Daily Walking Steps and Physical Fitness in Middle-Aged and Older Adults in Community Dwellers

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Abstract

Increasing age is related to decrease in physical activity and physical fitness. This leads to decline in physical function, decrease quality of life and dependency. This research aimed to determine daily walking steps and physical fitness in middle-aged and older adults in community. Second objective is to examine the correlation between age, daily walking steps and physical fitness. A total 48 participants in community, 22 middle-aged (mean age 51.50 ± 4.07 years) and 26 older adults (mean age 69.42 ± 7.61 years) were recruited and assessed daily walking steps by wearing accelerometer for 7 consecutive days. Physical fitness, including handgrip strength, 5 Times Sit-to-Stand Test (5TSST), 6-Minute Walk test (6MWT) were assessed to determine upper limb strength, lower limb strength and cardiovascular function, respectively. The result showed that there were no significantly differences in daily walking steps, handgrip strength and 5TSTS between middle-aged and older adults. Whereas, 6MWT was higher in middle-aged when compared with older adults (p = 0.017). Age was associated with daily walking steps (r= -0.573, p= 0.000), handgrip strength (r=-0.287, p= 0.048), 5TSTS (r= 0.466, p= 0.001) and 6MWT (r= -0.609, p= 0.000). In addition, daily walking steps was correlated with physical fitness. Daily walking steps had positive correlation with physical fitness in community dwellers aged over 45 years. The finding would give benefit information for promote physical activity and health in middle-aged and older adults in community.

Keywords: Physical activity, Walking, Accelerometer, Physical fitness, Elderly

Introduction

At present, Thailand has rapidly increasing numbers of aging population which develops to complete aging society in 2050 (1). Increasing age has degenerative changes in all systems in the body and has high risk develop to chronic diseases and dependence conditions. Aged related decline in physical fitness, including aerobic power, muscle mass and muscle strength and exercise tolerance (2). Physical fitness is ability of people to perform activity in daily life Physical fitness consists of 4 domains, including body composition, muscular strength and endurance, cardiovascular endurance and flexibility (3). Muscle strength reached to peak force at 25-30 years old and slightly decreased at early middle-aged (40-49 years old). After 50 years old, strength rapidly declined approximately 12 - 15% per decade in both upper and lower extremities (2, 4). In cardiovascular system, the aerobic capacity showed significant reduction after 40 years old and reached approximately 30% at 65 years old (5). Rate of decline in maximal oxygen uptake was approximately 0.5% - 1.0% per year in advancing age (6). Taken together, rate of decline in each domain of physical fitness was different across aged. Beside increasing aged, contributing factors related to decline of physical fitness were comorbidity and sedentary lifestyle (low physical activity) (7). Lifestyle modification is an alternative way to delay aging process and maintain physical fitness. Lifestyle modification can be applied by increased physical activity. Physical activity is a part of daily life involved body movements by using skeletal muscles in exercise and non-exercise events (8). There were evidences showed the positive effects of physical activity on improving physical fitness, including cardiovascular, muscular, nervous system and mental health (9, 10).

Walking is a subset of physical activity. It is basic activity in daily life and most practical leisure time physical activity performed by elderly. There are several studies showed that walking has many benefits on human health and decreased incidence of non-communicable diseases (11). Consistently with cross-sectional analyses study from Williams PT. 2008, in found that higher self-report of walking in weekly was related with decreased risk of development of diabetes mellitus, hypertension and dyslipidemia. The decreased risk of diseases was depending on walking distance, and walking intensity (12). In addition, walking at moderate intensity decreased risk of diseases equivalent to running at vigorous intensity (13). Therefore, walking has been recommended as a simple tool (instead structural exercise) for enhanced physical activity and improved health conditions in older adults.

