The Effects of the Community-Based Lifestyle Intervention Program on the Prevention of Type 2 Diabetes Mellitus among pre-diabetic elderly people at Khlong Lat Phrao community

ผลของโปรแกรมปรับเปลี่ยนวิถีชีวิตโดยชุมชนเป็นฐานเพื่อป้องกันโรคเบาหวานชนิดที่ 2 ในผู้สูงอายุกลุ่มเสี่ยงเบาหวานบริเวณชุมชนริมคลองลาดพร้าว

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Abstract

This quasi-experimental research aimed to study the effects of community-based lifestyle intervention program on the prevention of Type 2 Diabetes Mellitus among the pre-diabetic elderly people in Khlong Lat Phrao community, an urban poverty area in Bangkok. A total of 32 participants with pre - diabetes aged over 60 years were purposively assigned to the community-based lifestyle intervention or the experimental group (n = 18), and the usual care or the control group (n = 14). The program was implemented in partnership with the current community volunteers to combine diet, physical activity, and behavior revision strategies. Clinical and metabolic factors, dietary behaviors and physical activity were measured. Percentage, means, and standard deviation were utilized for data analysis by means of the SPSS, Version 24. Analyses of between-group differences at baseline for 12 weeks revealed that the participants in the intervention group achieved greater decreases as compared to the usual care group in fasting plasma glucose (-18.67±1.9 versus 6±3.8 mg/dl), body weight (-1.62±1.35 versus 0.46±0.68 kg), body mass index (-0.63±0.53 versus 0.18±0.36 kg/m2),

dietary intake (-295.61±184.22 versus 115.85±149.58 kcal/day), total cholesterol (-32.66±35.35 versus -24.27±23.50 mg/dl), triglycerides level (-78±39.44 versus -38.90±37.73 mg/dl) and LDL cholesterol (-32.26±45.96 versus -13.27±22.94 mg/dl). Moreover,the physical activities of participants in the intervention group were increased significantly as compared to the normal group (+646.66±422.93 versus -35.71±85.27 MET.min.wk-1), including HDL cholesterol (+15.13±11.01 versus +4.36±11.48 mg/dl). It can be concluded that the implementation of the community-based lifestyle intervention program was effective and practical for the prevention of T2DM in the elderly people in Khlong Lat Phrao community, and this also can facilitate satisfactory effects on clinical and metabolic parameters.

Keywords: *community-based lifestyle intervention program, type 2 diabetes mellitus, pre-diabetic elderly people, Klong lat prao community in bangkok*

