ผลของโปรแกรมส่งเสริมสุขภาพต่อระดับกิจกรรมการเคลื่อนไหวออกแรง สมรรถนะทางกาย และสมรรถภาพทางกาย ในวัยผู้ใหญ่ตอนปลายและผู้สูงอายุ

Effects of Health Promotion Program on the Levels of Physical Activity, Physical Function, and Physical Fitness in Late Adults and Older Persons

นิพนธ์ต้นฉบับ

Original Article

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บทคัดย่อ

วัตถุประสงค์: เพื่อศึกษาผลของโปรแกรมส่งเสริมสุขภาพต่อการใช้พลังงานทำกิจกรรมเคลื่อนไหวออกแรง สมรรถนะทางกายและสมรรถภาพทางกายผู้ใหญ่ตอนปลายและผู้สูงอายุ **วิธีการศึกษา:** การวิจัยกึ่งทดลองแบบกลุ่มเดียวทดสอบก่อนและหลัง มีตัวอย่างเป็นวัยผู้ใหญ่ตอนปลายและผู้สูงอายุ 50 คน ร่วมโปรแกรมโดยให้ความรู้และพาปฏิบัติกิจกรรมเคลื่อนไหวออกแรง 1 วัน จากนั้นติดตามและกระตุ้นพฤติกรรมการเคลื่อนไหวออกแรงนาน 8 สัปดาห์ ประเมินการเปลี่ยนแปลงผลลัพธ์ดังนี้ 1) กิจกรรมการเคลื่อนไหวออกแรงโดยใช้แบบสอบถามเพื่อคำนวณเป็นพลังงานที่ใช้ 2) ทดสอบสมรรถนะทางกาย (physical function และ 3) ทดสอบสมรรถภาพทางกาย (physical fitness) ที่ก่อนเริ่มโปรแกรม และ 4 และ 8 สัปดาห์ ทดสอบการเปลี่ยนแปลงผลลัพธ์โดยการวิเคราะห์ความแปรปรวนทางเดียวแบบวัดซ้ำ **ผลการศึกษา:** หลังเข้าร่วมโปรแกรม ทั้ง 1) ค่าพลังงานทำกิจกรรมการเคลื่อนไหวออกแรง (47.34, 58.04 และ 32.61 METS-min/week ที่ก่อนโปรแกรม 4 สัปดาห์ และ 8 สัปดาห์ ตามลำดับ) แตกต่างกันอย่างมีนัยสำคัญทางสถิติในทุกคู่เวลาที่เปรียบเทียบ (P-value < 0.05 ทั้งหมด) ค่าสมรรถนะทางทางกาย (เฉพาะ sit-to-stand test) (13.12, 14.48 และ 15.24 ครั้งต่อนาที) แตกต่างกันอย่างมีนัยสำคัญเฉพาะก่อนและ 4 สัปดาห์ และ ก่อนและ 8 สัปดาห์ (P-value < 0.05 ทั้งคู่) ส่วนค่าสมรรถภาพทางกาย (เฉพาะ cardio-respiratory endurance) (336.80, 388.40 และ 398.80 เมตร จาก 6-minute walk test) ที่ 4 และ 8 สัปดาห์เพิ่มขึ้นจากก่อนโปรแกรมอย่างมีนัยสำคัญทางสถิติ (P-value < 0.05 ทั้งคู่) แต่ไม่ต่างกันระหว่าง 4 และ 8 สัปดาห์ **สรุป:** โปรแกรมการส่งเสริมสุขภาพให้ความรู้ส่งเสริมกิจกรรมการเคลื่อนไหวออกแรงและการส่งเสริมสมรรถนะทางกายกับสมรรถภาพทางกาย และการติดตามและกระตุ้นกิจกรรมการเคลื่อนไหวออกแรง มีผลต่อสมรรถนะทางกายและสมรรถภาพทางกายของผู้ใหญ่ตอนปลายและผู้สูงอายุ