The Japanese walking campaign in 2001 recommended that accumulation of 10,000 steps make a healthy life and many benefits on health (14-17). However, 10,000 steps per day is a difficultly to reach in older adults due to special conditions and less of movement (18). In the middle-aged lifestyle (aged 45-59 years old), they are office worker which spent more time in sitting (19). Similarly, with older adults (aged over 6o years old), they have degenerative changes and easy to fatigue. These lead to decline in physical activity including walking (20). Therefore, the aim of present study was to determine the difference of physical fitness and walking steps per day between middle-aged (aged 45 – 60 years) and older adults (aged more than 60 years) in community dwellers. Secondary objective was to determine the correlation between age, physical fitness and walking steps per day in community dwellers aged over 45 years. The results from this study were used as baseline health status and used for health promotion for community dweller.

Method

Participants and study design

Participants aged over 45 years were recruited from community nearby Mahidol University, Nakorn Pathom province. Participants were included following by inclusion criteria 1) age 45 years and older, 2) Able to walk without assistive device, 3) able to understand testing instructions and 4) Able to wear accelerometer at least 10 hours per day for 7 consecutive days. Participants were excluded if they had any musculoskeletal problems at lower limb (Visual Analog Scale >5/10 scores). Of the 51 participants were enrolled in the study and 3 participants were excluded from the study due to musculoskeletal pain. Total 48 participants divided into 2 groups; middle-aged (age 45 – 59 years old) and older adults (age over 60 years old). All participants provided written informed consent which was approved by Mahidol University Institutional Review Board (MU-IRB). And all participants were recorded demographic data, including body weight, years of education and medical comorbidity. Cognitive impairment and depression were evaluated by using Mini-Mental State Examination (MMSE)-Thai version and Hospital Anxiety and Depression Scale (HADS), respectively.

Participants were interviewed to obtain demographic data, MMSE and HADS scores. After that, physical fitness was evaluated for muscular strength and cardiovascular endurance. Participants were worn accelerometer for 7 consecutive days.

Assessment of daily walking steps

Walking steps was assessed by Actigraph accelerometer GT3X (Actigraph, Pensacola, USA). Participants were worn accelerometer at hip level at least 10 hours per day for 7 consecutive days. Wearing time of accelerometer was recorded in each day. The accelerometer was set sampling frequency at 60 Hz and number of counts was collected in 1-min epochs. The used of accelerometer at least 4 days (3 working days and 1 holiday) and more than 10 hours per day were included for analysis. The data were expressed as daily walking steps.

Assessment of physical fitness

Handgrip strength represents proximal upper extremity strength which is an indicator of general vitality (21). Handgrip strength was measured by handgrip dynamometer. Participants sat on a chair, hold the dynamometer closed their body with dominant hand and squeezed the grip with maximum force. Grip strength was measured 3 times. Maximal value was used for the analysis and expressed as kilogram (kg).

5 Time-Sit-to-Stand Test (5TSST) is used to assess lower extremity muscular strength and balance in older adults. 5TSST is correlated with knee extension strength and mobility (22, 23). The test consists of measuring time required to perform 5 times successive chair stand as fast as possible without pushing off. Before testing, participants were instructed about procedure and allowed to practices for twice. Participants were crossing their arms on their chest and sitting with their back against the chair (45 cm higher from the floor). Participants are prompt not to bounce off the chair when returning to the standing position and reminded to fully straighten their legs while standing. Participants were instructed to stand up and sit down for 5 times as quickly as possible. Time were recorded from the initial seat position to the final seat position after complete 5 times standing. The data was expressed as seconds (s).

6-Minute Walk Test (6MWT) is a field test of submaximal aerobic capacity which represents cardiovascular endurance. Participants were walked as quickly as possible in 6 minutes. The walk way must be 30 meters in length and marked every 3 meters. A plastic cone was used to mark at the turning point. Participants were instructed to slow down or rest if they felt tried or uncomfortable. Participants were received the feedback and elapsed time in every minute. Heart rate, blood pressure, respiratory rate, and rating of perceived exertion borg scale were recorded before and after the test. The walk distances in six minutes were used for the analysis and expressed as meters (m).

