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Original Article

Effects of the exercise program using a pedometer on daily step counts and physical fitness among community dwelling elderly

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Abstract

The aim of this study was to evaluate the effect of an exercise program using pedometer for community dwelling elderly on step counts and physical fitness.

The subjects were 220 participants aged 65 and over community dwelling elderly. The exercise program was conducted once a week and supported daily walking by using pedometer for ten weeks. Step counts were recorded every time in the program and physical fitness was evaluated by the measurement of physical fitness at pre- and post- program.

The result showed the mean of step counts increased over 1500 step counts at the 9th week from the baseline (5643 step counts of male and 5858 step counts of female). Moreover, subjects were divided two groups as walker and non-walker by the setting goal of Healthy Japan 21. While walker showed stay step counts, non-walker increased step counts for 9weeks and there were significantly difference between 1st week and last week for both male and female non-walker.

Physical fitness was progress and significantly difference between pre- and post-program for both of male and female.

Self-reported change in physical fitness was asked by questionnaire survey at the last time of the program. 96 % of male and 86.3 % of female awaked to change of physical fitness, and 90 % of female and 80% of male awaked to change of daily living.

The results in this study suggested that the exercise program using pedometer have affected increase in daily walking and progress in physical fitness for elderly people. It is a significant consideration that the exercise program using a pedometer encourages to be motivated daily walk for community dwelling elderly people.

Key words： pedometer, exercise program, preventive long term care, community dwelling elderly

I. INTRODUCTION

In Japan, elderly population aged 65 years and over was about 27million and 21.5% of total population in 2007. With increase in the elderly proportion, raising the number of elderly people with need help has been predicted.

Public concern about increasing older population in the future, exercise programs to prevent fall for elderly people have been a significant elderly service which is aim of preventive care and extending health expectancy. The report of preventive care authorized by Ministry of Health, Labor and Welfare stated that "the program for preventive fall offered to support prolonging health expectancy and enhancing quality of life" [1)]

Havighurst[2)] and Lemon et al. [3)] has demonstrated Activity theory, which has given a basic study frame work about enhancing quality of life in elderly people. Previous study based on activity theory has shown that participation in activities such as social activity [4-8)] and physical activity [9-10)] affect enhancing quality of life among elderly people.

As a participation in physical activity for elderly people, the

report of American College of Sports Medicine demonstrated that engaging in moderate physical activity have affected to prevent decreasing physical function, onset of chronic diseases, and enhance physical fitness and psychological well-being[11]. Moreover, previous study showed the effects of participation in physical activity on psychological well-being related in quality of life [12-16].

As a preventive long-term care for elderly people, to prevent fall and decreasing physical function with aging has been a significance consideration. In this regard, Healthy Japan 21[17], National Institute on aging[18] and Tokyo metropolitan aging institute[19] stated a physical activity for elderly people as daily walking has been an effective exercise to prevent decreasing physical function.

As the effects of walking counts for community dwelling elderly, people who walked more enhancing of QOL[20], effective of step counts as a health promotion parameter[21] and more walking elderly showing higher physical fitness[22] among community dwelling older.

Even though these report and studies showed effective of daily walking among older people, most elderly people have been difficult to be motivated daily walk by themselves, especially elderly people who have no habit daily walking.

Okuno et al. investigated effects of using pedometer for three months on increasing step counts and exercise adherence among community dwelling elderly[23].

Moreover, it is more challenging to initiate exercise behavior among older people for community dwelling elderly.[24] Thus, an exercise program for elderly people should support exercise adherence and initiate exercise behavior such as daily walking.

Many previous studies showed effects of an exercise program to prevent fall for elderly people on progress physical fitness, but did not make to initiate daily exercise for elderly people. It is possible to be good opportunity that an exercise program to prevent fall encourage them to walk in daily living.

This study was to evaluate effects of exercise program using pedometer on changes of step counts and physical fitness among independent community dwelling elderly.

II. METHODS

1. Subjects

The study subjects were 220 elderly people, those who were senior club members aged over 65 living in H-city, Osaka. The exercise program to prevent fall has been conducted at 11 places, where was divided a school division. Each program has had once a week and 10 times at each place for three month during September in 2007 and September in 2008. Mean age of total subjects was 72 years old, 74 years old of male and 71 years old of female.

