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Research Article
Obesity Prevention through Regular Physical Activity and Healthy Eating Behavioral among Overweight Women of Thailand

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Abstract

Background and Objective: The prevalence of overweight and obesity is increased rapidly and becoming a public health problem in many countries of the world including Thailand. Overweight increases the risk of several Non Communicable Diseases (NCDs). This study aimed to evaluate the effectiveness of e-Health to manage obesity through regular physical activity and healthy eating behavior among Thais overweight women. **Materials and Methods:** A comparative cross-sectional study with the pre-post design was conducted by recruiting one hundred overweight women with a mean Body Mass Index (BMI) 27.8 kg m^{-2} and ages 35-65 years were allocated into two groups (N = 100). The intervention group was given Health messages through mobile applications while a control group was observed through their routine activities. Baseline and end line data after 24 weeks of measurement were taken. The data were analyzed with the Pearson's chi-square test and independent t-test to check differences within the group and an independent t-test and paired t-test were used to compare the differences between groups and within group. Ethical approval was granted prior to conduct this study. **Results:** Fifty participants in the interventional group had a significant decreased in mean systolic and diastolic blood pressure ($p<0.001$), blood glucose ($p<0.001$), body fat percentage ($p<0.001$), spent sitting time/day ($p = 0.001$), increase of food frequency scores ($p<0.001$) and moderate to vigorous physical activity per week ($p<0.001$) as compared to equal numbers in the control group which was statistically found non-significant. **Conclusion:** The study has concluded that health is effective to manage obesity through regular exercise and behavior change among overweight women of Thailand.

Key words: Evaluation, behavior change, mobile intervention, obesity, exercise and diet

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Overweight and obesity have become a significant public health problem and cases have been increasing during last four decades in some countries[1]. Prevalence of obesity among males was reported (33%) and quite high among females (43%) in Thailand[2,3]. Health consequences of overweight and obesity have increased the risk of various Non Communicable Diseases (NCDs) including type-2 diabetes mellitus, coronary heart disease, high blood pressure, stroke, some types of cancer and other health problems[4]. Lack of physical activity and unhealthy eating behavior are strongly related to the increase in the prevalence of overweight and obesity[5]. However, lifestyle modification interventions involving changes in physical activity and healthy eating behavior have proved as effective measures to control overweight and obesity in population[6].

As health, information and communication technology have been investigated in relation to physical activity and healthy diet in many previous studies and bring better health outcomes in different settings of the world[7]. The use of smartphone devices has rapidly increased among the general public and healthcare providers[8]. The previous study has proved that the use of mobile technology could be beneficial on health interventions and positively affected on people's lifestyle and their behavioral change[9]. Social media is a powerful, cost-effective strategy used by the majority of the people in Thailand[10,11]. The mobile LINE application is the most popular social media application used by 92% of Thai population[12,13]. This LINE application can be used through smartphones including android and iOS, tablet and personal computer[14].

Previously, this application was used by researchers in social commerce, marketing and learning purpose and proved as better intervention. Interestingly this health intervention has not been tested for health promotion and awareness and obesity management[15,16]. Hence, this study was conducted to evaluate the use of Health to manage obesity through regular physical activity and healthy eating behavior among Thais overweight women.

MATERIALS AND METHODS

Study area and research design: A comparative cross-sectional study was conducted to measure the outcomes through pre and post-study design. Baseline and end line 24-weeks after intervention from October, 2017 to April, 2018 in urban community of Bangkok, Thailand was conducted through enrollment of 100 women, fifty in each group with an equal number of participants were randomly allocated. A 24-weeks study was conducted among a hundred overweight women recruited from the community and Public Health Center by inviting through flyers, posters and brochures. The sample size was estimated by taking the prevalence based on the previous study, which compared the effect through prevention, effect size 0.63 with an alpha level of 0.05 and a power of 0.80[17].

Research protocol: Female aged between 35-65 years with BMI 25-29.9 kg m^{-2}, don't exercise, having their own smartphone with good internet access with LINE application were included in this study. However, those who had a history of cardiac problems, taking other medication and pregnant at the time of the study were excluded.