คำสำคัญ: การให้ความรู้; กิจกรรมการเคลื่อนไหวออกแรง; การออกกำลังกาย; สมรรถนะทางกาย; สมรรถภาพทางกาย; วัยผู้ใหญ่ตอนปลาย; ผู้สูงอายุ

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Abstract

Objective: To determine effects of the Health Promotion Program on energy expenditure of physical activity (PA) engagement, physical function (P-Func), and physical fitness (P-Fit) in Thai late adults and older persons. **Method:** This one-group pretest-posttest quasi-experimental study recruited 50 Thai late adults and elderly. The outcomes measured at before, at 4 and 8 weeks of the 8-week program included 1) PA to converted to energy expenditure, 2) P-Func tests, and 3) P-Fit measures. The first day was for education and demonstration. The 8 weeks were for follow-up for encouragement. Changes in each of the three outcomes were tested using repeated measures ANOVA. **Results:** Changes in energy expenditure (METS-min/week) based on PA (47.34, 58.04 and 32.61 METS-min/week before the program, and at 4 and 8 weeks, respectively) were significantly different for all 3 comparisons (P-value < 0.05 for all). Changes in P-Func (only for sit-to-stand test) (13.12, 14.48 and 15.24 times/min) at 4 and 8 weeks were significantly different from that before the program (P-value < 0.05 for both). For P-Fit (only for cardio-respiratory endurance) (336.80, 388.40 and 398.80 meters from 6-minute walk test), performance at 4 and 8 weeks were significantly higher than that before the program (P-value < 0.05 for both) with no difference between those at 4 and 8 weeks. **Conclusion:** The health promotion program to providing health education to promote PA, P-Func and P-Fit with follow-up for encouragement improved physical activity and certain physical function and physical fitness measures in late adults and the elderly.

Keywords: health promotion program; physical activity; physical function; physical fitness; late adults; older persons

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Introduction

Currently, Thailand has completely entered an aging society. From 1990 to 2016, the average life expectancy of the Thai population was more likely to increase from 68.4 to 74.6 years for males, and 75.1 to 80.9 years for females. Age-induced degenerations NCD (i.e., diabetes, stroke, and ischemic heart disease) are the top 3 leading causes of loss of years of well-being and causes of death in the Thai population aged 60 years and above, regardless of sex.[1] This is consistent with the report of the World Health Organization (WHO) that the sedentary lifestyle is the main reason for the higher mortality rate.[2] In addition, in the survey conducted by the Department of Health in collaboration with the Health

Intervention and Technology Assessment Program (HITAP) in 2021, 58% of older persons had the highest mobility problems.[3] The older persons tend to have more than one underlying disease of NCDs and other common health problems. Various health problems cause sedentary behavior, and a decline in mobility control potentially affects the lifestyle[4] such as the risk of falls that turn to worse health status[5,6] and require more caring.[7] WHO recommends older persons to have exertion movements with moderate intensity of at least 30 minutes a day for five days a week or with high intensity accumulated at least 15 minutes a day for five days a week.

According to the physical activity (PA), only 62.8% of Thai adults aged 45 – 59 years old had adequate PA, while only 49.9% of those older than 59 years old did so.[9] In the elderly, about 57% exercised 30 minutes per day and 3 days per week. For those 80 years old or older, 43.9 – 48.6 % of them had inadequate exercise. Older adults exercise regularly on a downward trend from 41.2% in 2007 to 37.8% in 2014.[9] From these situations, physical movement allows good physical health and strength, and greatly slows down the dependence phase of older adults. Older persons should be encouraged to perform regular PA to strengthen muscles and joints to effectively slow down the disease in the elderly and lengthen their longevity.[10] According to the report of Thailand Health Profile 2016 - 2017, proportions of individuals aged 45 years and over with insufficient PA as recommended by the WHO increased with age, specifically, 15.0%, 19.9%, 31.3%, and 48.6% (45 – 59, 60 – 69, 70 – 79, and 80 years and over, respectively).[11] In addition, 41.3% of older persons had sedentary lifestyle and over half of them (56.3%) tended to avoid using PA for traveling activities.[12] Most of them conducted sedentary activities, such as reading, watching TV, and listening to the radio for more than four hours per day. One-fifth of them engaged in PA with less than 150 minutes per week. Poorer PA was also related to increased BMI.[12]