Sample size

The sample size of this study was calculated by using the correlation coefficient from Jenkins S, et al. 2009 (24). Power of analysis was set at 90%. The correlation coefficient (r) was -0.46 between age and 6 minute walk distance of female. The equation of sample size calculation was

$$n = \left[\frac{(Z_{\alpha/2} + Z_{\beta})}{[F(Z_0) + F(Z_1)]} \right]^2 + 3$$

When;

n = number of sample size

α = probability of type I error = 0.05 (2-sided)

$Z_{0.025} = 1.96$

β = Probability of type II error = 0.1

1-β = Power = 0.90

$Z_{0.1} = 1.282$

F(Z) = Fisher's Z transformation

= 0.5 ln [(1+ρ)/(1-ρ)]

Therefore;

Under H_0: ρ=0 $F(Z_0) = 0.5 \times \ln[(1+0) / (1-0)]$ = 0

Under H_1: ρ= -0.46 $F(Z_1) = 0.5 \times \ln[(1+(-0.46) / (1-(-0.46))]$ = -0.497

Thus: $n = [(1.96 + 1.282) / (0 - (-0.497))]^2 + 3$

$= 45.55 \cong 46$

Therefore; the expected of sample size of present study is 46 participants.

Statistical analysis

Statistical analysis was performed using the SPSS version 19© software package. Variable value are expressed as means ± standard deviation (SD) and proportions of baseline characteristics including age, BMI, gender, comorbidity, years of education, MMSE, HADS. The normality distribution of data was used the Kolmogorov Smirnov Goodness of fit Test for test (p>0.05) before using parametric analysis. Independent T-Test was used to analyze mean difference between middle-aged and older adults groups in physical fitness and daily walking steps. Pearson's correlation coefficient was used to evaluate the correlation between age, daily walking steps and physical fitness. The level of significance was set probability level less than 0.05 ($p<$ 0.05).

Results

Fifty-one participants were recruited into the study, 3 participants were excluded from the study due to pain at lower extremity (VAS >5/10). Therefore, 48 participants were divided into 2 groups, middle-aged (aged 45 – 49 years old, n=22) and older adults group (aged over 60 years old, n=26). The demographic and clinical characteristics are summarized in Table 1. Participants were in middle-aged were 77.27 percent of female and had a mean age 51.50 years old. In older group, participants were 76.92 percent of female and had mean age 69.42 years old. 50 percent of middle-aged and 80.77 percent of older adults had one or more medical comorbidity. The common frequencies of medical comorbidity were dyslipidemia, hypertension and diabetes. Other medical comorbidities were heart, respiratory, kidney and autoimmune diseases. All participants had normal cognition not and no dementia which indicated by MMSE score > 23. None of participants had depression (HADS ≥ 11).

Table1 **Participant characteristics (n = 48)**

	Middle-aged (N= 22)	Older adults (N= 26)	*p*-value
Age (years), mean ± SD	51.50 ± 4.07	69.42 ± 7.61	0.005
BMI (Kg/m^2), mean ± SD	23.87 ± 3.17	24.43 ± 4.37	0.282
Gender (N, %)	22	26	0.955
Male	5 (22.73)	6 (23.08)	
Female	17 (77.27)	20 (76.92)	
Medical comorbidity (Frequency, %)	18	41	0.338
Dyslipidemia	7 (38.89)	13 (31.71)	
Hypertension	6 (33.33)	11 (26.83)	
Diabetes Mellitus	2 (11.11)	5 (12.19)	
Other diseases	3 (16.67)	12 (29.27)	
Year of Education (years), mean ± SD	7.68 ± 5.23	5.04 ± 3.32	0.035
MMSE-Thai 2002 (scores), mean ± SD	28.68 ± 1.70	27.85 ± 1.87	0.590
HADS (scores), mean ± SD	4.41 ± 2.97	5.04 ± 3.45	0.474

MMSE; Mini-Mental State Examination, HADS; Hospital Anxiety and Depression Scale.