The Principal Investigator has trained four-nurses as a data collector prior to start this intervention. Data were collected at baseline and 24 weeks after the intervention. Measurements consisting of socio-demographic characteristics, systolic and diastolic Blood Pressure (BP), blood glucose, body composition, knowledge, perception and practices of physical activity and eating behaviors, by using validated and reliable measurement tools[1]. The Food Frequency Questionnaire (FFQ) from the Ministry of Public Health[2] was modified for the purpose of this study. (Cronbach's alpha coefficient = 0.841) and physical activity was measured using short-form International Physical Activity Questionnaire[18]. Level of knowledge based on Bloom's theory classified into 3 levels: the mean score <12 is low level, the mean score is 12-16 as moderate level and the mean score >16 as the high level). Perception level based on score use mean±SD into 3 levels: low level was score was <42.56, moderate level was score between 42.56-56.3 and high level was >56.34. Higher scores indicated a stronger feeling of each variable. Practices based on high and low scores, the higher scored indicated positive healthy behavior.

Ethical statement: The study was approved by the Ethics Review Committee for Research Involving Human Research Subjects, Health Science Group, Chulalongkorn University Thailand (COA No. 190/2017). All participants provided informed written consent before start the intervention.

[1]Blood pressure monitor (Omron model: HEM-7200, Kyoto, Japan), blood glucose monitoring (FreeStyle Optium Neo H At-A-Glance, Abbott Diabetes Care Ltd., Range Road Witney Oxon OX29 OYL, UK), Body composition by Bioelectrical Impedance Analysis by physiotherapist. (Inbody 230, Biospace Co., Ltd., Seoul, Korea), weight and height were measured using a stadiometer and balance scales

[2]http://ihppthaigov.net/DB/publication/attachresearch/319/chapter2.pdf

[3]IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp

Statistical analysis: Data was analyzed using the Statistical Package for the Social Sciences (SPSS) version 22[3]. Descriptive statistics were used to describe socio-demographic characteristics, Pearson's Chi-squares test and independent t-tests were used to compare the differences between the groups at baseline. A paired t-test was used to determine significant differences before and after, within a group and an independent t-test for testing the differences between groups. A p-value was considered as significant <0.05.

Intervention group (50) comprised of the following four main components:

- **Face-to-face education group:** Knowledge and consequence on overweight, physical activity including daily work, leisure-time, household activity, healthy eating behavior including lower fat/sugar/salt/calories food intake and increased fruits and vegetables consumption were given in this face to face education weekly continued for four weeks. The second section was small group discussion performed for 1 h duration for another 5-8 weeks
- **LINE group communication:** The LINE group name "Be Healthy" was created and invited the respondents, where two-way communications were used to discuss their experiences on physical activity and healthy eating behaviors. The researcher has motivated, encouraged and reminded all the participants by sending text messages and visual aids for three days a week continued for 8 weeks
- **Individual free call counseling by LINE app:** Respondents have been approached through this individual call for counseling (15-30 min) twice a month via LINE app during 9-24 weeks
- **Self-monitoring and tailored feedback:** Participants were asked to self-monitoring body weight, food and beverage intake and physical activity. During this activity, participants have asked to check their body weight on weekly basis and report the change. This activity was continued throughout the intervention period

RESULTS

Hundred participants were included in this study, their average age was 53.02±9.19 (Intervention group 53.72±8.73 and control group 52.32±9.65). Both assigned groups were observed same at the baseline and there was no any statistically significant differences on socio-demographic characteristics like, age (0.449) marital status (0.479), an education level (0.950), occupation (0.246), income (0.755) and history of alcohol drinking (0.603) between the groups before to start the intervention (Table 1).

After the 24 weeks intervention (end line), there was a statistical significant differences observed in the mean systolic and diastolic blood pressure (-10.52, p<0.001 and -7.84, p<0.001), blood glucose (-11.62, p<0.001), BMI (-0.80, p = 0.02) and body fat percentage (-5.74, p = 0.001) between groups. Food frequency scores, physical activity-MET mins/week and sitting time between the baseline and after intervention also showed statistically significant

Table 1: Comparison of characteristics between the observation group and the control group at baseline