PA in older persons is beneficial. Two studies found that habitual PA engagement can reduce the risk of NCDs,[13] especially cardiovascular disease (20 - 50%), diabetes mellitus (30 - 40%), and mortality rate (30%).[14] PA was defined as “bodily movement that was produced by the contraction of skeletal muscle and that substantially increases energy expenditure”.[15] The older persons who regularly engage in PA have better physical function (PF) and physical fitness that could reduce dependent status and strengthen the vascular system, enhance NCDs prevention, and reduce complications from underlying disease. The evidence also showed that physical inactivity at baseline was associated with a greater rate of incident mortality disability in older adults.[15]

The older persons who perform PA according to the WHO recommendations will have better PF and physical fitness capabilities. A study in Nakhonnayok province promoting Thai older persons for regular PA showed that most of the participants (98%) had several underlying chronic diseases, such as diabetes, hypertension, kidney disease, and hyperlipidemia, and 34% of them had limited mobility and self-care with health problems of osteoarthritis, gout, rheumatoid, and Parkinson.[16] Another study in the central Thailand showed that among 1,675 older persons, 49.1% of them were healthy and had no limited PF, 50.9% had limited PF capability of PF, 21.8% had poor self-care, and 29.1% had limited capability in activities of daily living (ADL).[17]

Physical function (PF) is the ability of the physical capability and physiological capacity of the musculoskeletal system to perform activities necessary to ensure well-being and can be assessed by using the Physical Performance Test. A prior study showed a positive correlation between PF and quality of life.[18] The evidence showed that physical inactivity at baseline was associated with a greater decline in Short Physical Performance Battery in older adults among community-dwelling older adults,[19-22] COVID-19 adult survivors with post-acute symptoms, and older persons with hip and knee osteoarthritis.[23,24] In addition, yoga interventions improved multiple PF and health-related quality of life outcomes in this population compared to no yoga. This study provides robust evidence of promoting yoga in PA guidelines for older adults as a multimodal activity that improves various aspects of fitness including strength, balance, flexibility, and mental well-being.[19]

Physical fitness will promote physical health, ADL, and quality of life. It is the ability and endurance to accomplish activities in daily living needed to maintain independence from basic to advanced activities including daily living tasks, leisure time, and social activities, and can be assessed through body fat and cardio-respiratory endurance by using the 6-minute walk Test.[25] It also refers to the positive health outcomes of physically active behavior. Lepsy and colleagues (2021) studied the relationship between physical fitness and the quality of life of the older persons aged 80 - 93 years old and found that male older persons who had high physical fitness could perform ADL effectively and had better quality of life.[25]

Previous studies suggest that late adults and the older persons have low PA engagement, and many health problems related to low PA. Therefore, to prevent health problems, and to maintain good health in late adults and the older persons, it is crucial to provide health education to encourage them to perform regular physical activity, physical function, and physical fitness.

This study aimed to test the effects of health promotion program on the levels of 1) physical activity energy expenditure, 2) physical function (i.e., 1-lower extremity strength, 2-upper extremity strength, and 3-lower back and hamstring flexibility), and 3) physical fitness (i.e., 1-cardio-respiratory endurance, 2-% body fat, 3-BMI, and 4-waist circumference) in late adults and the older persons. Specifically, we examined the changes of values of each outcome mentioned above over time (i.e., before the program, and at week 4 and 8 of the program).