Table 2 Physical fitness and daily walking steps in middle-aged and older adults

	Middle aged (N=22)	Older adults (N=26)	*p*-value[a]
Daily walking steps (steps/day)	8,123.86 ± 2,422.37	5,039.85 ± 2,267.93	0.613
Handgrip strength	29.59 ± 8.26	24.12 ± 6.52	0.319
5TSTS	7.72 ± 1.63	9.74 ± 2.37	0.101
6MWT	466.82 ± 63.55	353.23 ± 109.86	0.017*

Values are mean ± SD. [a]Independent T-test was used for comparison all variables between two groups.

*p-value < 0.005

Mean and standard deviation of daily walking steps and physical fitness are shown in table 2. There was no significant difference in accelerometer-measured daily walking steps between middle-aged and older adults. However, daily walking steps in middle-aged tended to higher than older adults (p=0.613). In older adults, handgrip strength (p=0.227) and 5TSTS (p=0.177) tended to decline when compared with middle-aged group. Six-minute walk test in middle-aged was significantly higher than older adults group (p = 0.017).

According to Pearson's correlation, age had moderate negative correlation with daily walking steps (r= -0.573, p= 0.000) and physical fitness, including handgrip strength (r=-0.287, p= 0.048) and 6MWT (r= -0.609, p= 0.000). However, age was positive correlation with 5TSST (r= 0.466, p= 0.001). Daily walking steps showed positive correlation between handgrip strength (r=0.458, p=0.001) and 6MWT (r=0.621, p=0.000) and negative correlation with 5TSST (r=-0.399, p=0.005). The 6MWT had positive correlation with handgrip strength (r= 0.461, p= 0.001) in fair relationship and had moderate negative correlation with 5TSST (r= -0.614, p= 0.001) (Table 3)

Table 3 Pearson's correlation coefficient between age, daily walking steps and physical fitness in community dwellers aged over 45 years.

	Age	Daily walking steps	Handgrip strength	5TSST	6MWT
Age	1				
Daily walking steps	-0.573**	1			
Handgrip strength	-0.287*	0.458**	1		
5TSST	0.466**	-0.399**	-0.228	1	
6MWT	-0.609**	0.621**	0.461**	-0.614**	1

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Discussion

This is the first study to compare the difference between accelerometer-measured daily walking steps in middle-aged and older adults in community nearby Nakhom Pathom province. Although, we found no significant different between daily walking steps in middle-aged and older adults. Middle-aged tended to had more daily walking steps than older adults. Most of participants who live in community nearby Nakhom Pathom province have similar lifestyle and occupation (agriculture). Older participants in present study were not sedentary. Taken together, these factors may contribute to no difference in daily walking steps between middle aged and older adults. Interestingly, daily walking steps was correlated with increasing age and physical fitness. The walking steps was consistently with previous studies that age related with degenerative changes decreased in daily walking steps and senior fitness levels (6, 25). The present study measured walking steps by using a tri-axial of accelerometer (GT3X, Actigraph). This device can detect level of body movements. It has accuracy value when participants performed activities in daily life (26, 27). The mean daily walking steps in middle-aged and older adults were 8,124 and 5,040 steps, respectively. However, daily walking steps were not significantly difference between middle-aged and older adults. At present no study to compare the daily walking steps between middle-aged and older adults. However, Tudor-Locke CE, et al. 2001 and 2011 reported daily walking steps in middle age and healthy adults, older adults and sedentary/disability had approximately 7,000 – 13,000, 6,000 – 8500 and 3,500 – 5,000 steps/day respectively (18, 28). In middle-aged adults, Sugiura H, et al. 2002 found that women (aged 40 – 60 years old) had 5,400 – 8,300 steps per day which measured by self-monitor pedometer (29). In older adults, Croteau KA, et al. 2005 showed that baseline walking steps was 4,041 ± 2,824 steps per day (30) Daily steps count of older adults in community was 4,969 steps (31). Present study, daily walking steps of middle aged and older adults were 8,123 and 5,039 steps, respectively. Taken together, daily walking steps found in present study was similar to previous evidences. There were several factors influencing daily walking steps such as body anthropometric and body composition (15), special conditions or disability, income and regional of living (15, 18, 32, 33). In addition, aged had the negative relationship with daily walking steps. Consistent with previous study, showed that walking steps count per day continue declined from 55 – 85 years old (34).

