : mean (SD)	0.63 (0.41)	0.45 (0.45)	0.42 (0.51)
<b>Gingival index score (mm.)</b>			
- Intervention: mean (SD)	0.66 (0.41)	0.27 (0.29)	0.22 (0.27)
- Control : mean (SD)	0.76 (0.48)	0.48 (0.40)	0.46 (0.46)
<b>Pocket depth (mm.)</b>			
- Intervention: mean (SD)	2.36 (0.55)	2.04 (0.47)	2.09 (0.52)
- Control : mean (SD)	2.40 (0.81)	2.54 (0.88)	2.56 (0.91)
<b>Clinical attachment loss (mm.)</b>			
- Intervention: mean (SD)	3.35 (0.88)	2.96 (0.85)	2.97 (0.89)
- Control : mean (SD)	3.67 (1.30)	3.64 (1.37)	3.44 (1.29)

#### 4.11 The effectiveness of LCDC program on periodontal status by Repeated measure ANOVA

##### 4.11.1 Plaque index score

There was a statistically significant difference between the intervention and control groups ( $p=0.007$ ). Among within subjects, there was a statistically significant difference between measurements ( $p<0.001$ ). Interaction, there was a statistically significant difference between measurements of plaque index score depending on group ( $p=0.032$ ). (table 64 and figure 17)

Table 64: The effectiveness of LCDC program on plaque index score between the intervention and the control groups (n=130)

Source of variation	SS	df	MS	F-test	P-value
Between subjects					
Intervention	2.361	1	2.361	7.466	<b>0.007</b>
Within group (error) (between group error)	40.473	128	0.316		
Within subjects					
Time	7.079	1.812	3.906	40.685	<b>&lt;0.001</b>
Intervention x Time	0.633	1.812	0.349	3.640	<b>0.032</b>
Intervention x Within group (error) (within subject error)	22.272	231.981	0.096		
Total					

SS: Sum of Squares

df: Degrees of freedom

MS: Mean Squares

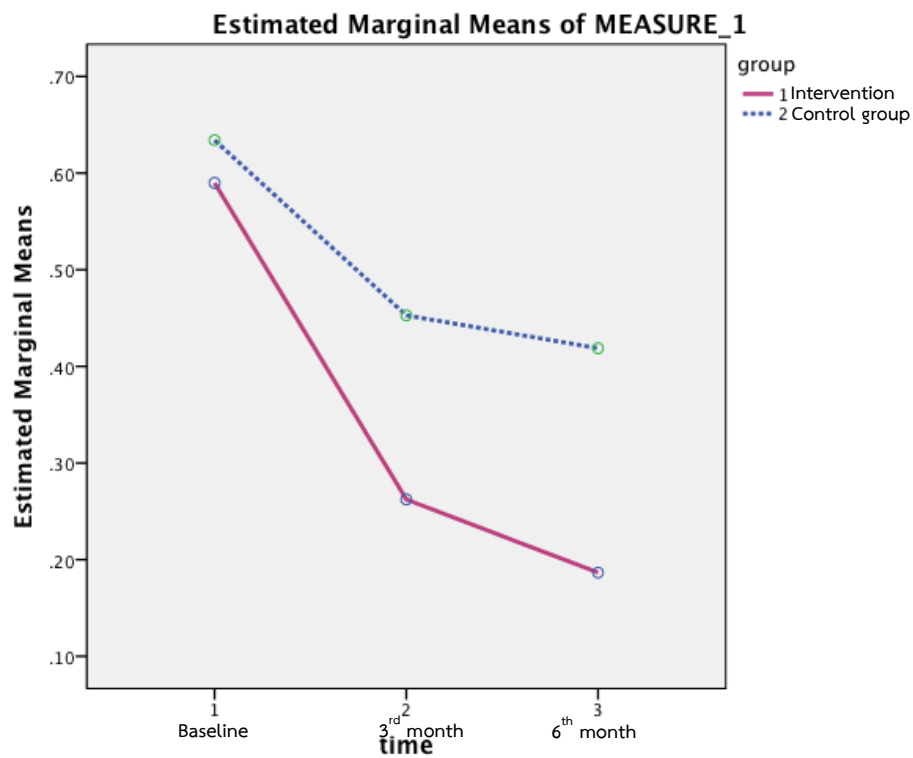


Figure 17: Change overtime on Plaque index score in the intervention and the control groups

There were statistically significant differences between the intervention and the control groups of plaque index score at 3 and 6 month follow up ( $p=0.006$  and  $0.002$ , respectively). (table 65)



Table 65: Pairwise comparisons of the different measurements of plaque index score between the intervention and the control groups (n=130)

Time	Group (i)	Group (j)	Mean Difference (i-j)	SE	P	95% Confidence Interval <sup>b</sup>	
						Upper	Lower
Baseline	Control	Intervention	0.044	0.073	0.544	-0.099	0.188
3 <sup>rd</sup> month	Control	Intervention	0.190 <sup>*</sup>	0.068	<b>0.006</b>	0.056	0.325
6 <sup>th</sup> month	Control	Intervention	0.232 <sup>*</sup>	0.072	<b>0.002</b>	0.090	0.374

Based on estimated marginal means

<sup>\*</sup>. The mean difference is significant at the 0.05 level.

<sup>b</sup>. Adjustment for multiple comparison: Bonferroni.

Plaque index score, there were statistically significant differences between baseline and 3 month follow up, and baseline and 6 month follow up of the intervention group (p=0.003 and <0.001, respectively). In the control group, there were statistically significant differences between baseline and 3 month follow up, and baseline and 6 month follow up (p=0.003 and 0.001, respectively). (table 66)

Table 66: Pairwise comparisons of the different measurements of plaque index score in the time of measurements of the intervention and the control groups (n=130)

Group	Time (i)	Time (j)	Mean Differenc e (i-j)	SE	P	95% Confidence Interval <sup>b</sup>	
						Upper	Lower
Intervention	baseline	3 <sup>rd</sup> month	0.328	0.054	<0.001	0.196	0.459
	baseline	6 <sup>th</sup> month	0.403	0.057	<0.001	0.265	0.542
	3 <sup>rd</sup> month	6 <sup>th</sup> month	0.076	0.043	0.239	-0.029	0.180
Control	baseline	3 <sup>rd</sup> month	0.181	0.054	0.003	0.050	0.313
	baseline	6 <sup>th</sup> month	0.215	0.057	0.001	0.077	0.354
	3 <sup>rd</sup> month	6 <sup>th</sup> month	0.034	0.043	1.000	-0.070	0.138

Based on estimated marginal means

\* . The mean difference is significant at the 0.05 level.

<sup>b</sup> . Adjustment for multiple comparison: Bonferroni.

#### 4.11.2 Gingival index score

There was a statistically significant difference between the intervention and control groups ( $p=0.001$ ). Among within subjects, there was a statistically significant difference between measurements ( $p<0.001$ ). Interaction, there was no statistically significant difference between measurements of gingival index score depending on group ( $p=0.217$ ). (table 67 and figure 18)

Table 67: The effectiveness of LCDC program on gingival index score between the intervention and the control groups (n=130)

Source of variation	SS	df	MS	F-test	P-value
Between subjects					
Intervention	3.473	1	3.473	12.123	<b>0.001</b>
Within group (error) (between group error)	36.667	128	0.286		
Within subjects					
Time	10.981	1.768	3.210	62.094	<b>&lt;0.001</b>
Intervention x Time	0.273	1.768	0.155	1.545	0.217
Intervention x Within group (error) (within subject error)	22.637	226.350	0.100		
Total					

SS: Sum of Squares

df: Degrees of freedom

MS: Mean Squares

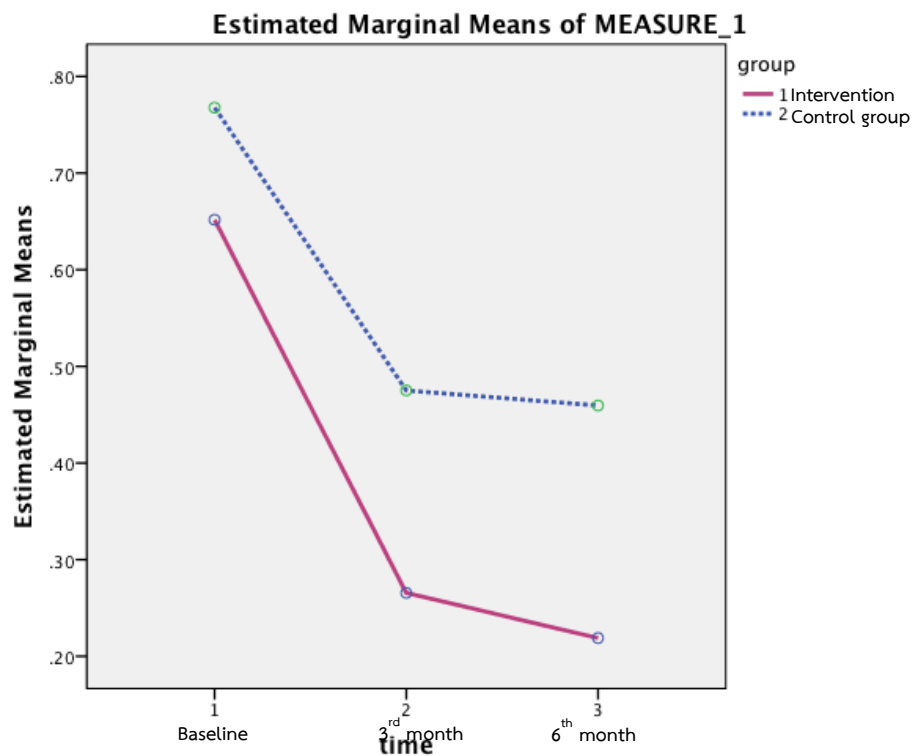


Figure 18: Change overtime on Gingival index score in the intervention and the control groups

There were statistically significant differences between the intervention and the control groups of gingival index score at 3 and 6 month follow up ( $p=0.001$  and  $<0.001$ , respectively). (table 68)

Table 68: Pairwise comparisons of the different measurements of gingival index score between the intervention and the control groups (n=130)

Time	Group (i)	Group (j)	Mean Difference (i-j)	SE	P	95% Confidence Interval <sup>b</sup>	
						Upper	Lower
Baseline	Control	Intervention	0.116	0.078	0.139	-0.038	0.270
3 <sup>rd</sup> month	Control	Intervention	0.210 <sup>*</sup>	0.062	<b>0.001</b>	0.088	0.331
6 <sup>th</sup> month	Control	Intervention	0.241 <sup>*</sup>	0.066	<b>&lt;0.001</b>	0.110	0.372

Based on estimated marginal means

<sup>\*</sup>. The mean difference is significant at the 0.05 level.

<sup>b</sup>. Adjustment for multiple comparison: Bonferroni.

Gingival index score, there were statistically significant differences between baseline and 3 month follow up, and baseline and 6 month follow up of the intervention group ( $p < 0.001$  and  $< 0.001$ , respectively). In the control group, there were statistically significant differences between baseline and 3 month follow up, and baseline and 6 month follow up ( $p < 0.001$  and  $< 0.001$ , respectively). (table 69)

Table 69: Pairwise comparisons of the different measurements of gingival index score in the time of measurements of the intervention and the control groups (n=130)

Group	Time (i)	Time (j)	Mean Differenc e (i-j)	SE	P	95% Confidence Interval <sup>b</sup>	
						Upper	Lower
Intervention	baseline	3 <sup>rd</sup> month	0.386	0.055	<0.001	0.253	0.519
	baseline	6 <sup>th</sup> month	0.433	0.058	<0.001	0.292	0.574
	3 <sup>rd</sup> month	6 <sup>th</sup> month	0.047	0.042	0.806	-0.055	0.148
Control	baseline	3 <sup>rd</sup> month	0.293	0.055	<0.001	0.159	0.426
	baseline	6 <sup>th</sup> month	0.308	0.058	<0.001	0.167	0.449
	3 <sup>rd</sup> month	6 <sup>th</sup> month	0.016	0.042	1.000	-0.086	0.117

Based on estimated marginal means

\* . The mean difference is significant at the 0.05 level.

<sup>b</sup> . Adjustment for multiple comparison: Bonferroni.