2. The frame of study

Figure 1 showed the study frame to investigate the effects

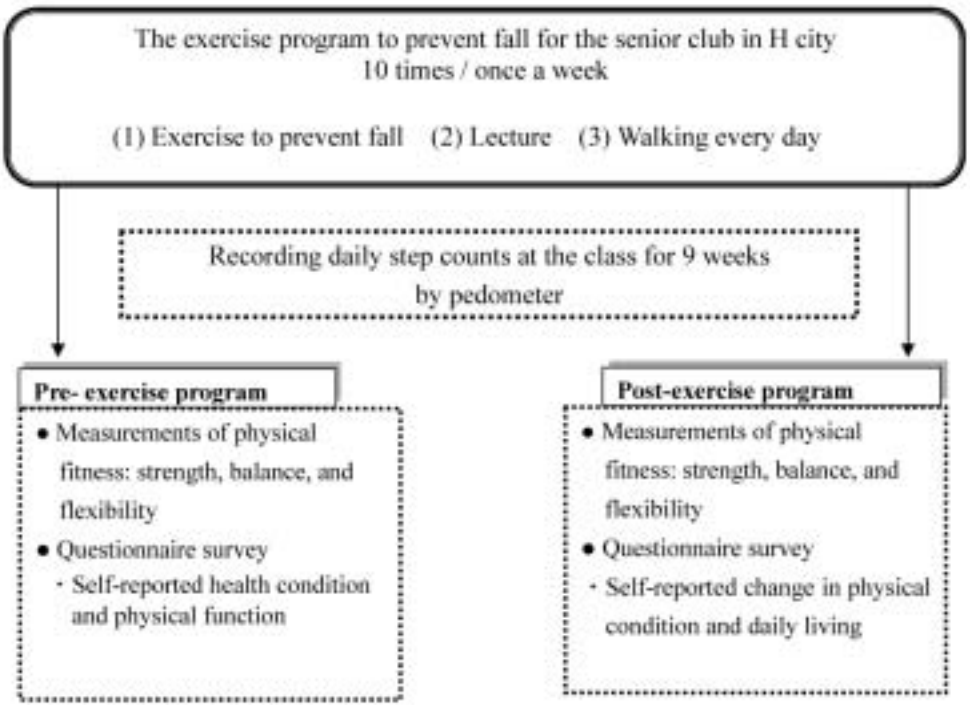

Figure 1. Study framework of the 10 weeks excercise program for community dwelling elderly

The exercise program conducted resistance training to prevent fall, lecture about health behavior once a week during three month and encouraged every day walking. The data in this study was collected during the program drawn a dot line.

Table 1. Characteristics of Subjects: Percentage of currently health condition

	Male n=72	Female n=119
Excellent	2.8 %	8.4 %
Fairly Good	16.7 %	34.5 %
Good	20.8 %	22.7 %
Fairly poor	52.8 %	27.7 %
Very poor	5.6 %	6.7 %
N/A	1.4 %	0.0 %

Table 2. Characteristics of Subjects: Percentage of currently Physical Condition

	Male n=72	Female n=119
Not impaired	55.6 %	51.3 %
Mildly impaired	36.1 %	34.5 %
Moderately impaired	6.9 %	10.9 %
Impaired	0.0 %	0.8 %
N/A	1.4 %	2.5 %

of an exercise program during 10 weeks on changes of step counts and physical fitness.

The exercise program to prevent fall has performed strength exercise, stretching, and physical game by sitting chair for 90 minutes. This program was conducted once a week.

In the program, participants have been distributed a pedometer (Omron, HJ133K) which had a memory function of step counts during one week. In the program on every week, participants wrote down step counts before starting an exercise program.

Evaluation of physical fitness for elderly participant, we performed physical fitness test measuring strength, flexibility, and balance function at pre- and post- program. We have distributed questionnaire survey at the first and last time in the program. The questionnaire consisted of self-reported change in physical fitness and daily living.

1) Investigation items

(1) The mean of step counts per week

The pedometer was given to each participant during the program to calculate the step counts every day. Participants wrote down step counts automatically recorded by the pedometer. The mean of step counts per week calculated every time in the program from the second week and the last week. For analyzing step counts, subjects were 144, those who reported and calculated the mean step counts of every single week during 9 weeks.