บทคัดย่อ

จุดประสงค์ของการศึกษานี้คือ เพื่อประเมินผลของแนวทางปรับวิถีการดำเนินชีวิตของชุมชนผู้สูงอายุกลุ่มเสี่ยงเบาหวาน เปรียบเทียบกับกลุ่มที่ใช้ชีวิตตามปกติในพื้นที่ยากจนของเขตชุมชนเมืองในกรุงเทพมหานครของประเทศไทย การศึกษากึ่งทดลองครั้งนี้ได้ดำเนินการทดลองในชุมชนคลองลาดพร้าว ซึ่งเป็นพื้นที่ยากจนของกรุงเทพมหานคร โดยมีผู้เข้าร่วมจากการคัดเลือกจำนวน 32 คนที่อยู่ในภาวะเสี่ยงต่อการเป็นโรคเบาหวานซึ่งมีอายุมากกว่า 60 ปี แบ่งเป็นกลุ่มที่ทำการปรับวิถีการดำเนินชีวิต (n = 18) เปรียบเทียบกับกลุ่มการดูแลชีวิตตามปกติ (n = 14) โดยอาสาสมัครผู้สูงอายุกลุ่มเสี่ยงเบาหวานในชุมชนได้มีการปรับอาหาร รูปแบบการออกกำลังกาย และพฤติกรรม จากนั้นทำการติดตามปัจจัยทางคลินิก อัตราการเผาผลาญ พฤติกรรมการบริโภคอาหาร และการออกกำลังกาย ผลจากการวิเคราะห์ความแตกต่างระหว่างกลุ่มทดลองและกลุ่มควบคุมเวลา 12 สัปดาห์ พบว่าผู้เข้าร่วมการปรับเปลี่ยนประสบความสำเร็จเมื่อเทียบกับกลุ่มที่ใช้ชีวิตตามปกติในการลดลงของระดับน้ำตาลในเลือด (-18.67±1.9 เทียบกับ 6±3.8 mg/dl) รวมถึงน้ำหนักตัว (-1.62±1.35 เทียบกับ 0.46±0.68 kg) ดัชนีมวลกาย (-0.63±0.53 เทียบกับ 0.18±0.36 kg/m2) การบริโภคอาหาร (-295.61±184.22 เทียบกับ 115.85±149.58 kcal/day) คอเลสเตอรอลรวม (-32.66±35.35 เทียบกับ -24.27±23.50 mg/dl) ระดับไตรกลีเซอไรด์ (-78±39.44 เทียบกับ -38.90±37.73 mg/dl) ระดับคอเลสเตอรอลชนิดเอลดีเอล(-32.26±45.96 versus -13.27±22.94 mg/dl) ขณะที่การเคลื่อนไหวของร่างกายในกลุ่มผู้เข้าร่วมการปรับเปลี่ยนเพิ่มขึ้นเมื่อเปรียบเทียบกับกลุ่มที่ใช้ชีวิตปกติ (+646.66±422.93 เทียบกับ -35.71±85.27 MET.min.wk-1) รวมถึงระดับคอเลสเตอรอลชนิดเอชดีเอล (+15.13±11.01 เทียบกับ +4.36±11.48 mg/dl) ดังนั้นการดำเนินการตามโปรแกรมการปรับวิถีชีวิตแบบเพื่อป้องกันโรคเบาหวานชนิดที่ 2 ในผู้สูงอายุกลุ่มเสี่ยงเบาหวานในเขตความยากจนในเมืองนั้นสามารถนำไปใช้ได้จริง สามารถส่งผลที่น่าพอใจผลในการตรวจสอบทางคลินิกรวมถึงอัตราการเผาผลาญที่เปลี่ยนแปลงไป

คำสำคัญ: *โปรแกรมปรับเปลี่ยนวิถีชีวิตโดยชุมชนเป็นฐาน โรคเบาหวานชนิดที่ 2 ผู้สูงอายุกลุ่มเสี่ยงเบาหวาน ชุมชนริมคลองลาดพร้าวในกรุงเทพมหานคร*

Introduction

The epidemic of Type 2 Diabetes Mellitus (T2DM) is a global public health problem and has become common among the developing countries (Roberts et al., 2017; Thakur et al., 2017). In most developing countries diabetes has increased alongside growing urbanization, dietary changes, reduced physical activity and unhealthy behaviors (Pengpid et al., 2019; Papier et al., 2016). Thailand is among the developing countries with a high occurrence of diabetes, particularly in elderly population. Currently, the prevalence of diabetes was estimated to be 8% among all adults, and 15% among adults aged over 60 years old. Moreover, inactive lifestyle and unhealthy diet have become common in Thailand, increasing the risk of this population for developing diabetes mellitus particular in aging society (Deerochanawong & Ferrario, 2013; Khunkaew et al., 2019; Kramer et al., 2018).

Lifestyle modification has been found to be effective in preventing and delaying the development of diabetes (Shirinzadeh et al., 2019; Mäntyselkä et al., 2019; Thankappan et al., 2018). Currently, there is a lot of evidence that lifestyle changes can help prevent the development of diabetes in old adults. Many controlled trials of structured lifestyle modification have reliably demonstrated that achieving and continuing a healthy body weight through a combination of a change in dietary behaviors and an increase of physical activity decreases the occurrence of diabetes in the elderly at high risk (Ibrahim et al., 2016; Kimura et al., 2019; Chang et al., 2020). Encouraged by these results, many attempts have been made to explain the prevention trials into community-based programs (Castaneda et al., 2002; Hill et al., 2017).

Even during the 10 years' follow-up randomizing many to many studies such as U.S. Diabetes prevention program (DPP Outcome Study), the diabetes occurrence rate was reduced by 34% in the lifestyle group compared with control, about 20% of the participants were aged ≥60 years at enrollment. Prediabetes lifestyle interventions for relatively healthy people aged 60 years or older seem to be highly cost-effective, although evidence is sparse. Furthermore, modelling studies for diabetes prevention which include a screening stage, indicate that screening for Type 2 diabetes and impaired glucose tolerance, with appropriate intervention for those with impaired glucose tolerance, in an above average risk, overweight and aged ≥60 years, seems to be cost effective (Matte et al., 2016).