#### 4.11.3 Pocket depth

There was a statistically significant difference between the intervention and control groups ( $p=0.003$ ). Among within subjects, there was a statistically significant difference between measurements ( $p=0.222$ ). Interaction, there was no statistically significant difference between measurements of pocket depth depending on group ( $p<0.001$ ). (table 70 and figure 19)

Table 70: The effectiveness of LCDC program on pocket depth between the intervention and the control groups (n=130)

Source of variation	SS	df	MS	F-test	P-value
Between subjects					
Intervention	11.386	1	11.386	9.206	<b>0.003</b>
Within group (error) (between group error)	158.304	128	1.237		
Within subjects					
Time	0.430	1.814	0.237	1.518	0.222
Intervention x Time	4.338	1.814	2.391	15.304	<b>&lt;0.001</b>
Intervention x Within group (error) (within subject error)	36.281	232.179	0.156		
Total					

SS: Sum of Squares

df: Degrees of freedom

MS: Mean Squares

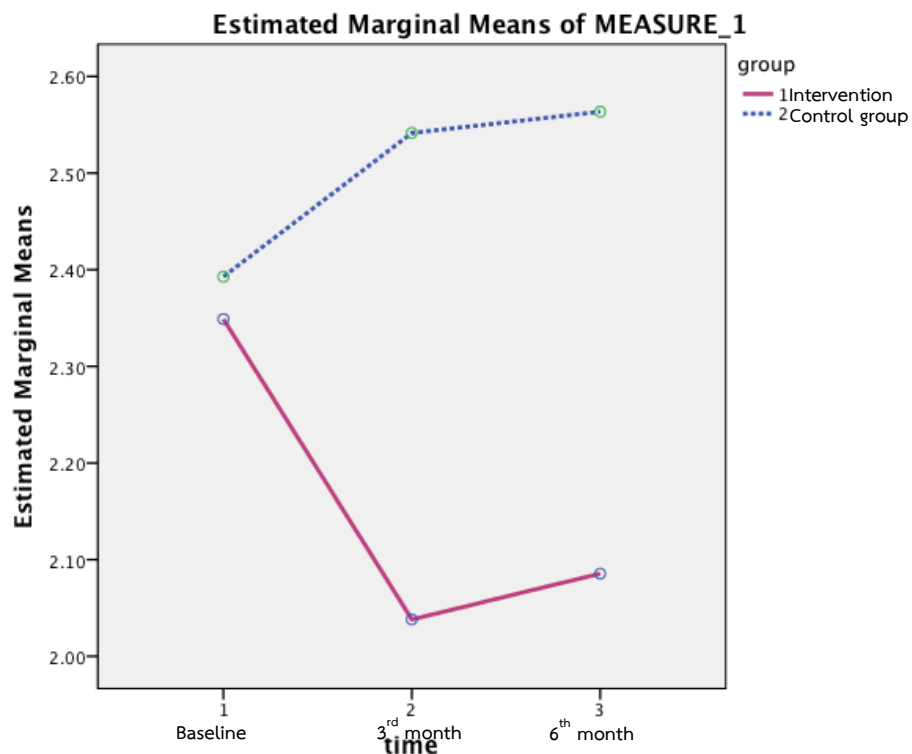


Figure 19: Change overtime on Pocket depth in the intervention and the control groups

There were statistically significant differences between the intervention and the control groups of pocket depth at 3 and 6 month follow up ( $p < 0.001$  and  $< 0.001$ , respectively). (table 71)



Table 71: Pairwise comparisons of the different measurements of pocket depth between the intervention and the control groups (n=130)

Time	Group (i)	Group (j)	Mean Difference (i-j)	SE	P	95% Confidence Interval <sup>b</sup>	
						Upper	Lower
Baseline	Control	Intervention	0.044	0.121	0.719	-0.196	0.284
3 <sup>rd</sup> month	Control	Intervention	0.503 <sup>*</sup>	0.124	<b>&lt;0.001</b>	0.259	0.748
6 <sup>th</sup> month	Control	Intervention	0.478 <sup>*</sup>	0.129	<b>&lt;0.001</b>	0.222	0.734

Based on estimated marginal means

<sup>\*</sup>. The mean difference is significant at the 0.05 level.

<sup>b</sup>. Adjustment for multiple comparison: Bonferroni.

Pocket depth, there were statistically significant differences between baseline and 3 month follow up, and baseline and 6 month follow up of the intervention group (p<0.001 and 0.002, respectively). (table 72)

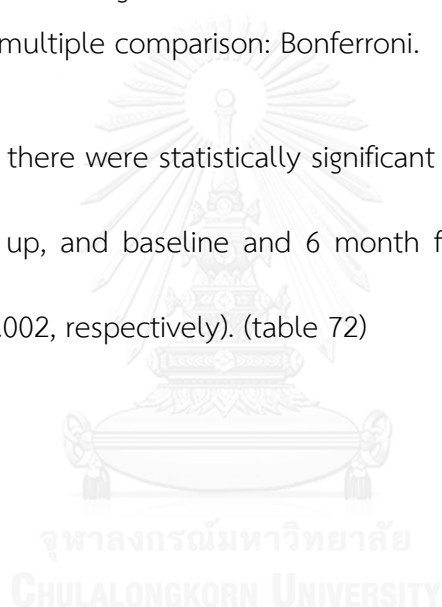


Table 72: Pairwise comparisons of the different measurements of pocket depth in the time of measurements of the intervention and the control groups (n=130)

Group	Time (i)	Time (j)	Mean Differenc e (i-j)	SE	P	95% Confidence Interval <sup>b</sup>	
						Upper	Lower
Intervention	baseline	3 <sup>rd</sup> month	0.311	0.068	<b>&lt;0.001</b>	0.147	0.475
	baseline	6 <sup>th</sup> month	0.264	0.074	<b>0.002</b>	0.084	0.443
	3 <sup>rd</sup> month	6 <sup>th</sup> month	-0.047	0.055	1.000	-0.182	0.087
Control	baseline	3 <sup>rd</sup> month	-0.149	0.068	0.089	-0.313	0.015
	baseline	6 <sup>th</sup> month	-0.171	0.074	0.067	-0.350	0.008
	3 <sup>rd</sup> month	6 <sup>th</sup> month	-0.022	0.055	1.000	-0.156	0.112

Based on estimated marginal means

\* . The mean difference is significant at the 0.05 level.

<sup>b</sup> . Adjustment for multiple comparison: Bonferroni.

#### 4.11.4 Clinical attachment loss (CAL)

There was a statistically significant difference between the intervention and control groups ( $p=0.008$ ). Among within subjects, there was a statistically significant difference between 3<sup>rd</sup> measurements ( $p<0.001$ ). Interaction, there was no statistically significant difference between measurements of CAL depending on group ( $p=0.022$ ).

(table 73 and figure 20)

Table 73: The effectiveness of LCDC program on CAL between the intervention and the control groups (n=130)

Source of variation	SS	df	MS	F-test	P-value
Between subjects					
Intervention	24.111	1	24.11	7.304	<b>0.008</b>
Within group (error) (between group error)	422.504	128	3.301		
Within subjects					
Time	5.979	2	2.990	13.125	<b>&lt;0.001</b>
Intervention x Time	1.773	2	0.886	3.891	<b>0.022</b>
Intervention x Within group (error) (within subject error)	58.312	256	0.228		
Total					

SS: Sum of Squares

df: Degrees of freedom

MS: Mean Squares

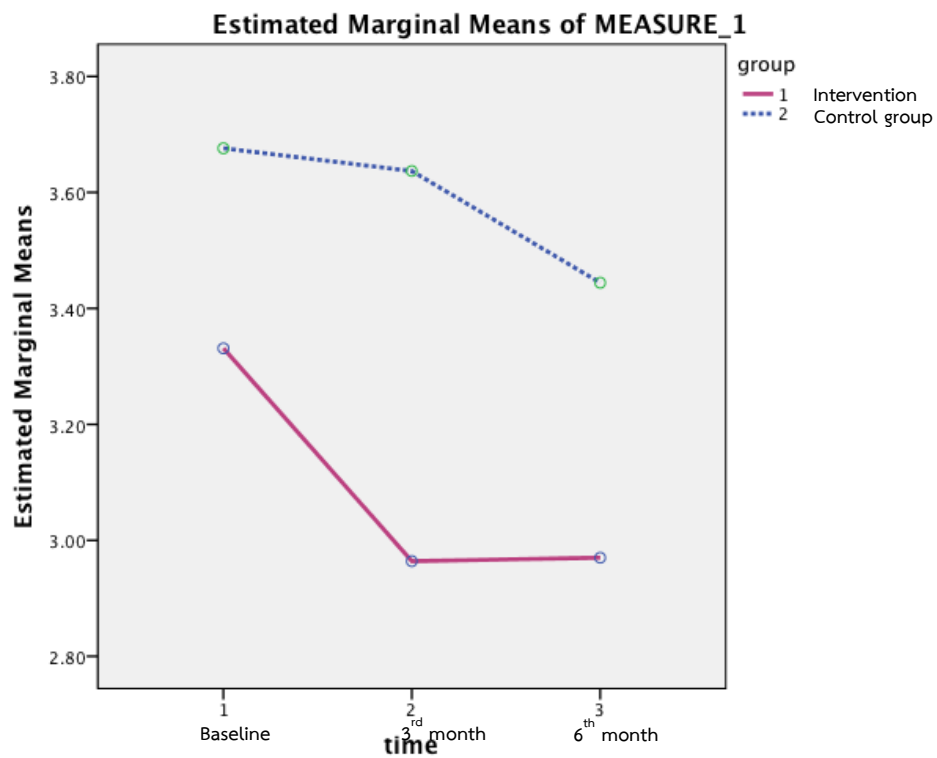


Figure 20: Change overtime on Clinical attachment loss (CAL) in the intervention and the control groups

There were statistically significant differences between the intervention and the control groups of CAL at 3 and 6 month follow up ( $p=0.001$  and  $0.016$ , respectively). (table 74)

Table 74: Pairwise comparisons of the different measurements of CAL between the intervention and the control groups (n=130)

Time	Group (i)	Group (j)	Mean Difference (i-j)	SE	P	95% Confidence Interval <sup>b</sup>	
						Upper	Lower
Baseline	Control	Intervention	0.345	0.195	0.079	-0.041	0.731
3 <sup>rd</sup> month	Control	Intervention	0.673 <sup>*</sup>	0.199	<b>0.001</b>	0.279	1.067
6 <sup>th</sup> month	Control	Intervention	0.474 <sup>*</sup>	0.195	<b>0.016</b>	0.089	0.859

Based on estimated marginal means

<sup>\*</sup>. The mean difference is significant at the 0.05 level.

<sup>b</sup>. Adjustment for multiple comparison: Bonferroni.

CAL, there were statistically significant differences between baseline and 3 month follow up, and baseline and 6 month follow up of the intervention group ( $p < 0.001$  and  $0.002$ , respectively). In the control group, there was a statistically significant differences between baseline and 6 month follow up ( $p = 0.032$ ). (table 75)

Table 75: Pairwise comparisons of the different measurements of CAL in the time of measurements of the intervention and the control groups (n=130)

Group	Time (i)	Time (j)	Mean Differenc e (i-j)	SE	P	95% Confidence Interval <sup>b</sup>	
						Upper	Lower
Intervention	baseline	3 <sup>rd</sup> month	0.367	0.079	<0.001	0.175	0.559
	baseline	6 <sup>th</sup> month	0.361	0.090	<0.001	0.144	0.579
	3 <sup>rd</sup> month	6 <sup>th</sup> month	-0.006	0.082	1.000	-0.205	0.193
Control	baseline	3 <sup>rd</sup> month	0.039	0.079	1.000	-0.153	0.232
	baseline	6 <sup>th</sup> month	0.232	0.090	<b>0.032</b>	0.015	0.449
	3 <sup>rd</sup> month	6 <sup>th</sup> month	0.193	0.082	0.060	-0.006	0.391

Based on estimated marginal means

\* . The mean difference is significant at the 0.05 level.

<sup>b</sup> . Adjustment for multiple comparison: Bonferroni.

## CHAPTER V

### DISCUSSION, CONCLUSION, AND RECOMMENDATION

#### 5.1 Discussion

This study was a quasi-experimental study aim to assess the effectiveness of Lifestyle Change plus Dental Care (LCDC) program to improve glycemic and periodontal status in the elderly with type 2 diabetes patients who received services in BMA Health centers. Health Center 54 received the intervention program and the Health Center 59 received the routine program (control).

##### 5.1.1 Baseline characteristics

At baseline, more than half of the participants in both intervention and control groups were female. Most of them had age between 60-69 years, finish primary school, lived with family member, had universal coverage of health centers. Almost half of them had family history of diabetes. Duration of being diabetes was 6.86 years in the intervention group and 8.42 years in the control group. Most of the participants in both intervention and control groups never smoke. There were no statistically significant differences of general characteristics, biological parameters, knowledge, attitude, and practice toward DM and oral health, and periodontal status between the intervention and the control groups. These results showed the participants in both intervention and control groups had similar characteristics.

### **5.1.2 Difference of knowledge and attitude score between pre and post education**

After the lifestyle and oral health education, the participants in the intervention group increased the overall score of knowledge toward DM and oral health, knowledge toward DM, and knowledge toward oral health with statistically significant differences. The overall score of attitude toward DM and oral health, attitude toward DM, and attitude toward oral health also increased after education. However, there was a statistically significant difference only the attitude toward oral health. The increase of knowledge and attitude score stated the effectiveness of lifestyle and oral health education consistent with Yuen et al., 2009 found the participants who received oral health information related diabetes had 2.9 times the odds of possessing adequate oral health knowledge. [82] Pereira et al., 2012 found the educational intervention increased the disease knowledge of diabetic patients. [94] Moreover, Hartayu et al., 2012 found their participants increased knowledge and attitude immediately after education. [95] Furthermore, Saleh et al., 2012 found health education and motivation created positive changes in diabetes-control-related self-care practices. [96]

### **5.1.3 The relationship between blood glucose level and periodontal status**

The results of the present study found the uncontrolled glycemic group had higher plaque index score, pocket depth, and CAL than the controlled glycemic group. Furthermore, 10.1% of the uncontrolled glycemic group had severe



periodontitis whereas only 4.3% of controlled glyceemic group had severe periodontitis. However, there were no statistically significant differences between glyceemic control and periodontal status. The present study found no relationship between blood glucose level and periodontal status inconsistent with the previous studies. [16, 20, 40, 97, 98] The difference of the result might be due to the present study had low number of the controlled glyceemic group (n=23) when compare to the uncontrolled glyceemic group (n=109). Furthermore, the previous study used the difference cut point of glyceemic control. The present study used the level of HbA1c < 6.5% as glyceemic control whereas the previous study used the level of HbA1c < 7.0% as glyceemic control. When used the level of HbA1c < 7.0% as glyceemic control to analyze the relationship between blood glucose level and periodontal status in the present study found the relationship between pocket depth and CAL. (appendix W)

#### **5.1.4 Knowledge toward DM and oral health at baseline, 3 month, and 6 month follow up**

Although at baseline, there were statistically significant differences of the knowledge of drug's one of method to treat DM and monitoring blood pressure is the method to investigate DM between the intervention and the control groups; the control group had more knowledge of method to treat and to investigate DM than the intervention group. However, after received the LCDC program, the intervention

group had more knowledge of method to treat and to investigate DM than the control group with statistically significant differences.