Characteristics	Observational (n=50) N %	Control (n=50) N %	p-value
Age in years: Mean (±SD)	53.72 (8.734)	52.32 (9.650)	0.449[b]
Marital status			
Single	8 (16.0)	11 (22.0)	0.479[a]
Married	30 (60.0)	24 (48.0)	
Divorced/separated	12 (24.0)	15 (30.0)	
Educational level			
Primary school	18 (36.0)	15 (30.0)	0.950[a]
Secondary school	18 (36.0)	19 (38.0)	
Vocational diploma/bachelor degree	14 (28.0)	16 (32.0)	
Occupation			
Housewife	12 (24.0)	6 (12.0)	0.246[a]
General job	19 (38.0)	16 (32.0)	
Merchant	10 (20.0)	13 (26.0)	
Others	9 (18.0)	15 (30.0)	
Income: Mean (±SD)	11,606 (SD±8,861.73)	12,206 (SD± 10,230.87)	0.755[b]
Alcohol drinking			
No	42 (84.0)	40 (80.0)	0.603[a]
Yes	8 (16.0)	10 (20.0)	

a: Chi square, b: Independent t- test, Significant at p-value <<0.001

differences (p<0.001) when compared to the control group. There was no statistically significant difference in mean before and after the intervention. There was a lower weight and Waist Hip Ratio (WHR) in the intervention group (Table 2).

The intervention group showed significant improvement in mean of food frequency score (-3.88, p<0.001), physical activity MET-min/week (-151.86, p<0.001), systolic blood pressure (7.84 mmHg, p<0.001), diastolic blood pressure

Table 2: Comparison of food frequency score, physical activity MET-min/week, sitting time/day, systolic BP, diastolic BP, blood glucose, weight BMI and body composition at baseline and endline (n=100)

		Groups					
		Observational	Control			95% confidence interval[a]	
Variables	Time	Mean±SD	Mean±SD	Mean difference	p-value	Lower	Upper
Food frequency score	Baseline	39.96±7.12	38.06±6.92	1.9	0.17	-0.88	4.68
	Endline	43.84± 5.74	37.98±6.78	5.86	<0.001*	3.36	8.36
Physical activity MET-mins/week	Baseline	298.6±269.5	293.7±234.6	4.95	0.92	-95.35	105.25
	Endline	450.5±282.6	314.1±202.1	136.3	0.007*	38.78	233.85
Sitting time (min/day)	Baseline	298.65±269.58	293.70±234.67	4.95	0.92	-96.35	105.25
	Endline	186.00±87.24	295.20±99.55	-109.2	<0.001*	-146.35	-72.04
Systolic B (mmHg)	Baseline	129.86±12.69	129.18±12.92	0.68	0.79	-4.4	5.76
	Endline	122.02±9.85	132.54±11.48	-10.52	<0.001*	-14.76	-6.27
Diastolic BP (mmHg)	Baseline	81.06±10.30	83.64±9.33	-2.58	0.19	-6.48	1.32
	Endline	77.04±9.22	84.88±8.15	-7.84	<0.001*	-11.29	-4.38
Blood glucose (mg dL^{-1})	Baseline	106.00±25.49	106.50±16.96	-0.5	0.9	-9.09	8.09
	Endline	99.06±13.10	110.68±15.96	-11.62	<0.001*	-17.41	-5.82
Weight (kg)	Baseline	68.62±7.60	66.68±6.11	1.94	0.16	-0.79	4.68
	Endline	66.55±7.65	66.92±5.73	-0.37	0.78	-3.06	2.3
BMI (kg m^{-2})	Baseline	27.83±1.78	27.73±1.69	0.09	0.78	-0.59	0.78
	Endline	27.02±1.88	27.83±1.70	-0.8	0.027*	-1.52	-0.09
SMM (kg)	Baseline	22.96±4.44	22.58±3.33	0.37	0.63	-1.18	1.93
	Endline	25.48±5.07	22.84±3.22	2.63	0.003*	0.94	4.32
FM (kg)	Baseline	27.57±9.25	26.65±6.99	0.92	0.57	-2.33	4.17
	Endline	27.90±30.04	27.32±6.78	-0.58	0.89	-8.06	9.22
FFM (kg)	Baseline	41.05±8.16	39.96±7.12	1.09	0.47	-1.95	4.13
	Endline	42.96±8.51	39.87±6.99	-3.09	0.05*	0.00	6.18
%BF	Baseline	39.01±8.20	39.68±7.15	-0.67	0.66	-3.72	2.38
	Endline	34.05±8.88	39.80±6.96	-5.74	<0.001*	-8.91	-2.57
WHR	Baseline	0.92±0.05	0.93±0.04	-0.12	0.17	-0.03	0.006
	Endline	0.86±0.05	1.11±1.27	-0.25	0.15	-0.61	0.1