In Thailand, many community-based programs have reported some success in modifying indicators of diabetes through lifestyle intervention (Saengtipbovorn & Taneepanichskul, 2014; Eknithiset & Somrongthong, 2017). However, there is poor evidence of community-based diabetes prevention programs in older adults, in relatively pre-diabetic elderly people, with high risk of developing Type 2 Diabetes, on body weight as well as metabolic factors, through a combination of changes in dietary habits and an increase in physical activity particular in the urban poverty area. Therefore, the present study was to evaluate the effects of community-based lifestyle intervention program to prevent Type 2 Diabetes Mellitus in pre-diabetic elderly people

in Khlong Lat Phrao community in Bangkok, Thailand.

Material & Methods

The sample

This study was a quasi-experimental research with repeated measures, conducted in the urban poverty area located in Khlong Lat Phrao community nearby a major canal in Bangkok. This community was once known for its putrid water, proliferation of rubbish and land encroachment along it, approximately 7,069 households and 30,000 individuals (Bhatkal & Lucci, 2015). The population consists of mostly nationally Thai residents, but is diverse in terms of religious affiliation, socioeconomic status, and rural village of origin. The case study neighborhood is located in Bangkok and cuts through the middle of the city. Few roads are wide enough for cars and several are just small footpaths. Although the community is in part a squatter settlement, its ways, footpaths, and communal spaces are well preserved by residents. The period of study was 12 weeks (August-October 2019). The study was started only after taking permission from the institutional ethical committee. A consecutive sampling approach was used to recruit select participants based on the criteria that they must be 60 years old or above and were diagnosed with pre-diabetes. Based on Krejcie & Morgan's (1970) formula for calculating sample size of a finite population, 135 participants were achieved. Then only thirty-two of them were finally selected as the sample for this study. Eighteen of them were assigned into the experimental group who participated in the intervention program. The other 14 were assigned into the control group with usual care.

The community-based lifestyle intervention program process

The community-based lifestyle intervention program was designed following review of evidence and guidelines (Ibrahim et al., 2016; Chang et al., 2020). Modification was tailored according to the needs and the cultural sensitivity of the community. The main goals of the lifestyle intervention were based upon available evidence on diabetes risk factors according to the Finnish diabetes prevention study (DPS). They were 1) weight loss ≥5% for overweight and obese individuals, 2) carbohydrate intake 50-55% of total energy, 3) total fat intake <35% of total energy, of which saturated fat <10%, 4) fiber consumption ≥15 gr/1000 kcal, and 5) achieving moderate intensity physical activity ≥30 min/day (Lindström et al, 2003). Few discussions were conducted with participants (i.e., dieticians, physical trainers, family medicine specialists, local community organizations and potential participants) before the intervention. The content was based on several theoretical frameworks such as Transtheoretical Model, Stages of Change Model, Social Support, Motivational Interviewing and Self-Regulation (Pattanaik et al., 2019; Thewjitcharoen et al., 2018).

The intervention

The participants were allocated to the intervention and control group at the time of the baseline screening. The intervention program is 12 weekly 3-hour sessions. In every session, in

formation on diabetes risk issues, healthy lifestyle, individualized discussions focusing on specific individual problems and published material were delivered. Moreover, improved nutritional programs were provided for each participant to decrease body weight. Levels of energy intake were calculated by estimating the daily energy needs to maintain the present body weight. No formal workout sessions were offered, except for common counselling to increase physical activity. All the group sessions were held during weekends, at community halls or recreational parks.

Measurements

The outcome measures for this study were required to fast overnight for a minimum of eight hours prior to each blood test and included weight, BMI, total cholesterol, triglyceride, LDL cholesterol, HDL cholesterol, physical activity, dietary intake. All these measurements were taken at baseline and every week of the intervention for both experimental and control groups.