The average overall score of knowledge toward DM and oral health, knowledge toward DM, and knowledge toward oral health at baseline, 3 month, and 6 month follow up were increasing with statistically significant differences between the intervention and the control groups and time of measurements. These results stated the effectiveness of the LCDC program by increase the knowledge toward DM and oral health in the elderly with type 2 diabetes patients. Furthermore, the knowledge also sustained to 6 month follow up. Consistent with Inoue et al., 2013 who studied the impact of communicative and critical health literacy in type 2 diabetes patients which receiving services in primary care in Japan, found clear patient-physician communication associated with an understanding of diabetes care and self-efficacy. [75] Moreover, Xiao-hui et al., 2012 studied in China found diabetes education increased knowledge score of type 2 diabetes patients. [99] Yuen et al., 2009 found oral health knowledge also increased after patients received oral health information from health professionals. [82] Hernandez-Tejada et al., 2012 found diabetes empowerment improved self-care behaviors included diabetes knowledge. [76] Rise et al., 2013 who studied a qualitative study to maintain lifestyle change after type 2 diabetes education who found that knowledge was essential for making lifestyle change following education. [100] Pereira et al., 2012 found significantly increased knowledge toward diabetes after educational intervention which was

maintained to 6 month follow up. [94] Hartayu et al., 2012 also found improved knowledge toward self-care in type 2 diabetes patients after implementing the community-based interactive approach. [95]

#### **5.1.5 Attitude toward DM and oral health at baseline, 3 month, and 6 month follow up**

The average overall score of attitude toward DM and oral health, attitude toward DM, and attitude toward oral health at baseline, 3 month, and 6 month follow up were increasing with statistically significant differences between the intervention and the control groups and time of measurements. These results stated the effectiveness of the LCDC program by increase the attitude toward DM and oral health in the elderly with type 2 diabetes patients. Furthermore, the attitude also sustained to 6 month follow up. Consistent with Hartayu et al., 2012 found the improving attitude toward self-care in type 2 diabetes patients after implementing community-based interactive approach. [95] Bayat et al., 2013 found that education based on the health belief model in type 2 diabetes patients increased perceived susceptibility, perceived intensity, perceived benefits, perceived barriers, and self-efficacy to 6 month follow up. [101]

#### **5.1.6 Practice toward DM and oral health at baseline, 3 month, and 6 month follow up**

##### **5.1.6.1 Practice toward DM**

Physical activity, at baseline found no statistically significant difference of the frequency of physical activity between the intervention and the control groups. At 3

and 6 month follow up, the percentage of participants who exercise more than 6 days per week were increasing from baseline in the intervention group and the percentage of participants who never exercise were decreasing from baseline in the intervention group with statistically significant differences of the frequency of physical activity between the intervention and the control groups. These results showed LCDC program increased the physical activity in the elderly with type 2 diabetes patients. Consistent with Venditti et al., 2014 found lifestyle coaching solved a problem and increased regular self-monitoring skills for exercise in diabetic patients. [102] Hernandez-Tejada et al., 2012 found diabetes empowerment improved self-care behaviors included exercise. [76] Insulin sensitivity was more dependent on exercise duration than exercise intensity. [103] However, Miller et al., 2012 found mindful eating intervention to a diabetes self-management intervention had no significant difference of physical activity in 3 months. [104] Khunti et al., 2012 studied the effect of a single education and self-management program for 3 years found no statistically significant difference of physical activity. [77] The difference between the result of the current study and the above mentioned study is due to the fact that the above mentioned study used group education, did not use educational boosters, and used long term follow up.

Weight measurement, there were no statistically significant differences of the frequency of weight measurement at baseline, 3 month, and 6 month follow up. Most of the participants in the intervention and the control groups measured their

weight one time per month. When the patients received services in Health Center 54 and 59 which were the intervention and the control groups, every patient must measure their weight. So the results stated the participants less concentrated to control their weight at home. These results linked to the BMI because BMI also found no statistically significant differences between the intervention and the control groups at baseline, 3 month, and 6 month follow up.

Diet modification, at baseline found no statistically significant difference of the percentage of diet modification and the frequency of diet modification between the intervention and the control groups. At 3 and 6 month follow up, the percentage of participants who modified diet as advice were increasing from baseline with statistically significant difference between the intervention and the control groups. However, the frequency of diet modification found a statistically significant difference only at 6 month follow up and most of them modified diet sometimes. The present study used only two self-report questions for diet included modified diet as doctor's advice and the frequency of modified diet which not a valid measurement. However, the biomarkers including FPG and HbA1c could confirm the answer of diabetic patients. These results showed LCDC program increased diet modification in the elderly with type 2 diabetes patients without regularly diet modification. Consistent with Morimoto et al., 2012 found consuming healthy diet was associated with a lower risk of diabetes. [105] Furthermore, Yamada et al., 2014 found low carbohydrate diet is effective in lowering the HbA1c and TG in type 2 diabetes

patients. [106] Furthermore, Hernandez-Tejada et al., 2012 found diabetes empowerment improved self-care behaviors included diet. [76]

Drug adherence, there were no statistically significant differences of the percentage and the frequency of participants who ever forgot to take any drugs prescribed at baseline, 3 month, and 6 month follow up between the intervention and the control groups. Whereas, almost half of the participants in both intervention and control groups ever forgot to take drugs prescribed. These results indicated the LCDC program lacked of the effectiveness to increase drug adherence in the elderly with type 2 diabetes patients. Inconsistent with the previous study found diabetes empowerment improved self-care behaviors included medication adherence. [76]

Eye examination, there were no statistically significant differences of the eye examination at baseline, 3 month, and 6 month follow up between the intervention and the control groups. Most of the participants in the intervention and the control groups received eye examination in the past year. These results were not statistically significant differences because the doctor only sends the diabetic patients to receive eye examination. Thai Diabetes Association had Thai Clinical Practice Guideline 2010 [107] which included received eye examination once a year. However, the present study found only half of the participants received eye examination. In other countries such in UK [108] when service providers implement the Ministry of Health diabetes guidelines they receive economic incentives (paid by results policies). Furthermore, the results of eye examination might be not valid because the results

came from the diabetic patient's report, so these results might be different from retrieved from medical record.

Foot care, at 3 and 6 months, there were statistically significant differences of received foot examination, always covered shoes when outdoors, and frequency of foot screening by themselves between the intervention and the control groups. These results indicated the effectiveness of LCDC program to increase foot care in the elderly with type 2 diabetes patients. Consistent with Hernandez-Tejada et al., 2012 found diabetes empowerment improved self-care behaviors included foot care. [76]

#### **5.1.6.2 Practice toward oral health**

Utilization of dental services, there were no statistically significant differences of the utilization of dental services at baseline, 3 month, and 6 month follow up between the intervention and the control groups. One third of the participants in the intervention and the control groups received dental services. These results indicate the LCDC program did not increase the utilization of dental services in the elderly with type 2 diabetes patients. Consistent with Chaudhari et al., 2012 found patients with diabetes had lower odds of visiting a dentist. [15] Type of dental treatment, there was only a statistically significant difference of the filling at 3 month follow up between the intervention and the control groups. Inconsistent with Chaudhari et al., 2012 found diabetic patients had higher odds of receiving periodontal maintenance. [15] The elderly with type 2 diabetes patients did not increase the utilization of

dental services after received the LCDC program. The informal interview found participants did not use of dental services because some participants afraid of dental treatments and thought the loss of teeth in the elderly was normal. Furthermore, the progression of periodontal disease was slow and not affected diabetes patients life.

Oral health behaviors, at 3 month follow up, there were statistically significant differences of the used salt solution and dental floss between the intervention and the control groups. At 6 month follow up, there were statistically significant differences of the utilization of the used dental floss and inter-proximal brush between the intervention and the control groups. These results indicate the effectiveness of LCDC program to improve oral health behaviors in the elderly with type 2 diabetes patients. Dental floss and inter-proximal brush were the part of intensive oral hygiene instructions which is the most important to treat periodontal disease and maintain periodontal health. [71]

#### **5.1.7 Biological parameters (triglyceride, HDL, LDL, and BMI) at baseline, 3 month, and 6 month follow up**

TG, HDL, LDL, and BMI were no statistically significant differences between the intervention and control groups, within subjects, and interaction effects. These results indicated the LCDC program could not improve the level of TG, HDL, LDL, and BMI in the elderly with type 2 diabetes patients. Yamada et al., 2014 studied in patients with type 2 diabetes found that TG can reduce by low-carbohydrate diet.



[106] However, Drozek et.al., 2014 studied short-term effectiveness of a lifestyle intervention program found these program reduced BMI, total cholesterol, and LDL. [109] Aguiar et al., 2014 reviewed the efficacy of interventions that include diet, aerobic, and resistance training for type 2 diabetes prevention found weight loss was one of the effect of intervention. [110] Morrison et al., 2012 found monthly face-to-face counseling improved LDL cholesterol control. [28] Kanaya et al., 2012 found a community-based, translational lifestyle program decreased weight and TG in 6 month follow up. [27] Furthermore, Noda et al., 2012 also found dietary counseling by dietitians and delivery of calorie-controlled meals reduced body weight. [25] The results of the present study differed from these previous because the physical activity in the LCDC program used the exercise which appropriated for the elderly patients. Furthermore, the LCDC program did not adjust environmental factors of the diabetic patients.

#### **5.1.8 The LCDC program**

The LCDC program used common risk factor approach [111] which integrated approach in chronic disease (DM and periodontal disease) prevention by lifestyle change and dental care. This approach is one of the methods to overcome social inequalities. [111] The LCDC program was accomplished by a multi-professional team including doctors, nurse practitioners, dentists, and dental assistants. The LCDC program improved glycemic and periodontal status by multiple levels including midstream and downstream intervention. The midstream intervention which

occurred within Health centers by increase access to diabetes and oral health care by proactive dentistry from dentists and dental assistants, and nurse practitioners. The downstream intervention involved individual-level behavioral approach for prevention and disease management by the cooperation between multi-professionals including doctors, nurse practitioners, dentists, and dental assistants. [112]

The LCDC program used dental assistants to educate diabetic patients instead of dental hygienists because in BMA health centers setting dental hygienists responsible for school children. Most of them work in school whereas dental assistants work in dental clinic.

#### **5.1.8.1 The effectiveness of LCDC program on glycemic status**

FPG had a statistically significant difference between groups (intervention and control), and interaction between group and time. HbA1c had a statistically significant difference between groups (intervention and control), within subjects, and interaction between group and time. These results indicated the effectiveness of the LCDC program by decreased FPG and HbA1c when compare to the routine program. Furthermore, the LCDC program also sustained to 6 month follow up. Consistent with Drozek et.al., 2014 studied short-term effectiveness of a lifestyle intervention program found these program reduced FPG. [109] Gao et al., 2013 studied the effect of self-care, self-efficacy, social support in type 2 diabetes found self-care had a direct effect on glycemic control. [113] Valinsky et al., 2013 found educational

program for diabetic patients reduced resistance to treatment by improve glycemic control. [114] Morrison et al., 2012 found monthly face-to-face counseling improved glycemic control. [28] However, Miller et al., 2012 found mindful eating intervention to a diabetes self-management intervention had no significant difference of glycemic control in 3 months. [104] Mons et al., 2013 found supportive telephone counseling decreased HbA1c in both intervention and control groups with no significant difference. [115] Furthermore, Khunti et al., 2012 studied the effect of a single education and self-management program for 3 years found at three years the HbA1c decreased in both intervention and control groups with no significant difference. [77] The difference between the result of the current study and the abovementioned study might be due to the fact that the abovementioned study used group education, did not use educational boosters, and used long term follow up.

#### **5.1.8.2 The effectiveness of LCDC program on periodontal status**

Plaque index score had statistically significant differences between groups (intervention and control), within subjects, and interaction between group and time. Gingival index score had statistically significant differences between groups (intervention and control) and within subjects. Pocket depth had statistically significant differences between groups (intervention and control) and interaction between group and time. CAL had statistically significant differences between groups (intervention and control), within subjects, and interaction between group and time. These results indicated the effectiveness of the LCDC program by decreased plaque

index score, gingival index score, pocket depth, and CAL. The LCDC program differs from the previous studies because the previous studies [30-32, 67, 116, 117] had periodontal therapy whereas LCDC program had oral health education and individual oral hygiene instruction. Although only oral health education and individual oral hygiene instruction are not enough to treat periodontal disease, the intensive oral hygiene instructions included teaching tooth brushing, flossing, and others devices is important to treat and maintain periodontal disease. [71, 74] Promsudthi et al., 2005 studied the effect of periodontal therapy on uncontrolled type 2 diabetes in elderly found periodontal treatment decreased FPG and HbA1c with no significant differences. [32] Singh et al., 2008 found periodontal therapy improved plaque index score, gingival index score, pocket depth, CAL, FPG, and HbA1c with significant differences. [67] Long and Fan, 2011 also found periodontal therapy improved pocket depth, CAL, FPG, and HbA1c with significant differences. [31] Sun et al., 2011 found periodontal intervention consist of oral hygiene instruction, full mouth scaling, root planing, periodontal flap surgery when indicated, extraction of hopeless teeth, restored of balanced occlusion, and antibiotics were associated with improved probing depth, CAL, bleeding index, plaque index, and glycemic control after 3 months. [30] Telgi et al., 2013 found nonsurgical periodontal therapy in type 2 diabetes decreased periodontal pocket, gingival index score, plaque index score, FPG, and HbA1c with significant differences. [116] Katagiri et al., 2013 studied the effect of glycemic control on periodontitis found after the improvement of glycemic control;

the percentage of bleeding on probing decreased however glycemic control did not affect periodontal depth. [117] Champaiboon, 2013 found local factors including calculus, dental anatomy (furcation anatomy, furcation invasion, cervical enamel projection, root concavity, tooth position, open or loose contact, root proximity, and palatogingival groove), overhanging restorations, subgingival restorative margins, and effect of restorative materials etc. which associated with biofilm accumulation at each site could initiate and modify periodontal disease. [118] The LCDC program did not treat these factors, which might decrease the improvement of periodontal status from the LCDC program.

## **5.2 Strength and weakness**

The strength of the present study was a high valid measure for two of the outcome variables because the present study used biomarkers for glycemic (FPG and HbA1c) and periodontal status (plaque index, gingival index, pocket depth, and CAL). The other strength of the present study was a high response rate (98.5%).