Methods

A quasi-experimental one-group pre-post research design was used to investigate the benefits of the 8-week health promotion program on physical activity, physical function and physical fitness) at before, and 4 and 8 weeks of the program. The study population was 50 Thais aged between 45 and 79 years who resided in Nongsaeng subdistrict, Pakplee district, Nakhonnayok province, Thailand. The sample size was estimated based on the power analysis according to repeated measure ANOVA. With type I error of 0.05, power of 95%, and an effect size of 0.25 for an F test, a total of 43 participants were required. To compensate for an attrition rate of 10%, a total of 48 participants were needed.

In the study conduct, 50 late older adults and older persons were recruited using purposive sampling. To be eligible, they had to be 45 years old or older, ambulatory, with intact cognitive function using orientation and cognitive function screening, and able to understand Thai language.

The intervention program

At the Nongsaeng subdistrict health-promoting hospital, the potential participants were informed of the study via letters and direct contact. On the day of the first visit, all 50 eligible participants completed the questionnaire on demographic characteristics including gender, age, marital status, occupation, body mass index (BMI), and health problems. They also completed the self-reported physical activity (PA) questionnaire (SPAQ) which took about 20 minutes. After the questionnaire completion, the researcher provided the participants with health education and documents about physical activity practice and its benefits on physical functions and physical fitness performance. Applicable activities included daily living activities, caring elderly and nieces/nephews, household chores, gardening, working, transportation, exercise, running errand, leisure exercise including aerobic exercise, and light football game. For aerobic exercise, participants could perform up to 30 minutes per day collectively.

After the educational session, the participants were physically tested with physical function and physical fitness measurement devices. The researchers records their physical test performance.

After the one-day first visit, the participants were expected to perform physical activities at home in the 8-week study period. The 4 trained research assistants visited individual participant's house weekly to encourage performing physical activities. According to the WHO recommendation, we encouraged the participants to perform PA at least at a moderate level of energy expenditure for 3 - 5 days/week. The participants were encouraged to practice at least 5 - 7 days/week if possible but unnecessary.

The second and third formal outcomes assessments were conducted at Nongsaeng sub-district health promoting hospital at the end of week 4 and week 8, respectively.

Outcomes assessments

Three outcomes namely **physical activity (PA) energy expenditure, physical functions (Physical function) and physical fitness (P-Ft)** were included in this study. For the **physical activity (PA) energy expenditure**, it was assessed using the self-reported PA questionnaire (SPAQ) which was developed and tested for psychometric property by Visuthipanich and colleagues.[26] With 4 dimensions of 55 items, SPAQ has a good 7-day test-retest reliability with a coefficient of 0.93, an acceptable concurrent validity with a moderate correlation with an accelerometer (r = 0.31, P-value = 0.01), and moderate predictive validity with a correlation with the 6--minute walk test with a borderline significance (r = 0.75, P-value = 0.05).

This study used the same method to calculate the total energy expenditure (EE) for all self-reported physical activities.

The actual number of frequency and duration of each self-reported physical activity was recorded, scored and entered the computer for calculation. Incomplete information was excluded. The total energy expenditure per week as total metabolic equivalent (MET) (minutes/week) was computed using the equation of frequency × duration × intensity. Each specified activity was adjusted to MET value depending on the intensity of the activity on the PA listed in the 2011 Compendium of PA.[27] PA energy expenditures from all activities of SPAQ in this study were summed into a single value.

The test of **physical functions** consisted of three tests.[28] First, **the 30-second repeated numbers of the sit-to-stand position** were used to assess lower extremity strength. The participants were asked to complete a repetition of full stands from a seated position as quickly as possible in 30 seconds. The numbers to complete the test of the chairs sit-to-stand were recorded and calculated as times within 30 seconds. The normal value for the late adults and older persons was at least 8 times per 30 seconds.[29]

The **30-second repeated numbers of arm curls** were used to assess upper extremity strength. Four and two kilograms of weight were used for men and women, respectively. The participants were asked to complete a repetition arm curl in 30 seconds. The numbers to complete the test were recorded and calculated as times per 30 seconds. The normal value for the late adults and older persons was at least 11 times per 30 seconds.[29,30]