(2) The Measurement of physical fitness: strength, flexibility and balance

As a measurement of physical fitness for elderly, we used following test items:

a. Static-balance function: One-leg standing time with eyes open (sec)
b. Dynamic-balance function: Functional reach (cm)
c. Flexibility: Trunk flexion (cm)
d. Locomotive movement: Timed Up & Go (sec)
e. Strength of the upper limbs: Hand grip strength (kg)
f. Leg strength: maximum width of one-step (cm)

For analyzing physical function intervened the exercise program, subjects were 180, those who participated in physical fitness test conducted both of the second and the last time in the program.

(3) Self-reported changes of physical fitness and daily living

The questionnaire was distributed at the first time and last time in the program. Questionnaire in the last time consisted in questions about recognized change physical fitness and daily living after the exercise program. For example, "Comparing before participation in the program, Do you feel that you are making progress in physical fitness?" and "Comparing before participation in the program, Do you feel that you are change to be eating more and sleep well in the daily living?"

2) Statistical analysis

To investigate difference in physical fitness between pre- and post- program, mean score of each test item was analyzed by using t-test.

Variation of step counts for 9 weeks was calculated the mean of step counts at each week. The baseline was step counts at the first week and difference in every week from baseline was analyzed by using t-test. Difference in life satisfaction score was analyzed by using t-test.

All calculations and statistical analyses were performed using the StatView computer program. For all tests of significance, a value of $p < .05$ was considered statistically significant.

III. Results

1. Characteristics of subjects

Self-reported health condition was asked by a questionnaire before the program. Total of 56% subjects who participated in the program answered "Good" "Fairly Good" and "Excellent". Table 1 showed subjective health condition by sex among participants in exercise program.

Table 3. Differences in physical function at pre- and post- of the exercise

Items of Physical Fitness Test	Male (n= 70)					Female (n= 109)				
	Pre		Post		*p*	Pre		Post		*p*
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
One-leg standing time with eyes open (sec)	23.2	19.9	26.6	21.6	0.103 ns	20.8	18.5	25.0	20.0	0.006 **
Functional reach (cm)	32.0	6.2	33.1	6.8	0.093 ns	30.5	5.2	32.6	5.8	0.000 ***
Trunk flexion (cm)	27.8	9.6	29.1	9.3	0.151 *	33.5	9.6	34.1	9.0	0.360 ns
Timed Up and Go (sec)	6.6	1.2	6.2	1.1	0.000 ***	6.4	1.0	6.2	1.0	0.000 ***
Right hand grip (kg)	30.9	6.3	32.7	7.5	0.000 ***	20.8	3.8	21.3	3.8	0.018 *
Left hand grip (kg)	30.0	5.9	31.5	7.0	0.002 **	19.7	3.7	20.1	3.3	0.039 *
Maximum width of onestep(cm)	65.6	15.9	69.0	14.9	0.007 **	59.2	12.8	63.9	13.8	0.000 ***

ns : no significance *p<.05 **p<.01 *** p<.001

Table 4. Variation of the mean steps count during the ten week program

	Male				Female			
	n	Mean	SD	Difference in baseline	n	Mean	SD	Difference in baseline
Baseline	56	5643	2650		88	5858	2575	
week 2	56	6627	2634	984 ***	88	6584	2882	725 ***
week 3	56	6419	2899	776 **	88	6651	2988	792 ***
week 4	56	6381	2865	738 **	88	6459	3028	636 **
week 5	56	6679	2914	1036 ***	88	6982	2776	1123 ***
week 6	56	6637	2858	993 **	87	7006	2824	1130 ***
week 7	56	6963	3037	1319 ***	88	7280	2658	1421 ***
week 8	54	7194	3026	1518 ***	87	6891	2730	992 ***
week 9	44	6807	2824	872 **	61	7020	2729	1024 **

*p<.05 **p<.01 ***p<.001

Total of 52% subjects who participated in the program had not impaired in daily living. Table 2 showed subjective physical condition by sex.

2. Difference in the measurements of physical fitness

Table 3 showed differences in the mean score of physical fitness test at pre- and post-program by sex.

Trunk flexibility, Timed up & Go, Hand grip, and maximum width of one-step were significantly difference in pre- and post- program for male. All of items except trunk flexibility were significantly difference in pre- and post-program for female.

3. Variation of step counts for 9 weeks

Table 4 showed differences in the mean of step counts between baseline and each week. The baseline as mean step counts at first week showed 5643 step counts for male and 5858 step counts for female. The mean of step counts per week was gradually increased in every week both of male and female. Most different of step counts from the baseline was 1518 step (p<.0001) at 8th week of male and 1421 step (p<.0001) at 7th week of female.