Weakness of the present study may include the questions about diet habits: the questionnaire used two self-report diet questions only modified diet as doctor's advice and the frequency of modified diet which not a valid measurement of the real changes in diet habits before and after the intervention. Another ill faked question was about family history of diabetes that did not specifically investigate family history among first degree relatives only (the only ones really relative diabetic patients, according to most recent genetic studies. Some measurements in the

present study relied on self-reports only for example duration of having diabetes disease and eye examination. Self-report is easily subject to bias such as recall bias, social desirability bias, and response fatigue bias. A cross-check of self-report information with the same information available in the patients' medical records would have greatly increase the validity of the measurements taken. The non-investigation of factors related to the control of diabetes such as sleep and vitamin D also a weakness of the present study. Furthermore, the present study did not have a cost-effectiveness component but an effectiveness component only.

### **5.3 Conclusion**

The study was a quasi-experimental study aim to assess the effectiveness of the Lifestyle Change plus Dental Care (LCDC) program to improve glycemic and periodontal status in the elderly with type 2 diabetes who receiving curative services in Health Center 54 and 59, Bangkok, Thailand. Purposive sampling was used to select two health centers. Health Center 54 and 59 were randomly assigned to the intervention and the control groups. Health Center 54 was an intervention group, which received the Lifestyle Change plus Dental Care (LCDC) program. Health Center 59 was a control group, which received the routine program. The Lifestyle Change plus Dental Care (LCDC) program used common risk factor approach which integrated diabetes mellitus and periodontal disease prevention by lifestyle change and dental care using multi-professionals including doctors, nurse practitioners, dentists, and dental assistants. This program included

- At baseline: 20 minutes lifestyle and oral health education, individual lifestyle counseling using motivational interviewing (MI), application of self's regulation manual, and individual oral hygiene instruction.
- At 1<sup>st</sup>, 2<sup>nd</sup>, 4<sup>th</sup>, and 5<sup>th</sup> month: participants were received 15 minute educational video for diabetes and oral health education.
- At 3<sup>rd</sup> month: participants were received individual lifestyle counseling and oral hygiene instruction.

Both the intervention and the control groups (132 diabetic patients, 66 diabetic patients per each Health center) were interviewed by face-to-face interviewed using a structured questionnaire, tested blood samples, and received oral examination for periodontal status at baseline, 3 month, and 6 month follow up from 1<sup>st</sup> October 2013 to 24<sup>th</sup> April 2014. Of the 132 participants who enrolled at baseline (66 intervention and 66 control), 130 (98.5%) were eligible for follow up at 3 months and 6 months.

The results of the present study show that LCDC program improved glycemic status in the elderly with type 2 diabetes patients by decreased fasting plasma glucose (FPG) and glycated hemoglobin (HbA1c) with statistically significant differences between the intervention and the control groups depending on time (baseline, 3 month, and 6 month follow up). Moreover, LCDC program also improved periodontal status in the elderly with type 2 diabetes patients by decreased plaque

index score, gingival index score, pocket depth, and clinical attachment loss (CAL) with statistically significant differences between the intervention and the control groups depending on time (baseline, 3 month, and 6 month follow up). The LCDC program also increased knowledge, attitude, and practice toward diabetes mellitus and oral health with statistically significant differences between the intervention and the control groups.

The common risk factor approach (LCDC program) improved glycemic and periodontal status by multiple levels including the midstream intervention which occurred within Health centers by increase access to diabetes and oral health care by proactive dentistry and nurse practitioners, and the downstream intervention which involved individual-level behavioral approach for prevention and disease management by the cooperation between multi-professionals including doctors, nurse practitioners, dentists, and dental assistants. [112] The midstream and downstream intervention improved glycemic and periodontal status. However, downstream intervention (individual level) only increased the use of dental floss and interproximal brush, did not increase the utilization of dental services in the elderly with type 2 diabetes patients.



## 5.4 Recommendations

### Programmatic recommendations

To implement the LCDC program in Health Center 59, the other health centers in Bangkok, and the other groups of population for example rural area or the other provinces.

Develop the LCDC program to increase diabetic patients control their weight, regular diet modification, regular drug adherence, utilization of dental services, regular dental check-up to improve the management of type 2 diabetes in the elderly.

Improve the measurement tools by using more valid measurements or questions in particular for measuring

- Diet by using dietary records
- Eye examination by retrieved data from medical records.
- Parental sibling or children history of diabetes by asking a specific question on these kinds of relatives only.

Investigate the role of sleep duration and vitamin D in the control of diabetes among Bangkok resident diabetes patients suffering of as a content of the LCDC program.

Increase the upstream intervention (for large population) [112] by policy implication for the LCDC program.

The health service providers in charge of diabetes to elderly patients should strictly follow Thai Diabetes Clinical Practice Guideline 2010 [107] that recommend eye examination (once a year) for all diabetes patients. The implement of this guideline can be enhanced if the service providers implementing the policy receive financial incentives (paid by results policies).

### **Recommendations for further research**

Further studies needed to

- Incorporate a longer follow-up period to generate understanding of intervention effects, adherence and sustainability over time, by randomized controlled trial.
- Cost-effectiveness analysis of the LCDC program
- Study the effect of lifestyle change and dental care intervention separately by allocating elderly with type 2 diabetes to different intervention group: group education, educational video, and individual lifestyle counseling. This kind of research may offer important information on which of three interventions is the most effective and, therefore, provide program managers with recommendation to implement the most effective intervention only and save time and resources for health providers and to the patients alike.

- Study the reason why the patient fears of dental care and the perception that loss of teeth normal in the elderly. Furthermore, develop intervention to reduce dental fear and change the perception.
- Study the program to improve biological parameters such as TG, HDL, LDL, BMI, etc. which can be associated with the severity of type 2 diabetes in the elderly.

#### **Expected benefits and application**

The results from this study created new information and form a basis for further research in the effectiveness of program for reducing type 2 diabetes complications, which included diabetes and oral complications.

The results of this study showed an effectiveness and acceptability of the LCDC program by the staffs in health center which could be adapted into routine work.

This will have further benefit to improve diabetes and oral health prevention and promotion program for diabetic patients. This program if effective will decrease the treatment need of diabetic patient for periodontal treatment and diabetic complications.

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APPENDIX

จุฬาลงกรณ์มหาวิทยาลัย  
CHULALONGKORN UNIVERSITY

## Appendix A

## Checklist for screening participant

NO.....

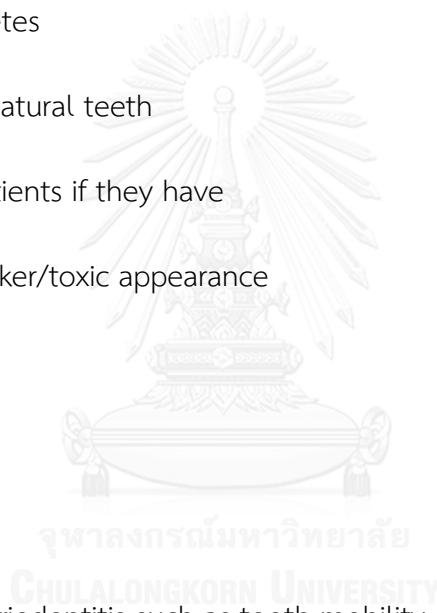
- Include in the study                       Exclude in the study

Including diabetic patients if they have

- Age > 60 years
- Have type 2 diabetes
- Have at least 16 natural teeth

Excluding diabetic patients if they have

- Depend on caretaker/toxic appearance
- Blood disease
- Liver damage
- Kidney disease
- Severe chronic periodontitis such as tooth mobility
- Cannot speak Thai language





## Appendix B

## Questionnaire at baseline

NO.....

Date.....

**Part 1: Biological parameters**

1. Fasting plasma glucose (FPG).....(mmol/l)
2. Glycosylated hemoglobin (HbA1C).....(%)
3. Triglyceride (TG).....(mmol/l)
4. High-density lipoprotein (HDL).....(mmol/l)
5. Low-density lipoprotein (LDL).....(mmol/l)

**Part 2: General characteristics**

6. Gender

 1. Male 2. Female

7. Age.....years

8. Weight.....kg.

9. Height.....m.

10. BMI..... kg/m<sup>2</sup>

11. Blood pressure:

Systolic.....mmHg Diastolic.....mmHg

12. Income (monthly) ..... baht

13. Education

- 1. Illiteracy
- 2. Primary school
- 3. Secondary school
- 4. Vocational school
- 5. Bachelor degree
- 6. Other.....

## 14. Marital status

- 1. Single
- 2. Married
- 3. Divorce/separate
- 4. Widowed

## 15. Living arrangements

- 1. Lives alone
- 2. Lives with family member

## 16. Occupation

- 1. Agricultural
- 2. Employee
- 3. Retired
- 4. Merchant
- 5. Private business
- 6. No occupation



7. Other.....

17. Systemic disease

17.1 Hypertension

1. Yes

2. No

17.2 Cardiovascular disease

1. Yes

2. No

17.3 High cholesterol

1. Yes

2. No

17.4 Other.....



18. Health insurance type

1. Universal coverage (Health center no.54)

2. Universal coverage (other.....)

3. Social insurance

4. Government or State enterprise officer

5. Do not have any health insurance

6. Others.....

19. Did your family have history of diabetes?

1. Yes

2. No

20. How long do you have diabetes?

.....months/years

21. Do you have any complication of diabetes?

1. High blood pressure

2. Stroke

3. Heart disease

4. Eye problems

5. Kidney disease

6. Foot problem

22. Have you ever received diabetes and oral health care information from health personnel?

1. Yes

2. No

23. Smoking

1. Never

2. Ever, stop smoking.....years

(please answer the question no. 24 and 25)

3. Yes (please answer the question no. 24 and 25)

24. How many cigarettes did/do you smoke a day?

.....rolls/day

25. How long did you smoke?

.....years

### Part 3: Utilization of dental services

26. How long is it since you last have seen a dentist?

- 1. Less than 6 months
- 2. 6-12 months
- 3. More than 1 year, but less than 2 years
- 4. More than 2 years, but less than 5 years
- 5. More than 5 years
- 6. Never received dental care (go to question no.27)

27.If you ever visit a dentist, what type of dental service did you receive last time?

- 1.Extraction
- 2.Restoration
- 3.Cleaning/Scaling
- 4.Denture
- 5.Other.....

28. If you ever visit a dentist, usually why did you go to the dentist?

- 1. Routine/planned
- 2. Emergency

**Part 4: Knowledge toward diabetes mellitus and oral health**

29. Which of the following is the best characterizes of disease condition?

- 1. High blood sugar
- 2. Low blood sugar
- 3. High urine sugar
- 4. Don't know

30. Which of the following are the common symptoms of diabetes mellitus?

(multiple response possible)

- 1. Weight gain/loss
- 2. Frequent urination
- 3. Frequent hunger
- 4. Frequent thirst
- 5. Numbness
- 6. Asymptomatic
- 7. Don't know

31. Which of the following are the common complications of diabetes mellitus?

(multiple response possible)

- 1. Heart disease
- 2. Kidney disease
- 3. Eye disease
- 4. Stroke

5. Foot problems

6. Gum disease

7. Don't know

32. Which of the following are the treatments of diabetes mellitus? (multiple response possible)

1. Drugs

2. Insulin

3. Healthy diet

4. Regular exercise

5. Weight control

6. Quit smoking

7. Don't know

33. Do you think the complications of diabetes mellitus can be prevented by routine investigation?

1. Yes

2. No

3. Don't know

34. If yes, which investigation should be done? (multiple response possible)

1. Blood sugar

2. Monitoring BP

- 3. Eye examination
- 4. Foot examination
- 5. Oral examination
- 6. Test body weight
- 6. Don't know

35. Diabetic patients are more likely to have infection in their mouths.

- 1. Yes
- 2. No
- 3. Don't know

36. Diabetic patients are more likely to have gum disease.

- 1. Yes
- 2. No
- 3. Don't know

37. Diabetes can make teeth and gum worse.

- 1. Yes
- 2. No
- 3. Don't know

38. Bleeding gums when brushing teeth is an early sign of gum disease.

- 1. Yes
- 2. No



3. Don't know

39. Gum disease can lead to loss of teeth.

1. Yes

2. No

3. Don't know

**Part 5: Attitude toward diabetes mellitus and oral health**

40. Attitude toward diabetes

**Direction:** Please put a tick (✓) in an appropriate box.

Items	Strongly agree	Agree	Not sure	Dis agree	Strongly disagree
<p><b>Attitude toward diabetes mellitus</b></p> <p>1.Regular exercise helps in keeping diabetes under control.</p> <p>2.People with diabetes should control their weight.</p> <p>3.Dietary modification by control starch and sugar is useful for keeping diabetes under control.</p> <p>4.Diabetic patient can lead near</p>					

Items	Strongly agree	Agree	Not sure	Dis agree	Strongly disagree
<p>normal life with sugar controlled.</p> <p>5. If diabetic patient has well sugar controlled by drug, no need to control diet.</p> <p><b>Attitude toward oral health</b></p> <p>6. Routine dental care is important to prevent diabetic complications.</p> <p>7. Regular visits (every 3-6 months) to the dentist necessary to prevent diabetic complications.</p> <p>8. Tooth brushing is important to prevent diabetic complications.</p> <p>9. Using dental floss is important to prevent gum disease.</p> <p>10. Dental treatment (scaling and root planning) is important to</p>					

Items	Strongly agree	Agree	Not sure	Disagree	Strongly disagree
prevent progression of gum disease.					

### Part 6: Oral health behaviors

41. Which methods do you clean your oral cavity?

41.1 Tooth brushing

1. Yes

2. No

41.2 Antiseptic mouth rinse

1. Yes .....times/day

2. No

41.3 Salt solution mouth rinse

1. Yes .....times/day

2. No

41.4 Dental floss

1. Yes .....times/day

2. No

41.5 Tooth pick

1. Yes .....times/day

2. No

41.6 Interproximal brush

1. Yes .....times/day

2. No

41.7 Other....., .....times/day

42. How often do you brush your teeth?

1. Once a day

2. Two times per day

3. Three times per day

4. More than 3 times per day

43. How long do you brush your teeth?

.....minutes

**Part 7: Practice toward control/prevention of diabetes mellitus**

44. For the past month, how often have you taken part in any moderate physical activity lasting more than half an hour (such as yoga, light sport, physical exercise, gardening, taking long walk)?