Statistical analysis

The collected data was entered in MS-Excel and analyzed and statistically evaluated using the Statistical Package for Social Sciences (SPSS) software version 24 (Chicago, IL, USA). To evaluate the demographic and clinical characteristics of the subjects, the descriptive analyses including means, standard deviations, and percentages were applied. Chi-square tests and independent t-tests were performed to evaluate the homogeneity of the two groups. The main hypothesis was tested and all participants who completed the baseline and 12-week evaluations, regardless of session attendance. Distributions of all variables were first examined, and transformations conducted as necessary and indicated on each table.

Ethical consent

This study was approved by the Phranakhon Rajabhat University Research Ethics Committee (Reference number 62-61). Informed consent was signed by all participants.

Results

Baseline characteristics

All participants who enrolled at baseline 18 (experimental) and 14 (control) were eligible for follow up at 12 weeks. The baseline characteristics of the participants are presented in Tables 1. Most of them are female about 60-64 old years with at least primary school educational level, currently married and unemployed. More than half of them maintained chronic disease and used drugs, mainly for hypertension and dyslipidemia. There were no statistically significant differences among age, gender, educational level, marital status, occupation BMI, chronic disease, currently used drug and diabetes history in direct relatives between the intervention and the control groups in baseline characteristics ($p = 0.514$, 0.504, 0.441, 0.307, 0.107, 0.871, 0.360, 0.927 and 0.302, respectively) (The details are demonstrated in Table 1).

Table 1. Baseline characteristics.

Demographics and baseline measurements	Intervention group (n = 18) N(%)	Control group (n=14) N(%)	Control group (n=14) N(%)
Age (years)			.514
60-64	8(44.4)	7(50)	
65-69	3(16.7)	4(28.6)	
>70	7(38.9)	3(21.4)	
Gender			.504
Male	5(27.8)	3(21.4)	
Female	13(72.2)	11(78.6)	
Education			.441
Illiterate	0(0)	1(7.1)	
Primary	13(72.2)	13(81.30)	
High school	4(22.2)	4(28.6)	
Intermediate	1(5.6)	4(7.1)	
Graduation	0(0)	0(0)	
Marital status			.307
Currently married	10(55.6)	4(28.6)	
Never married	2(11.1)	4(28.6)	
Widowed	5(27.8)	5(35.7)	
Divorced	0(0)	1(7.1)	
Separated	1(5.6)	0(0)	
Occupation			.107
Unemployed	8(44.4)	8(57.1)	
Merchant	2(11.1)	0(0)	
Farmer	0(0)	0(0)	
Worker	3(18.7)	6(42.9)	
Retire	2(11.1)	0(0)	
Others	3(16.7)	0(0)	

Demographics and baseline measurements	Intervention group (n = 18) N(%)	Control group (n=14) N(%)	Control group (n=14) N(%)
Body mass index(BMI)			.871
Normal	3(16.7)	2(14.3)	
Overweight	4(22.2)	2(14.3)	
Obese	9(50)	9(64.3)	
Obesity	2(11.1)	1(7.1)	
Chronic Disease			.360
None	4(22.2)	5(35.7)	
Hypertension	6(33.3)	4(28.6)	
Dyslipidemia	8(44.4)	3(21.4)	
Hypertension and Dyslipidemia	0(0)	1(7.1)	
Others	0(0)	1(7.1)	
Medication used			.927
None	9(50)	7(50)	
Hypertension drugs	6(33.3)	4(28.6)	
Dyslipidemia drugs	3(16.7)	3(21.4)	
Diabetes history in direct relatives			.302
No	18(72.2)	8(57.1)	
Yes	5(27.8)	6(42.9)	

Values are n (%)

[a] *Determined with x2 test for categorical variables and independent t-test for continuous variables and, significant at p-value <0.05.*

Biomedical outcomes

Study outcomes and metabolic changes from baseline to week 12th were shown in Table 2. An intention-to-treat analysis of between groups at 12 weeks revealed that Fasting Plasma Glucose (FPG) in the intervention group decreased from 110.83 (6.68) mg/dl at baseline to 92.16 (14.70) mg/dl at week 12 follow up. Similar patterns of change were observed for the usual care group who also showed a decrease in FPG from 107.21 (6.68) mg/dl at baseline to 101.64 (9.88) mg/dl at week 12 follow up. There were statistically significant differences of FPG between the intervention and the control groups at week 12 follow up (p = <0.001).