To compare of variation of step counts by walker and non-walker, study subjects were divided two groups as walker and non-walker by the setting goal step counts of Healthy Japan 21. Male was divided by step counts of below 6700 as non-walker and more than 6700 as walker. Female was divided by step counts of below 5900 as non-walker and more than 5900 as walker.

Difference of the variation of mean step counts with

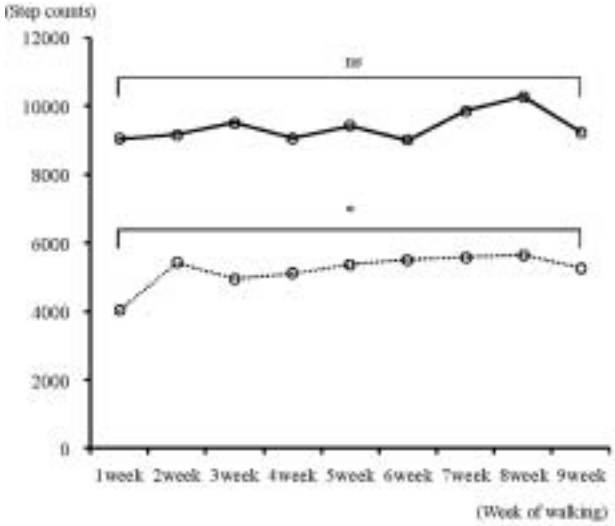

Figure 2-1. Comparing of the mean step counts during the exercise program by walker and non-walker (Male)

Solid line showed Walker's step counts and dot line showed non-walker's step counts.

The mean of step counts was divided walker and non-walker by more than 6700 steps and below 6700 steps which was set the goal step counts by Healthy Japan 21.

Non-walker showed significantly difference with increasing 1244 steps for 9 weeks (p<.05), from 4032 steps at the 1st week to 5276 steps at the 9th week, while walker showed 9044 steps to 9239 steps at the same week.

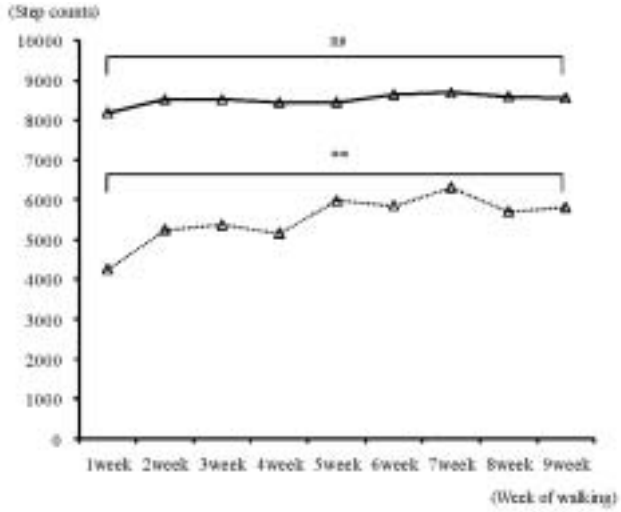

Figure 2-2. Comparing of the mean step counts during the exercise program by walker and non-walker (Female)

Solid line showed Walker's step counts and dot line showed non-walker's step counts.

The mean of step counts was divided walker and non-walker by more than 5900 steps and below 5900 steps which was set the goal step counts by Healthy Japan 21.

Non-walker showed significant difference with increasing about 1600 for 9 weeks (p<.01), from 4249 steps at the 1st week to 5801 steps at the 9th week, while walker showed 8184 steps to 8556 steps at the same week.

walker and non-walker showed Figure 2.

At the baseline, the mean step counts showed 4032 of non-walker and 9044 of walker for male, and 4249 and 8184 as same group for female.

While walker both male and female almost stayed step counts for 9 weeks, Non-walker of both male and female showed increasing step counts and significant difference of 1st week and 9th week.

4. Self-reported changes in physical fitness and daily living

Participants in the program recognized change in physical fitness and daily living after the exercise program. Figure 3 showed the answer for difference in self-reported change of physical fitness by sex. 96.1 % of male and 86.3 %of female had felt change in physical fitness.

Figure 4 showed the answer for self-reported change of daily living by sex. 84.7 % of male and 93.7 % of female had felt changed in daily living. Male had recognized more change of physical fitness than female, while female had felt more change of daily living than male.