1. More than 5 days/week

2. 2-5 days/week

3. Once a week

4. 2-3 times/month

5. Rarely/never

45. How often have you measured your weight in the last month?

1. More than once

2. Once

3. Not measured

46. Have you modified your diet as doctor's/dietician's advice following diagnosis of your disease?

1. Yes (answer question no. 47)

2. No (answer question no. 48)

2. Never received recommendation (answer question no. 48)

47. If yes, how frequently in the last month did you take your diet as advised by the doctor/dietician?

1. Mostly

2. Sometimes

3. Rarely/never

48. Did you ever forget to take any drugs prescribed by your doctor?

1. Yes (answer question no. 49)

2. No (answer question no. 50)

49. If yes, how many times in the last month?

1. 1-3 days/month

2. 1-2 days/week

3. More than 2 days

4. Could not remember

50. Did your undergo any eye examination in the past year?

1. Yes

2. No

51. Did your undergo any foot examination in the past year?

1. Yes

2. No

52. Do you always wear covered shoes when outdoors?

1. Yes

2. No

53. How often do you screen your foot?

1. Mostly

2. Sometimes

3. Rarely/never



## Appendix C

## Questionnaire at 3 month and 6 month follow up

NO.....

Date.....

**Part 1: Biological parameters**

1. Fasting plasma glucose (FPG).....(mmol/l)
2. Glycosylated hemoglobin (HbA1C).....(%)
3. Triglyceride (TG).....(mmol/l)
4. High-density lipoprotein (HDL).....(mmol/l)
5. Low-density lipoprotein (LDL).....(mmol/l)

**Part 2: General characteristics**

6. Weight.....kg.
7. Height.....m.
8. BMI..... kg/m<sup>2</sup>
9. Blood pressure:  
Systolic.....mmHg Diastolic.....mmHg

## 10. Smoking

1. Never
2. Ever, stop smoking.....years
3. Yes

**Part 3: Utilization of dental services**

11. Have you received dental services in the previous 3 months?

1. Yes

2. No

12. If you ever visit a dentist, what type of dental service did you receive last time?

1.Extraction

2.Restoration

3.Cleaning/Scaling

4.Denture

5.Other.....

**Part 4: Knowledge toward diabetes mellitus and oral health**

13. Which of the following is the best characterizes of disease condition?

1. High blood sugar

2. Low blood sugar

3. High urine sugar

4. Don't know

14. Which of the following are the common symptoms of diabetes mellitus?

(multiple response possible)

1. Weight gain/loss

2. Frequent urination

3. Frequent hunger



- 4. Frequent thirst
- 5. Numbness
- 6. Asymptomatic
- 7. Don't know

15. Which of the following are the common complications of diabetes mellitus?

(multiple response possible)

- 1. Heart disease
- 2. Kidney disease
- 3. Eye disease
- 4. Stroke
- 5. Foot problems
- 6. Gum disease
- 7. Don't know



16. Which of the following are the treatments of diabetes mellitus? (multiple

response possible)

- 1. Drugs
- 2. Insulin
- 3. Healthy diet
- 4. Regular exercise
- 5. Weight control
- 6. Quit smoking

7. Don't know

17. Do you think the complications of diabetes mellitus can be prevented by routine investigation?

1. Yes

2. No

3. Don't know

18. If yes, which investigation should be done? (multiple response possible)

1. Blood sugar

2. Monitoring BP

3. Eye examination

4. Foot examination

5. Oral examination

6. Test body weight

6. Don't know

19. Diabetic patients are more likely to have infection in their mouths.

1. Yes

2. No

3. Don't know

20. Diabetic patients are more likely to have gum disease.

1. Yes

2. No

3. Don't know

21. Diabetes can make teeth and gum worse.

1. Yes

2. No

3. Don't know

22. Bleeding gums when brushing teeth is an early sign of gum disease.

1. Yes

2. No

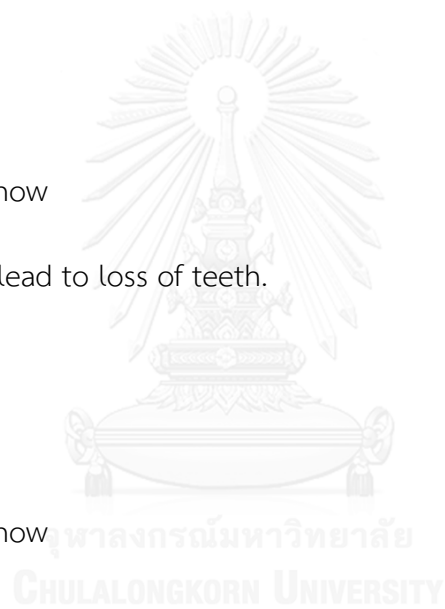
3. Don't know

23. Gum disease can lead to loss of teeth.

1. Yes

2. No

3. Don't know



**Part 5: Attitude toward diabetes mellitus and oral health**

24. Attitude toward diabetes

**Direction:** Please put a tick (✓) in an appropriate box.

Items	Strongly agree	Agree	Not sure	Disagree	Strongly disagree
<p><b>Attitude toward diabetes mellitus</b></p> <p>1.Regular exercise helps in keeping diabetes under control.</p> <p>2.People with diabetes should control their weight.</p> <p>3.Dietary modification by control starch and sugar is useful for keeping diabetes under control.</p> <p>4.Diabetic patient can lead near normal life with sugar controlled.</p> <p>5. If diabetic patient has well sugar controlled by drug, no need to control diet.</p>					

Items	Strongly agree	Agree	Not sure	Dis agree	Strongly disagree
<p><b>Attitude toward oral health</b></p> <p>6. Routine dental care is important to prevent diabetic complications.</p> <p>7. Regular visits (every 3-6 months) to the dentist necessary to prevent diabetic complications.</p> <p>8. Tooth brushing is important to prevent diabetic complications.</p> <p>9. Using dental floss is important to prevent gum disease.</p> <p>10. Dental treatment (scaling and root planning) is important to prevent progression of gum disease.</p>					

**Part 6: Oral health behaviors**

25. Which methods do you clean your oral cavity?

25.1 Tooth brushing

1. Yes

2. No

25.2 Antiseptic mouth rinse

1. Yes .....times/day

2. No

25.3 Salt solution mouth rinse

1. Yes .....times/day

2. No

25.4 Dental floss จุฬาลงกรณ์มหาวิทยาลัย

1. Yes .....times/day

2. No

25.5 Tooth pick

1. Yes .....times/day

2. No

25.6 Interproximal brush

1. Yes .....times/day

2. No

25.7 Other....., .....times/day

26. How often do you brush your teeth?

- 1. Once a day
- 2. Two times per day
- 3. Three times per day
- 4. More than 3 times per day

27. How long do you brush your teeth?

.....minutes

**Part 7: Practice toward control/prevention of diabetes mellitus**

28. For the past month, how often have you taken part in any moderate physical activity lasting more than half an hour (such as yoga, light sport, physical exercise, gardening, taking long walk)?

- 1. More than 5 days/week
- 2. 2-5 days/week
- 3. Once a week
- 4. 2-3 times/month
- 5. Rarely/never

29. How often have you measured your weight in the last month?

- 1. More than once
- 2. Once
- 3. Not measured

30. Have you modified your diet as doctor's/dietician's advice following diagnosis of your disease?

- 1. Yes (answer question no. 31)
- 2. No (answer question no. 32)
- 2. Never received recommendation (answer question no. 32)

31. If yes, how frequently in the last month did you take your diet as advised by the doctor/dietician?

- 1. Mostly
- 2. Sometimes
- 3. Rarely/never

32. Did you ever forget to take any drugs prescribed by your doctor?

- 1. Yes (answer question no. 33)
- 2. No (answer question no. 34)

33. If yes, how many times in the last month?

- 1. 1-3 days/month
- 2. 1-2 days/week
- 3. More than 2 days
- 4. Could not remember

34. Did your undergo any eye examination in the past year?

- 1. Yes
- 2. No



35. Did your undergo any foot examination in the past year?

1. Yes

2. No

36. Do you always wear covered shoes when outdoors?

1. Yes

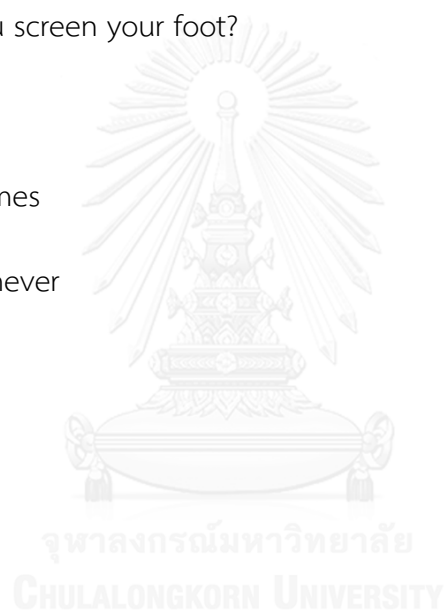
2. No

37. How often do you screen your foot?

1. Mostly

2. Sometimes

3. Rarely/never



## Appendix D

## Plaque Index (PI)

Tooth number	Tooth Score
16	
12	
24	
36	
32	
44	
Total	

## Appendix E

## Gingival Index (GI)

Tooth number	Tooth Score
16	
12	
24	
36	
32	
44	
Total	

## Appendix F

### Periodontal Chart

#### PERIODONTAL CHART :

INITIAL   
  EVALUATION   
  CORRECTIVE   
  MAINTENANCE   
 DATE \_\_\_\_\_  
 Patient name \_\_\_\_\_ HN \_\_\_\_\_

Dx/Px																
MGJ																
PD																
RE																
1 mm. apart	B U C C A L											L I N G U A L				
MO																
F																
PD																
RE																
1 mm. apart	L I N G U A L											B U C C A L				
	18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
1 mm. apart	L I N G U A L											B U C C A L				
RE																
PD																
F																
MO																
1 mm. apart	B U C C A L											L I N G U A L				
RE																
PD																
MGJ																
Dx/Px																

KEY TO CHARTING			
Gingival margin	Red line	RE	Recession
MGJ-Mucogingival junction	Black line	MO-Mobility	1, 2, 3
PD-Probing depth	Blue block (≥4 mm.)	Missing	↓
Bleeding	Red dot on crown	Food impaction	↑
Pus	Yellow dot on crown	Open contact	
F-Furcation involvement	1, 2, 3, 4	Drifting	→H
		Hypersensitivity	~~~~~
		Non-vital	NV
		Periapical lesion	○
		Bridge	—
		Crown	Yellow stripe
		Root resection	⊥

## Appendix G

## Checklist for screening participant (Thai version)

ลำดับที่.....

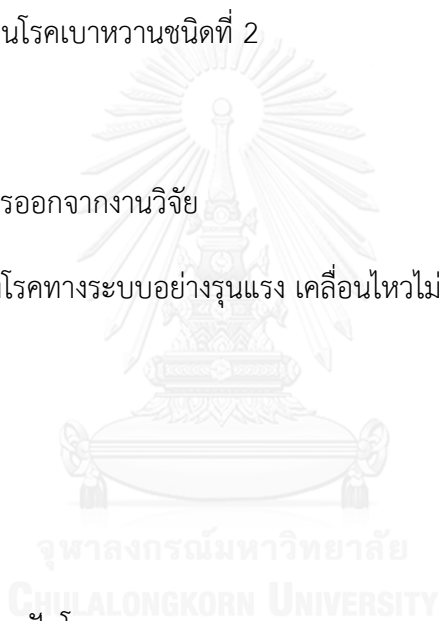
- คัดเข้า                       คัดออก

เกณฑ์ในการคัดอาสาสมัครเข้าร่วมวิจัย

- อายุ > 60 ปี
- ได้รับการวินิจฉัยว่าเป็นโรคเบาหวานชนิดที่ 2
- มีฟันอย่างน้อย 16 ซี่

เกณฑ์ในการคัดอาสาสมัครออกจากงานวิจัย

- มีภาวะแทรกซ้อนของโรคทางระบบอย่างรุนแรง เคลื่อนไหวไม่สะดวก
- โรคเลือด
- โรคตับ
- โรคไต
- โรคปริทันต์รุนแรง เช่น ฟันโยก
- พูดภาษาไทยไม่ได้



## Appendix H

## Questionnaire at baseline (Thai version)

แบบสัมภาษณ์ผู้ป่วยเบาหวาน  
(baseline)

ลำดับที่.....

วันที่.....

## ส่วนที่ 1: ผลตรวจทางห้องปฏิบัติการ

1. Fasting plasma glucose (FPG).....(mmol/L)
2. Glycosylated hemoglobin (HbA1C).....(%)
3. Triglyceride (TG).....(mmol/L)
4. High-density lipoprotein (HDL).....(mmol/L)
5. Low-density lipoprotein (LDL).....(mmol/L)

## ส่วนที่ 2: ข้อมูลทั่วไป

6. เพศ

 1. ชาย 2. หญิง

7. อายุ.....ปี

8. น้ำหนัก.....กิโลกรัม

9. ส่วนสูง.....เซนติเมตร

10. BMI..... kg/m<sup>2</sup>

11. ความดันโลหิต

Systolic.....mmHg Diastolic.....mmHg

12. รายได้เฉลี่ยต่อเดือน.....บาท

13. การศึกษา

 1. ไม่ได้เรียน 2. ประถมศึกษา 3. มัธยมศึกษา 4. ปวช. /ปวส. 5.ปริญญาตรี 6. อื่นๆ ระบุ.....

## 14. สถานภาพสมรส

1. โสด  2. สมรส  
 3. หย่า/แยกกันอยู่  4. หม้าย

## 15. การอยู่อาศัย

1. อยู่คนเดียว  2. อยู่กับครอบครัว

## 16. อาชีพ

1. เกษตรกร  2. รับจ้าง/ผู้ใช้แรงงาน  
 3. เกษียณ  4. ค้าขาย  
 5. ธุรกิจส่วนตัว  6. ไม่ได้ทำงาน  
 7. อื่นๆ ระบุ.....