*Significant at p-value <.05, PA, Physical activity; MET (minutes/week activity), Metabolic equivalents, BP: Blood pressure, BMI: Body mass index, SMM: Skeletal muscle mass, FM: Fat mass, FFM: Fat free mass, %BF: Body fat percentage, WHR: Waist hip ratio

Table 3: Pair wise different measurements of food frequency score, physical activity MET-min/week, sitting time, systolic BP, diastolic BP, blood glucose, weight, BMI and body composition within intervention group (n = 50)

	Time				95% confidence interval[a]	
Variables	Baseline	Endline	Mean difference	P-value*	Lower	Upper
Food frequency score	39.96±7.12	43.84±5.74	-3.88	<0.001*	-5.59	-2.16
Physical activity MET-min/week	298.65±269.58	450.51±282.67	-151.86	<0.001*	-197.74	-105.97
Sitting time (min/day)	306.00±119.54	186.00±87.24	120.00	<0.001*	96.57	143.42
Systolic BP (mmHg)	129.86±12.69	122.02±9.85	7.84	<0.001*	5.9	9.77
Diastolic BP(mmHg)	81.06±10.30	77.04±9.22	5.97	<0.001*	2.32	5.71
Blood glucose (mg dL^{-1})	106.00±25.49	99.06±13.10	6.94	<0.001*	2.53	11.34
Weight (kg)	68.62±7.60	66.55±7.65	2.07	<0.001*	1.67	2.47
BMI (kg m^{-2})	27.83±1.78	27.02±1.88	0.8	<0.001*	0.63	0.97
SMM (kg)	22.96±4.44	25.48±5.07	-2.51	<0.001*	-3.26	-1.76
FM (kg)	27.57±9.25	23.81±8.80	3.75	<0.001*	2.74	4.77
FFM (kg)	41.05± 8.16	42.96±8.51	-1.91	<0.001*	-2.76	-1.05
%BF	39.01±8.20	34.05±8.88	4.95	<0.001*	3.35	6.55
WHR	0.92±0.05	0.86±0.05	0.061	<0.001*	0.04	0.07

*Significant at p-value <0.05, PA, Physical activity; MET (minutes/week activity), Metabolic equivalents BP: Blood pressure, BMI: Body mass index, SMM: Skeletal muscle mass, FM: Fat mass, FFM: Fat free mass, %BF: Body fat percentage, WHR: Waist hip ratio

Table 4: Pairwise of the different measurements of food frequency score, physical activity MET-min/week, sitting time, systolic BP, diastolic BP, blood glucose, weight, BMI and body composition within control group (n = 50)

	Time				95% confidence interval[a]	
Variables	Baseline	6-month	Mean difference	p-value*	Lower	Upper
Food frequency score	39.96±7.12	43.84±5.74	-0.86	<0.001*	-1.25	-0.46
Physical activity MET-min/week	293.70±234.67	236.16±119.18	57.54	0.09	-9.21	124.29
Sitting time (min/day)	286.40±104.46	295.20±99.55	-8.8	0.12	-20.06	2.46
Systolic BP (mmHg)	129.18±12.92	132.54±11.48	-3.36	<0.001*	-4.36	-2.35
Diastolic BP (mmHg)	83.64±9.33	84.88±8.15	-1.24	0.001*	-1.93	-0.54
Blood glucose (mg dL^{-1})	106.50±16.96	110.68±15.96	-4.18	<0.001*	-5.58	-2.78
Weight (kg)	66.68±6.11	66.92±5.73	-0.24	0.78	-2.00	1.52
BMI (kg m^{-2})	27.73±1.69	27.83±1.70	-0.09	0.12	-0.22	0.02
SMM (kg)	22.58± 3.33	22.84± 3.22	-0.25	0.01*	-0.44	-0.06
FM (kg)	26.65±6.99	27.32±6.78	-0.67	0.007*	-1.15	-0.19
FFM (kg)	39.96± 7.12	39.87±6.99	0.08	0.69	-0.36	0.54
%BF	39.68±7.15	39.80± 6.96	-0.11	0.4	-0.39	0.16
WHR	0.93±0.04	1.11±1.27	1.26	0.31	-0.54	0.17

*Significant at p-value <0.05, PA, Physical activity; MET (minutes/week activity), Metabolic equivalents, BP: Blood pressure, BMI: Body mass index, SMM: Skeletal muscle mass, FM: Fat mass, FFM: Fat-free mass, %BF: Body fat percentage, WHR: Waist hip ratio

(5.97 mmHg, p<0.001), blood glucose (6.94 mg%, p<0.001), weight (2.07 p<0.001), BMI (0.80 kg m^{-2}, p<0.001) and % body fat BF (4.95%, p<0.001) (Table 3).