Sit-and-reach test was to measure lower back and hamstring flexibility. The participants were asked to get in the position (removing shoes and sitting on the floor with leg stretched out to the front, knees straight and feet flat against the front end of the test box). The participant began the movement by stretching as far as they could, resting and repeating three times. The farthest length to complete test was recorded and analyzed. Positive and negative length in centimeters were recorded for the length of middle finger exceeding and not reaching the toes, respectively. The higher positive length indicates more flexibility.[29,31]

The **last outcome** was **a physical fitness** test which consists of cardiovascular endurance, % body fat, BMI, and waist circumference of the participants. First, **cardio-respiratory endurance** is the ability to undertake the physically demanding activity of daily living using the Six-Minute Walk test. It is a test that involves walking as fast as possible in six minutes. The instruction is to walk from as far as possible within 6 minutes. They were also allowed to stop and rest. The total distance in meters walked was recorded. The cardiovascular endurance who could walk shorter, equal, and longer distances compared to the normal range of late adults and older persons within six minutes were interpreted as poor, normal, and good cardio-respiratory endurance, respectively.

The rest of physical fitness outcomes was **% body fat, BMI, and waist circumference**. Based on BMI (kg/m^2), late adults and older persons were categorized as underweight, normal, overweight, and obese (< 18.5, > 18.5 – 25, > 25 – 30, and > 30 kg/m^2, respectively). Body fat percentage was measured using the body automatic scale. Body fat percentage determines fitness level relative to body composition while BMI determines adiposity.[32-34] The acceptable value for % body fat in these persons was 25 - 31% for women and 18 - 25% for men.[33] For waist circumference, normal values of for women and men were less than 80 and less than 90 cm., respectively.[29] Each test was independently interpreted for physical fitness.

Participant ethical protection

This study was approved by the Ethical Committee, Srinakharinwirot University, Thailand (approval number: SWUEC-136/2563E). All participants were provided with objective, process, voluntary nature of the study. All participants were allowed to withdraw from the study at any time with no negative consequences in health care service. Written informed consent was obtained before participation. The results of the study were presented as a summary, not individual participant's data.

Statistical data analysis

Descriptive statistics including mean with standard deviation and frequency with percentage were used to summarize demographic and clinical characteristics and values of study outcomes. Values of ach of study outcomes over time (before the program, and at 4 and 8 weeks) were compared using one-way repeated measures ANOVA. Statistical significance was set at a type I error of 5% (or P-value < 0.05). All statistical analyses were conducted using the software program SPSS version 20.

Results

Of the total of 50 participants, most of them were women (98.0%) (Table 1). About two-thirds were older persons or 60 years old or older (68.0%). Majority of them were married (64.0%). Half of them had no occupation or did not work (50.0%) followed by farmers or agriculturists (40.0%). Based on BMI, the majority had normal weight (62.0%) followed by overweight (22.0%). The most common health problem was gout (21.4%), followed by (14.3%), and peptic ulcer (10.7%) (Table 1).

Table 1 Demographic characteristics of participants (N = 50).

Characteristics	N	%
Sex		
Female	49	98.0
Male	1	2.0
Age (years)		
46 - 59 (late adults)	16	32.0
≥ 60 (older persons)	34	68.0
Marital status		
Single	8	16.0
Married	32	64.0
Divorced/Separated/Widowed	10	20.0
Occupation		
No occupation	25	50.0
Farmer/agriculturist	20	40.0
Small business employee	5	10.0
BMI (kg/m^2)		
Underweight (< 18.5)	4	8.0
Normal (> 18.5 – 25)	31	62.0
Overweight (> 25 – 30)	11	22.0
Obese (> 30)	4	8.0
Underlining disease/health problems		
Gout	6	21.4
Hypertension	4	14.3
Peptic ulcer	3	10.7
Cardiovascular disease	1	3.6
Respiratory disease	1	3.6
Cataract	1	3.6
Benign Prostatic Hypertrophy	1	3.6

Changes of physical activity energy expenditure, physical function and physical fitness over time