## 17. ประวัติโรคประจำตัว อื่นๆ

## 17.1 โรคความดันโลหิตสูง

1. ใช่  
 2. ไม่ใช่

## 17.2 โรคหัวใจ

1. ใช่  
 2. ไม่ใช่

## 17.3 โรคไขมันในโลหิตสูง

1. ใช่  
 2. ไม่ใช่

## 17.4 อื่นๆ ระบุ.....

## 18. สิทธิการรักษาพยาบาล

1. บัตรประกันสุขภาพถ้วนหน้า (ศูนย์ฯ 54)  
 2. บัตรประกันสุขภาพถ้วนหน้า (อื่นๆ ระบุ.....)  
 3. ประกันสังคม  
 4. เบิกราชการ/รัฐวิสาหกิจ  
 5. ไม่มีสิทธิ  
 6. อื่นๆ ระบุ.....

## 19. มีคนในครอบครัวป่วยเป็นเบาหวานหรือไม่

1. ใช่  2. ไม่ใช่

## 20. ป่วยเป็นเบาหวานมานาน.....ปี

## 21. มีภาวะแทรกซ้อนของโรคเบาหวานหรือไม่

1. ความดันโลหิตสูง  2. โรคหลอดเลือดในสมองตีบ

3. โรคหัวใจ  4. โรคตา  
 5. โรคไต  6. แผลที่เท้า  
 7. ไม่มี

22. เคยได้รับข้อมูลเกี่ยวกับโรคเบาหวานและสุขภาพช่องปากจากเจ้าหน้าที่หรือไม่

1. ใช่  2. ไม่ใช่

23. คุณสูบบุหรี่หรือไม่

1. ไม่เคยสูบ  
 2. เคยสูบแต่หยุดแล้ว หยุดสูบบุหรี่มานาน.....ปี (กรุณาตอบข้อ 24 และ 25)  
 3. ปัจจุบันสูบ (กรุณาตอบข้อ 24 และ 25)

24. โดยเฉลี่ยคุณสูบบุหรี่วันละ.....มวน

25. คุณสูบบุหรี่มานาน.....ปี

### ส่วนที่ 3: การใช้บริการทางทันตกรรม

26. คุณไปหาหมอฟันครั้งสุดท้ายเมื่อไร

1. น้อยกว่า 6 เดือน  2. 6-12 เดือน  
 3. มากกว่า 1 ปี แต่น้อยกว่า 2 ปี  4. มากกว่า 2 ปี แต่น้อยกว่า 5 ปี  
 5. มากกว่า 5 ปี  6. ไม่เคยไปหาหมอฟัน (ข้ามไปคำถามข้อ 27)

27. ครั้งสุดท้ายที่ไปหาหมอฟันคุณได้รับการรักษาอะไร (เฉพาะผู้ที่เคยไปหาหมอฟัน)

1. ถอนฟัน  2. อุดฟัน  
 3. ขัดฟัน/ขูดหินปูน  4. ใส่ฟันปลอม  
 5. อื่นๆ ระบุ.....

28. ปกติแล้วคุณไปหาหมอฟันเพราะอะไร (เฉพาะผู้ที่เคยไปหาหมอฟัน)

1. ตรวจสอบสุขภาพช่องปากประจำ  
 2. เมื่อมีอาการ เช่น เสียฟัน ปวด บวม

### ส่วนที่ 4: ความรู้ต่อโรคเบาหวานและสุขภาพช่องปาก

29. อะไรคือลักษณะสำคัญของโรคเบาหวาน

1. ระดับน้ำตาลในเลือดสูง  2. ระดับน้ำตาลในเลือดต่ำ  
 3. ระดับน้ำตาลในปัสสาวะสูง  4. ไม่ทราบ

30. ข้อใดคืออาการของโรคเบาหวาน (ตอบได้มากกว่า 1 ข้อ)

1. น้ำหนักเพิ่ม/ลด  2. ปัสสาวะบ่อย



3. หิวบ่อย  4. กระจายน้ำบ่อย  
 5. ไม่มีอาการ  6. ไม่ทราบ

31. ข้อใดคือภาวะแทรกซ้อนของโรคเบาหวาน (ตอบได้มากกว่า 1 ข้อ)

1. โรคหัวใจ  2. โรคไต  
 3. โรคตา  4. เส้นเลือดในสมองตีบ  
 5. แผลที่เท้า  6. โรคปริทันต์  
 7. ไม่ทราบ

32. ข้อใดคือการรักษาโรคเบาหวาน (ตอบได้มากกว่า 1 ข้อ)

1. รับประทานยา  2. ฉีดอินซูลิน  
 3. ทานอาหารที่มีประโยชน์  4. ออกกำลังกายอย่างสม่ำเสมอ  
 5. ควบคุมน้ำหนัก  6. เลิกสูบบุหรี่  
 7. ไม่ทราบ

33. คุณคิดว่าภาวะแทรกซ้อนของโรคเบาหวานสามารถป้องกันโดยการตรวจร่างกายเป็นประจำได้หรือไม่

1. ได้  2. ไม่ได้  3. ไม่ทราบ

34. ถ้าใช่ ควรตรวจอะไรบ้าง (ตอบได้มากกว่า 1 ข้อ)

1. ระดับน้ำตาลในเลือด  2. ความดันโลหิต  
 3. ตรวจตา  4. ตรวจเท้า  
 5. ตรวจฟัน  6. ไม่ทราบ

35. ผู้ป่วยเบาหวานมีโอกาสติดเชื้อในช่องปากมากกว่าคนปกติ

1. ใช่  2. ไม่ใช่  3. ไม่ทราบ

36. ผู้ป่วยเบาหวานมีโอกาสเกิดโรคปริทันต์มากกว่าคนปกติ

1. ใช่  2. ไม่ใช่  3. ไม่ทราบ

37. โรคเบาหวานทำให้สุขภาพเหงือกและฟันแย่ลง

1. ใช่  2. ไม่ใช่  3. ไม่ทราบ

38. เลือดออกตามไรฟันเป็นอาการแรกเริ่มของโรคปริทันต์

1. ใช่  2. ไม่ใช่  3. ไม่ทราบ

39. โรคปริทันต์ก่อให้เกิดการสูญเสียฟัน

1. ใช่  2. ไม่ใช่  3. ไม่ทราบ

ส่วนที่ 5: ทักษะคิดต่อโรคเบาหวานและสุขภาพช่องปาก

40. ทักษะคิดต่อโรคเบาหวาน

คำชี้แจง โปรดทำเครื่องหมาย ✓ ลงในช่องที่ตรงกับความรู้สึก / ความคิดเห็นของท่านมากที่สุด

รายการ	เห็นด้วย อย่างยิ่ง	เห็น ด้วย	ไม่ แน่ใจ	ไม่ เห็น ด้วย	ไม่เห็น ด้วย อย่างยิ่ง
<p><b>ทักษะคิดต่อโรคเบาหวาน</b></p> <p>1. การออกกำลังกายอย่างสม่ำเสมอทุกวัน มีผลดีต่อการรักษาและควบคุมโรคเบาหวาน</p> <p>2. การควบคุมน้ำหนักตัวมีผลดีต่อการรักษาและควบคุมโรคเบาหวาน</p> <p>3. การควบคุมอาหารจำพวกแป้งและน้ำตาล ช่วย ควบคุมโรคเบาหวาน</p> <p>4. หากควบคุมระดับน้ำตาลได้ดีสามารถใช้ชีวิตได้เหมือนคนปกติ</p> <p>5. หากควบคุมระดับน้ำตาลได้ดี ไม่จำเป็นต้องควบคุมอาหาร</p> <p><b>ทักษะคิดต่อโรคเบาหวานและสุขภาพช่องปาก</b></p> <p>6. ผู้ป่วยเบาหวานที่ดูแลสุขภาพช่องปากเป็นประจำ มีโอกาสเกิดภาวะแทรกซ้อนของโรคเบาหวานลดลง</p> <p>7. ผู้ป่วยเบาหวานที่ตรวจสุขภาพช่องปากทุก 3-6 เดือน มีโอกาสเกิดภาวะแทรกซ้อนของโรคเบาหวานลดลง</p> <p>8. ผู้ป่วยเบาหวานที่แปรงฟันอย่างถูกวิธี ช่วยป้องกันการเกิดภาวะแทรกซ้อนของโรคเบาหวาน</p> <p>9. ผู้ป่วยเบาหวานที่ใช้ไหมขัดฟันเป็นประจำ</p>					

สามารถป้องกันการเกิดโรคปริทันต์					
10. ผู้ป่วยเบาหวานที่ได้รับการชูดหินปูน และ เกลารากฟันจะลดการลุกลามของโรคปริทันต์					

### ส่วนที่ 6: พฤติกรรมทันตสุขภาพ

41. คุณทำความสะอาดช่องปากโดยวิธีใด

41.1 แปรงฟัน

1. ใช่  
 2. ไม่ใช่

41.2 บ้วนปากด้วยน้ำยาบ้วนปาก

1. ใช่ วันละ.....ครั้ง  
 2. ไม่ใช่

41.3 อมเกลือ

1. ใช่ วันละ.....ครั้ง  
 2. ไม่ใช่

41.4 ใช้ไหมขัดฟัน

1. ใช่ วันละ.....ครั้ง  
 2. ไม่ใช่

41.5 ใช้ไม้จิ้มฟัน

1. ใช่ วันละ.....ครั้ง  
 2. ไม่ใช่

41.6 ใช้แปรงซอกฟัน

1. ใช่ วันละ.....ครั้ง  
 2. ไม่ใช่

41.7 อื่นๆ ระบุ....., วันละ.....ครั้ง

42. คุณแปรงฟันวันละกี่ครั้ง

1. วันละครั้ง  
 2. 2 ครั้งต่อวัน  
 3. 3 ครั้งต่อวัน  
 4. มากกว่า 3 ครั้งต่อวัน

43. คุณแปรงฟันนาน.....นาที

### ส่วนที่ 7: พฤติกรรมต่อโรคเบาหวาน

44. เดือนที่แล้วคุณออกกำลังกายนานกว่า 30 นาที บ่อยแค่ไหน

1. มากกว่า 5 ครั้ง/สัปดาห์  
 2. 2-5 ครั้ง/สัปดาห์  
 3. 1 ครั้ง/สัปดาห์  
 4. 2-3 ครั้ง/เดือน  
 5. ไม่ได้ออกกำลังกาย

45. เดือนที่แล้วคุณชั่งน้ำหนักบ่อยแค่ไหน

1. มากกว่า 1 ครั้ง  
 2. 1 ครั้ง  
 3. ไม่ได้ชั่ง

46. คุณได้ปรับเปลี่ยนอาหารตามคำแนะนำของเจ้าหน้าที่หรือไม่
1. ใช่ (ตอบข้อ 47)  2. ไม่ใช่ (ข้ามไปข้อ 48)  3. ไม่เคยได้รับคำแนะนำ (ข้ามไปข้อ 48)
47. คุณปรับเปลี่ยนอาหารตามคำแนะนำของเจ้าหน้าที่บ่อยแค่ไหน
1. เกือบทุกมื้อ  2. บางมื้อ
3. แทบจะไม่ได้ปรับ
48. คุณเคยลืมหานยาหรือไม่
1. ใช่ (ตอบข้อ 49)  2. ไม่ใช่ (ข้ามไปข้อ 50)
49. เดือนที่แล้วคุณลืมหานยาบ่อยแค่ไหน
1. 1-3 ครั้ง/เดือน  2. 1-2 วัน/อาทิตย์
3. มากกว่า 2 วัน  4. จำไม่ได้
50. ปีที่แล้วคุณได้ตรวจจอประสาทตาหรือไม่
1. ใช่  2. ไม่ใช่
51. ปีที่แล้วคุณได้ตรวจเท้าหรือไม่
1. ใช่  2. ไม่ใช่
52. คุณใส่รองเท้าหุ้มส้นทุกครั้งที่คุณออกจากบ้านหรือไม่
1. ใช่  2. ไม่ใช่
53. คุณตรวจเท้าเองบ่อยแค่ไหน
1. ทุกวัน  2. บางวัน
3. แทบจะไม่ได้ตรวจ

## Appendix I

## Questionnaire at 3 month and 6 month follow up (Thai version)

แบบสัมภาษณ์ผู้ป่วยเบาหวาน  
(ติดตามผล 3 และ 6 เดือน)

ลำดับที่.....

วันที่.....

**ส่วนที่ 1: ผลตรวจทางห้องปฏิบัติการ**

1. Fasting plasma glucose (FPG).....(mmol/L)
2. Glycosylated hemoglobin (HbA1C).....(%)
3. Triglyceride (TG).....(mmol/L)
4. High-density lipoprotein (HDL).....(mmol/L)
5. Low-density lipoprotein (LDL).....(mmol/L)

**ส่วนที่ 2: ข้อมูลทั่วไป**

6. น้ำหนัก.....กิโลกรัม
7. ส่วนสูง.....เซนติเมตร
8. BMI..... kg/m<sup>2</sup>
9. ความดันโลหิต  
Systolic.....mmHg Diastolic.....mmHg
10. คุณสุขสบายหรือไม่
  - 1. ไม่เคยสุข
  - 2. เคยสุขแต่หยุดแล้ว หยุดสุขมานาน.....ปี
  - 3. ปัจจุบันสุข

**ส่วนที่ 3: การใช้บริการทางทันตกรรม**

11. 3 เดือนที่แล้วคุณไปหาหมอฟันหรือไม่
  - 1. ใช่
  - 2. ไม่ใช่
12. ครั้งสุดท้ายที่ไปหาหมอฟันคุณได้รับการรักษาอะไร (เฉพาะผู้ที่เคยไปหาหมอฟัน)
  - 1. ถอนฟัน
  - 2. อุดฟัน

3. ชัดฟัน/ชุดหินปูน  4. ใส่ฟันปลอม

5. อื่นๆ ระบุ.....