IV. DISCUSSION

This study was to investigate the effects of the exercise program using pedometer for community dwelling elderly on step counts and physical fitness.

First, the result of the differences in the mean score of physical fitness test consisted of 6 items showed significantly difference both male and female. Female showed strongly difference between pre- and post- test; functional reach as dynamic balance function, Timed up & go as locomotive movement, and maximum width of one-step as leg strength

Arai et al. suggested that elderly people who had lower level of physical function showed higher progress of physical function after physical activity intervention[25]. Comparing of the mean test score in this study to the standard test score of physical fitness test for elderly people offered by the Tokyo Metropolitan Institute of Gerontology, the score in this study showed level 2 or 3. Thus, subjects in this study were low level of physical fitness even though they answered good health condition and not impaired.

This result suggested that even though an older people lived independent among community dwelling, their physical fitness was weak. Therefore, physical fitness of participants in

the exercise program progressed by intervention appropriate exercise training for 10 weeks.

Secondly, the result of step counts daily walking showed increasing both male and female. The baseline of the mean step counts showed 5643 step counts of male and 5858 step counts of female. The mean step counts for both of male and female have finally reached over 7000 step counts in the program.

Especially, non-walker those who did not walking habits as below daily step counts 6700 of male and 5900 of female showed increasing step counts.

Okuno et al. suggested that an older people were motivated with walking and increasing step counts by using pedometer [23].

The exercise program in this study conducted to encourage participants to walk every day by using a pedometer. Moreover, every time in the program once a week, participants wrote down recorded step counts in their notebook at the program every week. This effort may motivate participants to daily walking.

These results suggested that using pedometer encouraged walking daily for elderly people. Moreover, recording step counts in the program may motivate with their walking habitats.

Walking by oneself needs more effort to keep daily walk, while this program have tried to walk everybody in this program participants. The interaction between participants may help to encourage walking.

Figure 3. Self-reported change of physical fitness after the exercise program

After the exercise program participants were asked their feeling of physical fitness by questionnaire. About 80% of female and 90% of male answered to change of their physical fitness.

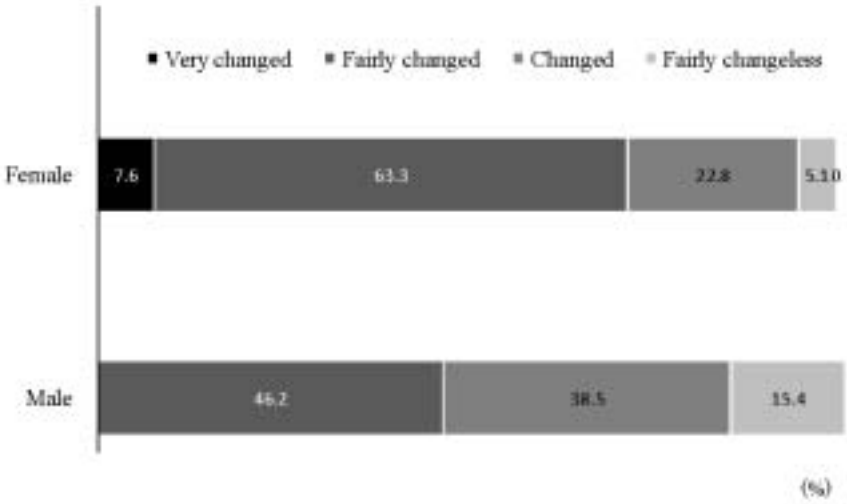

Figure 4. Self-reported change of daily living after the exercise program

After the exercise program participants were asked their feeling about daily living as change to sleep well, eat more by questionnaire. About 90% of female and 80% of male answered to change of their daily living.

Moreover, Yasunaga and Aoyagi suggested that over 5000 step counts of daily walking affect physically good condition indicating health related QOL [20].

Increasing step counts through this program may progress their physical fitness and encourage their positive physical images.

In this study, subjects answered self-reported changes of their physical fitness and daily living. The exercise program using a pedometer and encouraging daily walking, elderly people can change to be active in daily life.

"Healthy Japan 21" suggested that going out in daily life such as volunteer and social activity in the community is more needed to increase physically active level[17].

It is more significant to encourage an older people to motivate daily walking in the exercise program. Preventive care program of physical exercise consider being possible enhance daily exercise such as walking. Moreover, experience in the exercise program enables to be more active and motivate to initiate physical activity for an older people among community dwelling.

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