Control group has not shown significant differences (57.54, p = 0.09) in physical activity metabolic equivalent (MET-min/week), sitting time per day (-8.80, p = 0.12), weight (-0.24, p = 0.78), BMI (-0.09, p = 0.12), % BF(-0.11,p = 0.40) and WHR (1.26, p = 0.31). There were statistically significant difference observed in food frequency score (-0.86, p = 0.001), systolic (-3.36, p = 0.001) and diastolic (-1.24, p = 0.001) and blood glucose (-4.18, p = 0.001) (Table 4).

DISCUSSION

The findings of this study showed middle-aged participants in the intervention group had positive health outcomes observed through decreased BMI, blood pressure, blood glucose and body fat percentage as compared to those in the control group. The effect of e-health by using LINE application has successfully delivered health information within the group. There was a mean weight loss among the participants has been reported in the intervention group at baseline. These findings could be more beneficial for the policymakers to replicate this intervention to target this middle age group for better prevention of obesity in the country. However, there was no any changes were observed in control group and reported an increase in weight among the participants. Study findings were supported by previous study that reported that there was a minimal change in weight between the groups at 24-weeks of intervention[19]. Contrary, another study indicated that after the intervention, there were statistically significant differences between groups has been reported after some time[20]. It has been observed that the celebration activities during this intervention might affect of regular physical exercise and dietary restriction that could lead to obesity. These findings were consistent with previous research in United States, Germany and Japan had a significant increase in weight on other national holidays compared to pre-holiday weight[21]. A previous study has also indicated that an increase in dietary consumption would result in weight gain[22], even the elderly Thai population is not physically active and the majority suffering from obesity[23]. Moreover, regular exercise could control obesity among population[24]. Another findings were also consistent with the previous study that utilized social networks for attending monthly hypertension education sessions and found after 18 months follow-up a significant results[25]. Internet- and paper-based weight loss programs tailored for overweight and obese men has also showed positive significant differences (p<0.001) and supports these findings[26]. These finding differ from previous studies as this intervention was used through existing facebook account, which was entirely different from the LINE application used in this study[27]. According to the study of the American Heart Association's High Blood Pressure Research, Scientific Sessions reported that in healthy people who are more likely to be obese might develop high blood pressure[9]. A similar study found that higher body weight was associated with higher blood glucose level[28]. Study shows that working time is significant to motivate women in this study. Therefore, it is not valid for long-term/large cohorts or public/worldwide access. The onset of artificial intelligence in smartphones should facilitate this kind of study.

Physical activity of metabolic equivalent (MET- min/week) score was increased and the sitting time per day was decreased in the intervention group when compared with the control group. Study from Thailand conducted on elderly population also supports out findings that the physical activity program change intervention was statistically significant in health benefit after intervention program between intervention and control group[29]. These finding were consistent with the previous study used Facebook as a tool to deliver the physical activity intervention program and were shown significant improvement in the level of physical activity from baseline to the end line when compared with the control group[30,31].

This study used an innovative technology device like a smartphone camera in taking photos of foods and beverages to record the monitoring food intake. This method improved the recording accuracy [32], underreports, reduced recall bias of food records [33], suitable for those who do not like writing and low literacy and reduce the burden on participants.

CONCLUSION

The finding of this present study shows the strong positive effects of e-Health to increase physical activity and healthy eating behavior. The technology of smartphone application (LINE) was found effective to deliver health information and to motivate, encourage and remind people to change their behaviors. The positive results have found a decrease in systolic and diastolic blood pressures, blood glucose and body fat percentage. Hence, this application may be useful for healthcare providers to help patients change their lifestyle behaviors and control obesity.

SIGNIFICANCE STATEMENT

This study discovered the e-health interventions that can be beneficial for obesity prevention. This study will help the researchers to uncover the critical areas of Non-communicable disease control that many researchers were not able to explore. Thus a new theory on effective e-health interventions for the prevention of obesity may be arrived at Thai community.

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