#### ส่วนที่ 4: ความรู้ต่อโรคเบาหวานและสุขภาพช่องปาก

13. อะไรคือลักษณะสำคัญของโรคเบาหวาน

1. ระดับน้ำตาลในเลือดสูง

2. ระดับน้ำตาลในเลือดต่ำ

3. ระดับน้ำตาลในปัสสาวะสูง

4. ไม่ทราบ

14. ข้อใดคืออาการของโรคเบาหวาน (ตอบได้มากกว่า 1 ข้อ)

1. น้ำหนักเพิ่ม/ลด

2. ปัสสาวะบ่อย

3. หิวบ่อย

4. กระหายน้ำบ่อย

5. ไม่มีอาการ

6. ไม่ทราบ

15. ข้อใดคือภาวะแทรกซ้อนของโรคเบาหวาน (ตอบได้มากกว่า 1 ข้อ)

1. โรคหัวใจ

2. โรคไต

3. โรคตา

4. เส้นเลือดในสมองตีบ

5. แผลที่เท้า

6. โรคปริทันต์

7. ไม่ทราบ

16. ข้อใดคือการรักษาโรคเบาหวาน (ตอบได้มากกว่า 1 ข้อ)

1. รับประทานยา

2. ฉีดอินซูลิน

3. ทานอาหารที่มีประโยชน์

4. ออกกำลังกายอย่างสม่ำเสมอ

5. ควบคุมน้ำหนัก

6. เลิกสูบบุหรี่

7. ไม่ทราบ

17. คุณคิดว่าภาวะแทรกซ้อนของโรคเบาหวานสามารถป้องกันโดยการตรวจร่างกาย

เป็นประจำได้หรือไม่

1. ได้

2. ไม่ได้

3. ไม่ทราบ

18. ถ้าใช่ ควรตรวจอะไรบ้าง (ตอบได้มากกว่า 1 ข้อ)

1. ระดับน้ำตาลในเลือด

2. ความดันโลหิต

3. ตรวจตา

4. ตรวจเท้า

5. ตรวจฟัน

6. ไม่ทราบ

19. ผู้ป่วยเบาหวานมีโอกาสติดเชื้อในช่องปากมากกว่าคนปกติ

1. ใช่

2. ไม่ใช่

3. ไม่ทราบ

20. ผู้ป่วยเบาหวานมีโอกาสดเกิดโรคปริทันต์มากกว่าคนปกติ
1. ใช่                       2. ไม่ใช่                       3. ไม่ทราบ
21. โรคเบาหวานทำให้สุขภาพเหงือกและฟันแย่งลง
1. ใช่                       2. ไม่ใช่                       3. ไม่ทราบ
22. เลือดออกตามไรฟันเป็นอาการแรกเริ่มของโรคปริทันต์
1. ใช่                       2. ไม่ใช่                       3. ไม่ทราบ
23. โรคปริทันต์ก่อให้เกิดการสูญเสียฟัน
1. ใช่                       2. ไม่ใช่                       3. ไม่ทราบ

#### ส่วนที่ 5: ทักษะติดต่อโรคเบาหวานและสุขภาพช่องปาก

#### 24. ทักษะติดต่อโรคเบาหวาน

คำชี้แจง โปรดทำเครื่องหมาย ✓ ลงในช่องที่ตรงกับความรู้สึก / ความคิดเห็นของท่านมากที่สุด

รายการ	เห็นด้วย อย่างยิ่ง	เห็น ด้วย	ไม่ แน่ใจ	ไม่ เห็น ด้วย	ไม่เห็น ด้วย อย่างยิ่ง
<b>ทักษะติดต่อโรคเบาหวาน</b> 1. การออกกำลังกายอย่างสม่ำเสมอทุกวัน มีผลดีต่อการรักษาและควบคุมโรคเบาหวาน 2. การควบคุมน้ำหนักตัวมีผลดีต่อการรักษาและควบคุมโรคเบาหวาน 3. การควบคุมอาหารจำพวกแป้งและน้ำตาล ช่วย ควบคุมโรคเบาหวาน 4. หากควบคุมระดับน้ำตาล ได้ดีสามารถใช้ชีวิตได้เหมือนคนปกติ 5. หากควบคุมระดับน้ำตาลได้ดี ไม่จำเป็นต้องควบคุมอาหาร <b>ทักษะติดต่อโรคเบาหวานและสุขภาพช่องปาก</b> 6. ผู้ป่วยเบาหวานที่ดูแลสุขภาพช่องปากเป็นประจำ มีโอกาสเกิดภาวะแทรกซ้อนของ					

โรคเบาหวาน					
ลดลง					
7.ผู้ป่วยเบาหวานที่ตรวจสุขภาพช่องปากทุก 3-6 เดือน มีโอกาสเกิดภาวะแทรกซ้อน ของ โรคเบาหวานลดลง					
8. ผู้ป่วยเบาหวานที่แปรงฟันอย่างถูกวิธี ช่วยป้องกันการเกิดภาวะแทรกซ้อน ของ โรคเบาหวาน					
9.ผู้ป่วยเบาหวานที่ใช้ไหมขัดฟันเป็นประจำ สามารถป้องกันการเกิดโรคปริทันต์					
10.ผู้ป่วยเบาหวานที่ได้รับการขูดหินปูน และ เกลารากฟันจะลดการลุกลามของโรคปริทันต์					

#### ส่วนที่ 6: พฤติกรรมทันตสุขภาพ

25. คุณทำความสะอาดช่องปากโดยวิธีใด

25.1 แปรงฟัน

1. ใช่  
 2. ไม่ใช่

25.2 บ้วนปากด้วยน้ำยาบ้วนปาก

1. ใช่ วันละ.....ครั้ง  
 2. ไม่ใช่

25.3 อมเกลือ

1. ใช่ วันละ.....ครั้ง  
 2. ไม่ใช่

25.4 ใช้ไหมขัดฟัน

1. ใช่ วันละ.....ครั้ง  
 2. ไม่ใช่

25.5 ใช้ไม้จิ้มฟัน

1. ใช่ วันละ.....ครั้ง  
 2. ไม่ใช่

25.6 ใช้แปรงซอกฟัน

1. ใช่ วันละ.....ครั้ง  
 2. ไม่ใช่

25.7 อื่นๆ ระบุ....., วันละ.....ครั้ง

26. คุณแปรงฟันวันละกี่ครั้ง

1. วันละครั้ง  
 2. 2 ครั้งต่อวัน  
 3. 3 ครั้งต่อวัน  
 4. มากกว่า 3 ครั้งต่อวัน

27. คุณแปรงฟันนาน.....นาที



### ส่วนที่ 7: พฤติกรรมต่อโรคเบาหวาน

28. เดือนที่แล้วคุณออกกำลังนานกว่า 30 นาที บ่อยแค่ไหน

- |   |   |
|---|---|
| <input type="checkbox"/> 1. มากกว่า 5 ครั้ง/สัปดาห์ | <input type="checkbox"/> 2. 2-5 ครั้ง/สัปดาห์ |
| <input type="checkbox"/> 3. 1 ครั้ง/สัปดาห์         | <input type="checkbox"/> 4. 2-3 ครั้ง/เดือน   |
| <input type="checkbox"/> 5. ไม่ได้ออกกำลังกาย       |   |

29. เดือนที่แล้วคุณชั่งน้ำหนักบ่อยแค่ไหน

- |   |                                     |
|---|-------------------------------------|
| <input type="checkbox"/> 1. มากกว่า 1 ครั้ง | <input type="checkbox"/> 2. 1 ครั้ง |
| <input type="checkbox"/> 3. ไม่ได้ชั่ง      |                                     |

30. คุณได้ปรับเปลี่ยนอาหารตามคำแนะนำของเจ้าหน้าที่หรือไม่

- |   |   |  |
|---|---|--|
| <input type="checkbox"/> 1. ใช่ (ตอบข้อ 31) | <input type="checkbox"/> 2. ไม่ใช่ (ข้ามไปข้อ 32) | <input type="checkbox"/> 3. ไม่เคยได้รับคำแนะนำ (ข้ามไปข้อ 32) |
|---|---|--|

31. คุณปรับเปลี่ยนอาหารตามคำแนะนำของเจ้าหน้าที่บ่อยแค่ไหน

- |   |                                     |
|---|-------------------------------------|
| <input type="checkbox"/> 1. เกือบทุกมื้อ    | <input type="checkbox"/> 2. บางมื้อ |
| <input type="checkbox"/> 3. แทบจะไม่ได้ปรับ |                                     |

32. คุณเคยลืมหานยาหรือไม่

- |   |   |
|---|---|
| <input type="checkbox"/> 1. ใช่ (ตอบข้อ 33) | <input type="checkbox"/> 2. ไม่ใช่ (ข้ามไปข้อ 34) |
|---|---|

33. เดือนที่แล้วคุณลืมหานยาบ่อยแค่ไหน

- |   |   |
|---|---|
| <input type="checkbox"/> 1. 1-3 ครั้ง/เดือน | <input type="checkbox"/> 2. 1-2 วัน/อาทิตย์ |
| <input type="checkbox"/> 3. มากกว่า 2 วัน   | <input type="checkbox"/> 4. จำไม่ได้        |

34. ปีที่แล้วคุณได้ตรวจจอประสาทตาหรือไม่

- |                                 |                                    |
|---------------------------------|------------------------------------|
| <input type="checkbox"/> 1. ใช่ | <input type="checkbox"/> 2. ไม่ใช่ |
|---------------------------------|------------------------------------|

35. ปีที่แล้วคุณได้ตรวจเท้าหรือไม่

- |                                 |                                    |
|---------------------------------|------------------------------------|
| <input type="checkbox"/> 1. ใช่ | <input type="checkbox"/> 2. ไม่ใช่ |
|---------------------------------|------------------------------------|

36. คุณใส่รองเท้าหุ้มส้นทุกครั้งที่คุณออกจากบ้านหรือไม่

- |                                 |                                    |
|---------------------------------|------------------------------------|
| <input type="checkbox"/> 1. ใช่ | <input type="checkbox"/> 2. ไม่ใช่ |
|---------------------------------|------------------------------------|

37. คุณตรวจเท้าเองบ่อยแค่ไหน

- |   |                                    |
|---|------------------------------------|
| <input type="checkbox"/> 1. ทุกวัน          | <input type="checkbox"/> 2. บางวัน |
| <input type="checkbox"/> 3. แทบจะไม่ได้ตรวจ |                                    |

## Appendix J

## The evaluation form of self's regulation manual (for the expert)

Topics	Excellent 5	Good 4	Fair 3	Poor 2	Unsatisfied 1
<b>1. Content</b> - Sequence - Accuracy - Consistency - Clearness of content <b>2. Picture, language, and color</b> - Matching of picture and content - Accuracy of graphic - Consistency between picture and text - Appropriate of the size of text - Accuracy of language - Appropriate content color					

## Appendix K

The evaluation form of self's regulation manual for the expert (Thai version)

แบบประเมินคู่มือการปรับเปลี่ยนพฤติกรรมและการดูแลสุขภาพช่องปาก

สำหรับผู้เชี่ยวชาญ

เรื่อง	ดีมาก 5	ดี 4	ปานกลาง 3	พอใช้ 2	ควรปรับปรุง 1
<p><b>1. เนื้อหา</b></p> <ul style="list-style-type: none"> <li>- ลำดับขั้นตอนในการนำเสนอเนื้อหา</li> <li>- ความถูกต้องของเนื้อหา</li> <li>- ความสอดคล้องของเนื้อหาในแต่ละหัวข้อ</li> <li>- ความชัดเจนในการอธิบายเนื้อหา</li> </ul> <p><b>2. รูปภาพ ภาษา สี</b></p> <ul style="list-style-type: none"> <li>- ความเหมาะสมของรูปภาพต่อเนื้อหาของเรื่อง</li> <li>- ความถูกต้องของภาพกราฟิกที่ใช้ประกอบ</li> <li>- ความสอดคล้องของรูปภาพกับคำบรรยายในเนื้อหา</li> <li>- ขนาดตัวอักษรเหมาะสม</li> <li>- ภาษาที่ใช้มีความเหมาะสมถูกต้อง</li> <li>- การใช้สีในเนื้อหาเหมาะสม</li> </ul>					

## Appendix L

The evaluation form of educational video  
(for the expert)

Topics	Excellent 5	Good 4	Fair 3	Poor 2	Unsatisfied 1
<p><b>1. Content</b></p> <ul style="list-style-type: none"> <li>- Sequence</li> <li>- Accuracy</li> <li>- Consistency</li> <li>- Clearness of content</li> </ul> <p><b>2. Picture, language, color, and sound</b></p> <ul style="list-style-type: none"> <li>- Matching of picture and content</li> <li>- Accuracy of graphic</li> <li>- Consistency between picture and text</li> <li>- Appropriate of the size of text</li> <li>- Accuracy of language</li> <li>- Appropriate content color</li> <li>- Appropriate sound</li> </ul>					



## Appendix M

The evaluation form of educational video for the expert (Thai version)  
 แบบประเมินวิดีโอให้ความรู้เรื่องการปรับเปลี่ยนพฤติกรรมและการดูแลสุขภาพช่องปาก  
 (สำหรับผู้เชี่ยวชาญ)

เรื่อง	ดี มาก 5	ดี 4	ปาน กลาง 3	พอใ ซ์ 2	ควร ปรับปรุง 1
<p><b>1. เนื้อหา</b></p> <ul style="list-style-type: none"> <li>- ลำดับขั้นตอนในการนำเสนอเนื้อหา</li> <li>- ความถูกต้องของเนื้อหา</li> <li>- ความสอดคล้องของเนื้อหาในแต่ละหัวข้อ</li> <li>- ความชัดเจนในการอธิบายเนื้อหา</li> </ul> <p><b>2. รูปภาพ ภาษา สี เสียง</b></p> <ul style="list-style-type: none"> <li>- ความเหมาะสมของรูปภาพต่อเนื้อหาของเรื่อง</li> <li>- ความถูกต้องของภาพกราฟิกที่ใช้ประกอบ</li> <li>- ความสอดคล้องของรูปภาพกับคำบรรยายในเนื้อหา</li> <li>- ขนาดตัวอักษรเหมาะสม</li> <li>- ภาษาที่ใช้มีความเหมาะสมถูกต้อง</li> <li>- การใช้สีในเนื้อหาเหมาะสม</li> <li>- การใช้เสียงมีความเหมาะสม</li> </ul>					

## Appendix N

## The evaluation form of slide presentation

(for the expert)