For **physical activity energy expenditure**, the participants saw an increase from 47.34 ± 33.51 METS-min/week at the first visit (i.e., before program) to 58 ± 44.59 METS-min/week at the second visit (i.e., at 4 weeks), and a following decrease to 32.61 ± 30.66 METS-min/week at the third visit (i.e., at 8 weeks). The overall change over time was statistically significant ($F_{2,98}$ = 14.93, P < 0.001) with statistical significance for all three pairwise comparisons (P-value = 0.026, < 0.001, and < 0.001 for the pairs of 1st vs 2nd, 2nd vs 3rd, and 1st vs 3rd visits, respectively).

For **physical function**, the **three measures** were as follows. **First**, the **number of times per minute of the lower limb muscle strength (sit-to-stand test)** kept significantly increasing from visit 1 to visit 3 (13.12 ± 2.77, 14.48 ± 3.05, and 15.24 ± 3.60 times/minute, respectively) ($F_{1.57,76.97}$ = 13.33, P-value < 0.001). The all three pairwise comparisons were statistically significant (P-value < 0.001, = 0.096, and < 0.001 for the pairs of 1st vs 2nd, 2nd vs 3rd, and 1st vs 3rd visits, respectively).

Second, the **number of times per minute** of the **upper extremity strength (arm curl test)** kept increasing from visit 1 to visit 3 (16.46 ± 2.69, 18.60 ± 9.18, and 18.16 ± 3.36 times/minute, respectively) but with no statistical significance ($F_{2,98}$ = 2.19, P-value = 0.117).

Third, the **number of centimeters** of the **flexibility** test (sit-and-reach test) at the second and third visits were slightly higher that at the first visit (10.93 ± 6.16, 12.59 ± 6.13, and 12.46 ± 7.06 times/minute for the 1st, 2nd, and 3rd visits, respectively) with no statistical significance ($F_{2,98}$ = 2.67, P-value = 0.077).

For the **physical fitness test**, the changes of cardiovascular endurance (6-minute walk test), % body fat, BMI, and waist circumference were as follows. For the **cardio-respiratory endurance test**, the distance in meters of 6-minute walk test kept increasing from the first to the third visit with statistical significance (336.80 ± 95.90, 388.40 ± 113.50, and 398.80 ± 106.55 meters respectively, $F_{2,98}$ = 19.31, P-value = 0.008). The pairwise comparisons were statistically significant for the 1st vs 2nd visits and 1st VS 3rd visits (P-value < 0.001 for both), but not for the 2nd vs 3rd visits (P-value = 0.316).

For the body composition, the **% body fat** slightly decreased over time with no statistical significance (49.43 ± 6.50, 48.96 ± 6.15, and 48.12 ± 6.62 % for 1st, 2nd, and 3rd visits, respectively, $F_{2,98}$ = 1.32, P-value = 0.272). The **BMI** did not change over time (23.91 ± 4.93, 23.89 ± 4.91, and 24.00 ± 4.78 kg/m^2 for 1st, 2nd, and 3rd visits, respectively, $F_{2,98}$ = 0.42, P-value = 0.655). Lastly, **waist circumstance** in centimetres unexpectedly increased over time with statistical significance (82.50 ± 9.50, 83.50 ± 9.45, and 84.40 ± 9.90 cm for 1st, 2nd, and 3rd visits, respectively, $F_{2,98}$ = 3.11, P-value

= 0.049). Only the waist circumferences at 1st and 3rd visits were significantly significant (P-value = 0.017).

Table 2 Comparisons of changes in each outcome measure (N = 50).