Table 2. Study outcomes and metabolic changes from baseline to week 12

Variable	Intervention group (n = 18)		Control group (n=14)		p-value[a]
	Mean	Standard deviation	Mean	Standard deviation	
Fasting plasma glucose (mg/dl)					
baseline	110.83	5.56	107.21	6.68	.060
week 12	92.16	14.70	101.64	9.88	.000
	-18.67	13.73	-5.27	10.12	
Body weight (kg)					
baseline	61.72	9.89	63.07	9.53	.071
week 12	60.10	9.40	63.53	9.27	.000
	-1.62	1.35	+0.46	.86	
Body mass index (BMI) (kg/m2)					
baseline	26.18	3.05	26.52	3.71	.086
week 12	25.55	2.93	26.70	3.60	.000
	-0.63	.53	+0.18	.36	
Dietary Intake (kcal/day)					
baseline	2,046.83	238.48	2,070.64	179.95	.012
week 12	1,751.22	153.46	2,186.64	179.09	.000
	-295.61	184.22	+115.85	149.58	
Physical Activity (MET.min.wk-1)					
baseline	1,513.33	895.13	1,325.71	538.11	.141
week 12	2,162.22	825.84	1,290.64	500.69	.000
	+646.66	422.93	-35.71	85.27	
Cholesterol (mg/dl)*					
baseline	223.33	36.27	210.45	28.01	.006
week 12	190.66	28.01	186.18	41.29	.003
	-32.66	35.35	-24.27	23.50	
Triglycerides (mg/dl)*					
baseline	164.73	45.54	139.66	35.51	.007
week 12	86.73	11.31	100.18	14.58	.000
	-78	39.44	-38.90	37.73	

Variable	Intervention group (n = 18)		Control group (n=14)		p-value[a]
	Mean	Standard deviation	Mean	Standard deviation	
HDL cholesterol (mg/dl)*					
baseline	58.66	5.53	56.36	6.72	.236
week 12	73.80	10.67	60.72	7.33	.000
	+15.13	11.01	+4.36	11.48	
LDL cholesterol (mg/dl)*					
baseline	131.00	34.73	124.18	34.08	.084
week 12	98.73	29.48	110.18	35.53	.017

Values are in mean and standard deviation (SD). Means differences within and between group are in mean (95% Confidence Interval), a negative change indicates a fall on average from baseline to 12 weeks.

[a] *Determined with x2 test for categorical variables and independent t-test for continuous variables between groups comparison at significant at p<0.05*

***** *Analysis only those who does not take dyslipidemia drugs [Intervention group (n = 15), Control group (n=11)]*

Further analyses demonstrated that the body weight, body mass index (BMI) and dietary intake of the intervention group decreased from 61.72 (9.89) kg, 26.18 (3.05) kg/m2 and 2,046.83 (238.48) kcal/day at baseline to 60.10 (9.40) kg, 25.55 (2.93) kg/m2 and 1,751.22 (153.46) kcal/day, respectively. Whereas, the body weight, BMI and dietary intake of the control group increased from 63.07 (9.53) kg, 26.52 (3.71) kg/m2 and 2,070.64 (179.95) kcal/day at baseline to 63.53 (9.27) kg, 26.70 (3.60) kg/m2 and 2,186.64 (179.09) kcal/day, respectively. There were statistically significant differences of body weight, BMI and dietary intake between the intervention and the control groups at 12 weeks follow up (p = <0.001, <0.001 and <0.001, respectively). In addition, physical activities in the intervention group increased from 1,513.33 (895.13) MET.min.wk-1 at baseline to 2,162.22 (825.84) MET.min.wk-1 at week 12 follow up. Whereas, in the control group, physical activities decreased from 1,325.71 (538.11) MET.min.wk-1 at baseline to 1,290.64 (500.69) MET.min.wk-1 at week 12 follow up. There were statistically significant differences of physical activity activities between the intervention and the control groups at 12 weeks follow up (p = <0.001). Among the remaining 26 excluded participants who took dyslipidemia (15 intervention and 11 control), total cholesterol, triglycerides and LDL cholesterol in the interven-