Topics	Excellent	Good	Fair	Poor	Unsatisfied
	5	4	3	2	1
<b>1. Content</b> - Sequence - Accuracy - Consistency - Clearness of content <b>2. Picture, language, and color</b> - Matching of picture and content - Accuracy of graphic - Consistency between picture and text - Appropriate of the size of text - Accuracy of language					

## Appendix O

The evaluation form of slide presentation for the expert (Thai version)  
 แบบประเมิน Slide presentation ให้ความรู้เรื่อง การปรับเปลี่ยนพฤติกรรมและการดูแลสุขภาพ  
 ของปาก (สำหรับผู้เชี่ยวชาญ)

เรื่อง	ดี มาก 5	ดี 4	ปาน กลาง 3	พอใ ซ์ 2	ควร ปรับปรุง 1
<p><b>1. เนื้อหา</b></p> <ul style="list-style-type: none"> <li>- ลำดับขั้นตอนในการนำเสนอเนื้อหา</li> <li>- ความถูกต้องของเนื้อหา</li> <li>- ความสอดคล้องของเนื้อหาในแต่ละหัวข้อ</li> <li>- ความชัดเจนในการอธิบายเนื้อหา</li> </ul> <p><b>2. รูปภาพ ภาษา สี</b></p> <ul style="list-style-type: none"> <li>- ความเหมาะสมของรูปภาพต่อเนื้อหาของเรื่อง</li> <li>- ความถูกต้องของภาพกราฟิกที่ใช้ประกอบ</li> <li>- ความสอดคล้องของรูปภาพกับคำบรรยายในเนื้อหา</li> <li>- ขนาดตัวอักษรเหมาะสม</li> <li>- ภาษาที่ใช้มีความเหมาะสมถูกต้อง</li> <li>- การใช้สีในเนื้อหาเหมาะสม</li> </ul>					



## Appendix P

## The validity score of self's regulation manual by experts

Topics	Expert in DM	Expert in education	Expert in dentistry	Mean (SD)
<b>1. Content</b>				
- Sequence	4	5	5	4.67 (0.58)
- Accuracy	5	4	5	4.67 (0.58)
- Consistency	4	4	5	4.33 (0.58)
- Clearness of content	5	5	5	5.00 (0.00)
<b>2. Picture, language, and color</b>				
- Matching of picture and content	5	4	4	4.33 (0.58)
- Accuracy of graphic	5	4	4	4.33 (0.58)
- Consistency between picture and text	5	3	4	4.00 (1.00)
- Appropriate of the size of text	4	4	4	3.67 (0.58)
- Accuracy of language	4	4	5	4.33 (0.58)
- Appropriate content color	5	5	4	4.00 (0.00)
<b>Sum scores (50)</b>	<b>46</b>	<b>42</b>	<b>45</b>	<b>44.33 (2.08)</b>

## Appendix Q

## The validity score of educational video by experts

Topics	Expert in DM	Expert in education	Expert in dentistry	Mean (SD)
<b>1. Content</b>				
- Sequence	5	5	4	4.67 (0.58)
- Accuracy	5	5	5	5.00 (0.00)
- Consistency	5	4	5	4.67 (0.58)
- Clearness of content	4	5	4	4.33 (0.58)
<b>2. Picture, language, color, and sound</b>				
- Matching of picture and content	5	5	5	5.00 (0.00)
- Accuracy of graphic	5	4	5	4.67 (0.58)
- Consistency between picture and text	4	5	5	4.67 (0.58)
- Appropriate of the size of text	5	4	4	4.33 (0.58)
- Accuracy of language	4	4	5	4.33 (0.58)
- Appropriate content color	5	4	5	4.67 (0.58)
- Appropriate sound	5	5	5	5.00 (0.00)
<b>Sum scores (55)</b>	<b>52</b>	<b>50</b>	<b>52</b>	<b>51.33 (1.15)</b>

## Appendix R

## The validity score of slide presentation by experts

Topics	Expert in DM	Expert in education	Expert in dentistry	Mean (SD)
<b>1. Content</b>				
- Sequence	5	5	5	5.00 (0.00)
- Accuracy	5	5	5	5.00 (0.00)
- Consistency	5	5	5	5.00 (0.00)
- Clearness of content	5	4	5	4.67 (0.58)
<b>2. Picture, language, and color</b>				
- Matching of picture and content	5	5	5	5.00 (0.00)
- Accuracy of graphic	5	4	5	4.67 (0.58)
- Consistency between picture and text	4	4	5	4.33 (0.58)
- Appropriate of the size of text	5	5	4	4.67 (0.58)
- Accuracy of language	5	5	5	5.00 (0.00)
<b>Sum scores (45)</b>	<b>44</b>	<b>42</b>	<b>44</b>	<b>43.33 (1.15)</b>

## Appendix S

## The evaluation form of lifestyle and oral health education (for the expert)

Topics	Total score	Score	
<b>1. Prevention of type 2 diabetes from its complications and the relationship between type 2 diabetes and oral complications</b>			
- Sequence of the content	5		
- Accuracy of the content	5		
- Clearness of the content	5		
- Interesting of the content	5		
<b>2. Diet modification</b>			
- Sequence of the content	5		
- Accuracy of the content	5		
- Clearness of the content	5		
- Interesting of the content	5		
<b>3. Exercise</b>			
- Sequence of the content	5		
- Accuracy of the content	5		
- Clearness of the content	5		
- Interesting of the content	5		
<b>4. Foot care</b>			
- Sequence of the content	5		
- Accuracy of the content	5		
- Clearness of the content	5		
- Interesting of the content	5		
<b>5. Oral health care</b>			
- Sequence of the content	5		
- Accuracy of the content	5		
- Clearness of the content	5		
- Interesting of the content	5		
<b>Sum scores</b>	100		

Recommendation.....

.....

## Appendix T

The evaluation form of lifestyle and oral health education for the expert  
(Thai version)

แบบประเมินการให้ความรู้ เรื่อง การปรับเปลี่ยนพฤติกรรมและการดูแลสุขภาพช่องปาก  
สำหรับผู้เชี่ยวชาญ

เรื่อง	คะแนนเต็ม	คะแนนที่ได้	หมายเหตุ
<b>1. การป้องกันภาวะแทรกซ้อนของโรคเบาหวาน และ ความสัมพันธ์ระหว่างโรคเบาหวานและสุขภาพช่องปาก</b>			
- ลำดับขั้นตอนในการนำเสนอเนื้อหา	5		
- ความถูกต้องของเนื้อหา	5		
- ความชัดเจนในการอธิบายเนื้อหา	5		
- ความน่าสนใจในการดำเนินเรื่อง	5		
<b>2. การควบคุมอาหารในผู้ป่วยเบาหวาน</b>			
- ลำดับขั้นตอนในการนำเสนอเนื้อหา	5		
- ความถูกต้องของเนื้อหา	5		
- ความชัดเจนในการอธิบายเนื้อหา	5		
- ความน่าสนใจในการดำเนินเรื่อง	5		
<b>3. การออกกำลังกายในผู้ป่วยเบาหวาน</b>			
- ลำดับขั้นตอนในการนำเสนอเนื้อหา	5		
- ความถูกต้องของเนื้อหา	5		
- ความชัดเจนในการอธิบายเนื้อหา	5		
- ความน่าสนใจในการดำเนินเรื่อง	5		
<b>4. การดูแลเท้าในผู้ป่วยเบาหวาน</b>			
- ลำดับขั้นตอนในการนำเสนอเนื้อหา	5		
- ความถูกต้องของเนื้อหา	5		
- ความชัดเจนในการอธิบายเนื้อหา	5		
- ความน่าสนใจในการดำเนินเรื่อง	5		
<b>5. การดูแลสุขภาพช่องปากในผู้ป่วยเบาหวาน</b>			
- ลำดับขั้นตอนในการนำเสนอเนื้อหา	5		
- ความถูกต้องของเนื้อหา	5		
- ความชัดเจนในการอธิบายเนื้อหา	5		
- ความน่าสนใจในการดำเนินเรื่อง	5		
คะแนนรวม	100		

ความคิดเห็นและข้อเสนอแนะ.....

## Appendix U

## The evaluation scores of lifestyle and oral health education by experts

Topics	Total score	Expert in DM	Expert in education	Expert in dentistry	Average scores
<b>1. Prevention of type 2 diabetes from its complications and the relationship between type 2 diabetes and oral complications</b>					
- Sequence of the content	5	5	4	5	4.67 (0.58)
- Accuracy of the content	5	5	5	5	5.00 (0.00)
- Clearness of the content	5	4	5	4	4.33 (0.58)
- Interesting of the content	5	4	3	5	4.00 (1.00)
<b>2. Diet modification</b>					
- Sequence of the content	5	5	5	5	5.00 (0.00)
- Accuracy of the content	5	5	5	4	4.67 (0.58)
- Clearness of the content	5	5	5	5	5.00 (0.00)
- Interesting of the content	5	4	5	5	4.67 (0.58)
<b>3. Exercise</b>					
- Sequence of the content	5	5	5	5	5.00 (0.00)
- Accuracy of the content	5	5	5	5	5.00 (0.00)
- Clearness of the content	5	5	4	4	4.33 (0.58)
- Interesting of the content	5	5	5	4	4.67 (0.58)
<b>4. Foot care</b>					
- Sequence of the content	5	5	5	5	5.00 (0.00)
- Accuracy of the content	5	5	4	5	4.67 (0.58)
- Clearness of the content	5	4	5	5	4.67 (0.58)
- Interesting of the content	5	5	5	5	5.00 (0.00)
<b>5. Oral health care</b>					
- Sequence of the content	5	5	4	5	4.67 (0.58)
- Accuracy of the content	5	5	5	5	5.00 (0.00)
- Clearness of the content	5	5	4	4	4.33 (0.58)
- Interesting of the content	5	5	5	5	5.00 (0.00)
<b>Sum scores</b>	100	96	93	95	94.67 (1.53)

## Appendix V

## Ethic Approval

AF 02-12



The Ethics Review Committee for Research Involving Human Research Subjects,  
Health Science Group, Chulalongkorn University  
Institute Building 2, 4 Floor, Soi Chulalongkorn 62, Phayathai Rd., Bangkok 10330, Thailand,  
Tel: 0-2218-8147 Fax: 0-2218-8147 E-mail: eccu@chula.ac.th

COA No. 191/2013



## Certificate of Approval

**Study Title** No.123.1/56 : EFFECTIVENESS OF LIFESTYLE CHANGE PLUS DENTAL CARE (LCDC) PROGRAM ON IMPROVING GLYCEMIC AND PERIODONTAL STATUS IN ELDERLY WITH TYPE 2 DIABETES, BANGKOK THAILAND

**Principal Investigator** : MISS SARUTA SAENGTIPBOVORN

**Place of Proposed Study/Institution** : College of Public Health Sciences,  
Chulalongkorn University

The Ethics Review Committee for Research Involving Human Research Subjects, Health Science Group, Chulalongkorn University, Thailand, has approved constituted in accordance with the International Conference on Harmonization – Good Clinical Practice (ICH-GCP) and/or Code of Conduct in Animal Use of NRCT version 2000.

Signature:  Signature:   
(Associate Professor Prida Tasanapradit, M.D.) (Assistant Professor Dr. Nuntaree Chaichanawongsoj)  
Chairman Secretary

**Date of Approval** : 22 November 2013 **Approval Expire date** : 21 November 2014

## The approval documents including

- 1) Research proposal
- 2) Patient/Participant Information Sheet and Informed Consent Form
- 3) Researcher
- 4) Questionnaires



**Protocol No.** 123.1/56  
**Date of Approval** 22 NOV 2013  
**Approval Expire Date** 21 NOV 2014

The approved investigator must comply with the following conditions:

1. The research/project activities must end on the approval expired date of the Ethics Review Committee for Research Involving Human Research Subjects, Health Science Group, Chulalongkorn University (ECCU). In case the research/project is unable to complete within that date, the project extension can be applied one month prior to the ECCU approval expired date.
2. Strictly conduct the research/project activities as written in the proposal.
3. Using only the documents that bearing the ECCU's seal of approval with the subjects/volunteers (including subject information sheet, consent form, invitation letter for project/research participation (if available).
4. Report to the ECCU for any serious adverse events within 5 working days
5. Report to the ECCU for any change of the research/project activities prior to conduct the activities.
6. Final report (AF 03-12) and abstract is required for a one year (or less) research/project and report within 30 days after the completion of the research/project. For thesis, abstract is required and report within 30 days after the completion of the research/project.
7. Annual progress report is needed for a two- year (or more) research/project and submit the progress report before the expire date of certificate. After the completion of the research/project processes as No. 6.

## Appendix W

The relationship between blood glucose level and periodontal status when  
HbA1c < 7% as glycemic control

Variables	Glycemic control		t value / $\chi^2$	p-value
	Controlled (HbA1c<7.0) (n=51)	Uncontrolled (HbA1≥7.0) (n=81)		
<b>Plaque index score (mm.)</b>				
Mean (SD)	0.56 (0.39)	0.65 (0.42)	-1.227	0.222
<b>Gingival index score (mm.)</b>				
Mean (SD)	0.64 (0.43)	0.75 (0.45)	-1.403	0.163
<b>Pocket depth (mm.)</b>				
Mean (SD)	2.22 (0.52)	2.47 (0.76)	-2.236	<b>0.027</b>
<b>Clinical attachment loss (CAL) (mm.)</b>				
Mean (SD)	3.28 (0.91)	3.66 (1.22)	-2.051	<b>0.042</b>
<b>Severity of periodontitis</b>				
- Slight	2 (3.9)	2 (2.5)	1.210	0.546
- Moderate	46 (90.2)	70 (86.4)		
- Severe	3 (5.9)	9 (11.1)		



**VITA**

Name: Miss Saruta Saengtbovorn Age: 30 years old Date of Birth: 2 June 1984 Place of Birth: Bangkok, Thailand Education: 2008 Doctor of Dental Surgery, Faculty of Dentistry, Chulalongkorn University, 2012 Master of Public Health, College of Public Health Sciences, Chulalongkorn University Current Office: Health Center 54 Position: Dentist Telephone: 0-81710-7952 E-mail: saruta79@gmail.com