Measures	Actual range	Mean	SD	Repeated measures ANOVA test		
				Overall test		P-value for pairwise comparison test
				F*	P-value	
1. Total energy expenditure (METS-min/week) of physical activity						
1st visit	4 - 114	47.34	33.51			0.026†
2nd visit	7 - 224	58.04	44.59	14.93	< 0.001	< 0.001‡
3rd visit	3 - 109	32.61	30.66			< 0.001§
2. Physical function						
2.1 Number of times per minute of the lower limb muscle strength (sit-to-stand test)						
1st visit	7 - 18	13.12	2.77			< 0.001†
2nd visit	9 - 21	14.48	3.05	13.33	< 0.001	0.096‡
3rd visit	8 - 25	15.24	3.60			< 0.001§
2.2 Number of times per minute of the upper extremity strength (arm curl test)						
1st visit	10 - 23	16.46	2.69			
2nd visit	11 - 29	18.60	9.18	2.19	0.117	
3rd visit	10 - 26	18.16	3.36			
2.3 Number of centimeters of the flexibility test (sit-and-reach test)						
1st visit	1 - 25	10.93	6.61			
2nd visit	3 - 28	12.59	6.13	2.62	0.077	
3rd visit	1 - 28	12.46	7.06			
3. Physical fitness						
3.1 Cardio-respiratory endurance (6-minute walk test) (meters)						
1st visit	80 - 520	336.80	95.90			< 0.001†
2nd visit	80 - 520	388.40	113.50	19.31	0.008	0.316‡
3rd visit	120 - 520	398.80	106.55			< 0.001§
3.2 BMI (kg/m^2)						
1st visit	16 - 43	23.91	4.93			
2nd visit	16 - 43	23.89	4.91	0.42	0.655	
3rd visit	17 - 44	24.00	4.78			
3.3 Body composition (% body fat)						
1st visit	29 - 60	49.43	6.50			
2nd visit	30 - 61	48.96	6.15	1.32	0.272	
3rd visit	26 - 58	48.12	6.62			
3.4 Waist circumstance (centimeters)						
1st visit	60 - 104	82.50	9.50			0.156†
2nd visit	66 - 114	83.50	9.45	3.11	0.049	0.278‡
3rd visit	67 - 113	84.40	9.90			0.017§

* Repeated measures ANOVA F testwith degree of 2,98 for all measures except for the number of times per minute of the lower limb muscle strength (sit-to-stand test) with a degree of freedom of 1.57,76.97.

† Pairwise comparison of 1st and 2nd visits.

‡ Pairwise comparison of 2nd and 3rd visits.

§ Pairwise comparison of 1st and 3rd visits.

Discussions and Conclusion

In this study, the health promotion program offered certain benefits on energy expenditure, physical function (i.e., number of times per minute of the lower limb muscle strength (sit-to-stand test)) and physical fitness (i.e., cardio-respiratory endurance (6-minute walk test)) for the Thai late adults and older persons. The results from this study are consistent with the previous studies that more than half of the older persons had insufficient physical activity.[1,8,19] The problems and obstacles affecting the older person's physical activity in their daily life consisted of body aches, fatigue, and blurred eyesight.[35]

In this present study, after the health promotion program, more participants improved physical activity engagement, lower extremities strength, and cardiorespiratory endurance. This program made participants realize the benefits of physical activity towards physical function and physical fitness. Therefore, they would increase physical activity levels.

Habitual physical activities can improve muscle strength and promote cardiovascular endurance. Individuals who exercise will gain more benefits with the oxygen and nutrients supplying the tissues which helps the cardiovascular system to work more efficiently. When their heart and lung health improves, they have more energy to perform the daily activities living.[36] The former study found that the physical exercise program under supervision in community dwelling older adults has positive effects on essential physical functional capacity in daily life covering coordination, balance, flexibility, strength, and aerobic capacity.[37] Another study showing that multicomponent structured program of physical activity 2 - 3 times per week in 60-minute sessions targeting functional balance, cardiorespiratory fitness, and muscle strength could also promote the maintenance of physical energy with reduced fatigue levels.[38]

The physical function of the lower limb strength was more likely to increase after intervention (second visit) and follow up (third visit) related to the increase level of physical activity in this study. Physical activity across the life course may relate to physical function in several ways. The direct effects of specified type of physical activity could improve muscle strength, aerobic fitness, flexibility, and balance among population age 65 years and over.[15]