tion group decreased from 223.33 (36.27) mg/dl, 164.73 (45.54) mg/dl and 131 (34.73) mg/dl at baseline to 210.45 (41.27) mg/dl, 86.73 (11.31) mg/dl and 98.73 (29.48) mg/dl at week 12 follow up. When being compared with the control group, cholesterol, triglycerides and LDL cholesterol in the intervention group decreased from 190.66 (28.10) mg/dl, 139.66 (35.51) mg/dl and 124.18 (34.08) mg/dl at baseline to 186.18 (41.29) mg/dl, 100.18 (14.58) mg/dl and 110.18 (35.53) mg/dl at week 12 follow up, respectively.

Moreover, HDL cholesterol in the intervention group increased from 58.66 (5.53) mg/dl at baseline to 73.80 (10.67) mg/dl at week 12 follow up. Similarity to the control group, HDL cholesterol increased from 56.36 (6.72) mg/dl at baseline to 60.72 (7.33) mg/dl at week 12 follow up. There were statistically significant differences of HDL cholesterol between the intervention and the control groups at week 12 follow up ($p = <0.001$).

Discussion

To our knowledge, this is the first quasi -experimental research, evaluating the effects of lifestyle intervention program to prevent prediabetes in older adults resided in the urban poverty area in Thailand. The present study shows that the lifestyle changes improved both glycemic and healthy behaviors in the elderly with prediabetes. Our results indicated that the significant reductions in fasting plasma glucose, dietary intake, cholesterol, triglycerides, and LDL cholesterol but increase in physical activity and HDL cholesterol achieved as compared to the usual care group. Additionally, the decrease in weight circumference in the intervention group was in concordance with the results from other diet and exercise intervention studies. Moreover, it was found that the participants in the intervention group were more likely to exercise and modify their diet than the participants in the control group. This is inconsistent with a previous research paper, which studied a structured group diabetes education program, which was implemented in the community, with follow up for three years. It was found that there was no statistically significant difference in the physical activities (Thewjitcharoen et al., 2018; Khunti et al., 2012; Aekplakorn et al., 2019). Interestingly, the important success that reduces diabetes risk is weight loss and consequently all efforts to interpret the prevention trials to a community setting have intensive on weight reduction. Small community-based programs have reported minor success in weight reduction and modifying surrogate markers for diabetes through lifestyle intervention (Magill et al., 2018; Aekplakorn et al., 2019). In our study, community-based intervention program, the weight reduction was decrease from 61.72 (9.89) to 60.10 (9.40) kg in the intervention group compared with a gain of 63.07 (9.53) to 63.53 (9.27) in the control group at week 12. Therefore, this intervention program to aid weight reduction in older adults in an urban poverty community setting is practical and can have a satisfactory effect on clinical and metabolic parameters.

In addition, community-based intervention, have numerous boundaries that need to be addressed. Clinical trials typically enroll highly

interested individuals that are probably more aware of their own health conditions than the overall population. Such bias is frequently present and would be problematic to eliminate in the majority of studies evaluating lifestyle intervention. While a quasi-experimental study design may be more possible to conduct in the community setting, it may not sufficiently control the possibility of confounding factors due to lack of randomization (Ibrahim et al., 2016). For example, although we made sure that the control group was comparable to the intervention group on the socio-demographics and blood glucose characteristics, it was not fully equivalent in terms of pre-existing medication used and diabetes history in direct relatives. In the analysis, these baseline differences were considered and the comparisons between groups of lipid measurements should be interpreted with caution. We required an alternative way to assess the impact of the lifestyle intervention on these outcomes by tracking changes in the usage of medications during their follow up. Future studies essential to integrate a longer follow-up period to generate understanding of intervention effects, adherence and sustainability, over time, by randomized controlled trial.

Conclusions

It can be concluded that an adapted diabetes prevention program can be implemented in the community setting, with improvement in several diabetes risk factors. Collaborations with existing community partners demonstrated a promising channel for wide-scale distribution of diabetes prevention at the community level. Furthermore, the results of the present study show the effectiveness of the community-based lifestyle intervention program by increasing knowledge, attitudes, and practices toward health behavior of the elderly with type 2 prediabetes.

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