The physical fitness was assessed including handgrip strength, 5TSST and 6MWT. Only 6MWT had significant higher in middle-aged adults than older adults. 6MWT is use as field test for assessed cardiovascular endurance (35). Six-Minute Walk Distance (6MWD) depended on age, gender, BMI and health conditions (36). Older adults had more degenerative changes and medical comorbidity than middle-aged adults which could lead to decline in cardiovascular fitness (37). In addition, musculoskeletal problems and dyspnea contributed to decrease distance of 6MWT (24). Similarly, the longitudinal study found that aerobic capacity had changes in all age ranges according to gender and physical activity status. The rate of decline in aerobic capacity was from 3 - 6% in 20 years to 30 years old and more than 20% in 70 years old especially in men (37). Walking is an aerobic regular muscle training that uses oxygen for contracting muscle and may improve cardiovascular function (10) Consistent with present study, daily walking steps was correlated with 6MWT. In addition, higher daily walking steps was related with increased in thigh muscle mass and strength (38). Theses may contribute to increase aerobic capacity. Handgrip strength and 5TSST were related with upper limb and lower limb strength. In present study, there were no significantly differences in middle-aged and older adults. Previous study found that handgrip strength started decline after 45 years old and rapidly decline in older adults which increasing age from 50 to 85 years (39). Handgrip strength is an indicator of overall muscle strength especially upper extremities. These had also decline with age, gender and comorbidity (40-42). No significant different of handgrip strength between middle-aged and older adults may due to pool all gender for analysis. Men was had muscular strength higher than women due to they had larger muscle fiber in type I and type II especially in upper extremities (42, 43). Lopes J, et al. 2017 showed that handgrip strength were decrease in early 20 – 60 years old but no statistical difference. The handgrip strength depend on several factors, including gender and dominant hand (42, 44). In addition, handgrip strength had moderately correlation between weight, height, hand width and forearm circumference (44). However, there was no association between grip strength and age (44). Similar to present study found that weak correlation between age and handgrip strength (r= -0.287). Rantanen T, et al. 1998 followed the handgrip strength change over 27 years in Japanese-American men and found that handgrip strength started decline at middle-aged average 1% per years and more than 1.5% in older adults (45). The increasing physical activity and fitness in older adults (aged 60-64 years) showed the positive association with handgrip strength since aged 53 years old (46). In this study found that association of handgrip strength decreased since 45 years old.

5TSST is common functional test related with lower limb muscle strength in aging. The sit to stand involves in many systems such as sensorimotor, balance, and psychological factors and lower limb strength in knee extensor, knee flexor, and ankle dorsiflexor muscles. This task is similar to walking performance (47, 48). Previous study showed that quadriceps strength which is major muscle groups for performing the 5TSST, declined with age when compared with young and middle-aged adults (49). Consistently with longitudinal study follow up in 10 years participants aged 46 – 78 years found that rate of decrease in knee flexor and extensor muscle groups approximately 11.1 – 16.7% over time in both gender (50). Therefore, lower limb strength was decline especially related with age and gender (51-53).

The limitations of this study are 1) daily walking steps may overestimate from feedback of wearing the accelerometer 2) small number of participants. In present study showed the number daily walking steps and physical fitness of participants in community. These data will be a guideline to promote the walking steps in daily living up to the 10,000 steps/day according to suggestion for health benefits and increased physical fitness awareness when increasing age. This study has advantages for further study to design the intervention for promoting healthy life.

Conclusion

This study found only 6MWT had significant difference between middle-aged and older adults. And daily walking steps, handgrip strength had trend to difference between groups. Also we found association between age, and physical fitness in community dwellers aged over 45. The important was found that physical fitness and walking steps started to decline before getting older. Therefore, increased in physical fitness and walking in since middle-aged may preserve physical performance and improve health condition.

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