This present study corresponds to the findings of previous studies that population age 50 years and over who participate in a regular exercise regimen will have less adipose tissue resulting in decreased production of pro-inflammatory and increased anti-inflammatory biomarkers and better physical function.[39] The study of Peng and colleagues indicated that the health promotion program can improve lower limb strength and good mobility for late adults and older persons.[40] Previous studies showed that home-based exercise programs can enhance muscle strength, physical function, gait, and balance in older adults especially a supervised group as more effective for muscle strength when compared with an unsupervised group.[41,42]

In this study, not only the health promotion program improved physical function, but it also affected physical fitness, i.e., cardiorespiratory endurance measured by the 6-minute walk test. The participants were encouraged to perform physical activity regularly and continuously. Thus, their physical fitness capacity significantly increased.

The previous study indicated that long-term behavior is difficult to change. Behavioral counseling or support needs to be promoted regularly and continuously. The health policy to promote physical activity in the proper way for individuals are needed.[40] The study presented the average scores of 6-minute walk test rising at the second and third visits when compared with the first visit. This is because the activities of the health promotion program require physical activity at a moderate level of energy expenditure, 3 - 5 days a week, as recommended by U.S. Department of Health and Human Services.[15] Consistent with the research results of Rodphothong and colleagues, it was found that after undergoing cardiac rehabilitation, the subjects could walk a longer distance.[43] The prior study of Arsapakdee and Choosakul showed that there were statistically significant differences of the cardiovascular endurance among participants.[44] Therefore, work-related physical activity is advantageous for physical function and physical fitness. The more muscular endurance and strength, the more joint flexibility and cardiovascular endurance capacity.

There were no statistically significant effects between the second visit and the third visit of the health promotion program on physical function including upper extremities (arm curl) and flexibility (sit and reach) as well as physical fitness including body composition, waist circumference, and BMI. Despite increasing in physical activity, it was not enough to affect capacity of physical function or physical fitness. Since most participants were female, their physical activity exertion cold be with less energy expenditure. This could be that they had an underlying disease related to the musculoskeletal and vascular system. They performed activities that require little physical exertion and daily tasks such as doing housework or walking around the house. These activities caused a slight increase in physical fitness measured by the 6-minute walk test in the third visit.

The non-significant differences between the second and third visits could also be because of physical activity declining including physical and biological changes with aging, increased systemic inflammation, and greater risk for chronic conditions.[39] The waist circumference length increased over time with a statistical significance between the 1st and 3rd visits. The previous study showed that elders who had a deterioration in their energy metabolism had the habit of consuming food that was bought, not cooking it themselves. They often chose high carbohydrate food, more sugar, or a sweet taste for consumption.[45,46] Their eating behavior was associated with high BMI because of body deterioration, incorrect perception, and knowledge regarding food consumption behavior.[47]

This present study has certain limitations. The participants had several health problems which could hinder performing physical activity. For the self-reported physical activity, the participants might have difficulties recalling the activities in the 7 days accurately. Their actual performance of physical activity every three to five days a week could be inconsistent since they had to self-monitor. With the narrow range of characteristics of these 50 participants, generalization of the results could be somewhat limited. The most critical weakness was the no comparison group in this study.

Based on the findings and study conduct, it could be recommended that the sub-district health promoting hospital should be able to provide basic information for health promotion to improve physical fitness, physical performance, and the ability to conduct daily activities living. For practice and future research, more convenient recording form for the older persons to record each activity of daily living should be re-designed to get more accurate information. The future program should have a better method to encourage physical activity every 3 to 5 days per week by using technology such as online meetings, platforms or mobile phone applications. Control group should be included in the future study to control for confounders.

In conclusion, the health promotion program by providing health education and encouraging physical activity offered improvement in energy expenditure in physical activity, physical function (i.e., number of times per minute of the lower limb muscle strength (sit-to-stand test)) and physical fitness (i.e., cardio-respiratory endurance (6-minute walk test)) for the Thai late adults and older persons.

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