THE PHYSICAL ACTIVITY AND NUTRITIONAL INTAKE IN COMMUNITY-DWELLING ELDERLY: THE NAKANOJO STUDY

MIKIKO Matsuoka1, YUKARI KAWANO2, YOSHIKO AKIYAMA3, NOBUYOSHI SHIOZAWA3, KAORI HAYASHI3, YUKO MEKADA3, HARUMI HIRATA2, CHIYOKO TOKUE2, NORIKO TAKAHAISHI4, NOBUE NAGASAWA5, FUMIYO SATO5 and YUKITOSHI AOYAGI6

Abstract

Purpose: This study was undertaken to examine the relationship between pedometer counts and food intake in Japanese elderly people.

Methods: One-hundred-eighty healthy, community-dwelling elderly people were divided into three groups according to age. The number of steps taken by each subject was recorded with a pedometer over a 30-day period in August. The dietary and nutritional intakes were estimated using a food frequency questionnaire.

Results: There was no significant difference in the pedometer counts between men and women. The number of steps significantly decreased with age (p < 0.01). The intake of energy, protein and carbohydrate were significantly higher in men than in women (p < 0.05) and they were nearly the same among the three aged groups. The calcium and vitamin C intakes after adjusting for sex and age increased with the number of daily steps, except for the intakes of energy, protein and carbohydrates.

Conclusion: A higher number of daily steps was found to be associated with the calcium and vitamin C intakes.

key word: Japanese elderly people, community-dwelling, pedometer counts, food intake

Introduction

The number of elderly people has rapidly increased in Japan. The Japanese people consider healthy living to be a high priority. Nutrition and physical activity are of key importance in health promotion. However, little is known about the relationship between the food intake and physical activity in Japanese elderly people. This study investigated the relationship between the amount of physical activity and the nutritional intake among community-dwelling Japanese senior citizens in order to obtain basic data regarding their health care index.

Methods

Characteristics of the subjects:

One-hundred-eighty healthy, community-dwelling elderly people (90 men, 90 women) who lived in Nakanojo participated in this study. A signed consent form was obtained from each participant before the study began. The Tokyo University of Agriculture’s Ethics Committee on Human Subjects approved this study.

Nakanojo is located in the northwest part of Gunma Prefecture. Elderly people make up 26.8% of the population in this area. The main industry is agriculture; most of the participants in this study grew rice and vegetables. The participants were divided into three groups according to age: namely: 65~69
years (age 65; male 30, female 30), 70~74 years (age 70; male 30, female 30) and over 75 years (age 75; male 30, female 30). The physical activity of all subjects was monitored using an electric pedometer (modified Lifecorder; Kenz, Nagoya, Japan) which was attached to a belt on the left side of the body throughout the day. The participants wore their pedometers daily over a two-year period. The step counts were totaled over each 24-hour period from midnight to the following midnight. The daily variation in the step counts over a month was expressed as a coefficient of variation (CV). The analysis reported herein included only the pedometer count and nutritional intake data from August 2002.

**Statistical analysis**

All data are expressed as the means ±SE. The data were statistically analyzed using SPSS for Windows 2000XP version 12.0 (Japan) in order to verify the normality of the distribution. The variables of age and sex were compared using either Student’s t test or the Mann-Whitney U test for variables with a nonparametric distribution. The analysis of covariance (ANCOVA) was used to assess any independent associations between the individual step counts and the intakes of energy and various nutrients, after controlling for sex and age using a general linear regression analysis (GLM) and the Bonferroni post-hoc test when multiple comparisons were made. Statistical significance was accepted at a value of p<0.05.

**Results**

The average height, body mass, and pedometer counts were significantly lower in the over 75 years old group in comparison to the 65~69 group, especially in women (Table 1). There was no significant difference in the number of daily steps between men and women. The maximum walking speed for both sexes decreased significantly with aging.

We divided the subjects into quartiles according to their mean daily number of steps after adjusting for sex and age, with C1 indicating the lowest quartile and C4 indicating the highest (Fig. 1). The coefficients of variation in the daily steps within the groups were 31.6 ± 1.7% for C1, 23.1 ± 1.7% for C2, 22.5 ± 1.7% for C3, and 20.0 ± 1.7% for C4, respectively. The average walking speed and the maximum walking speed decreased with the steps, while no significant correlation between the steps and the maximum hand grip was observed.

The intakes of energy, protein, fat, and carbohydrates were significantly higher in men than in women, but the intakes of calcium, iron, various vitamins, dietary fiber, and sodium chloride did not differ between the sexes.

After adjusting for age and sex, ANCOVA showed some significant associations between the daily number of steps and intakes of calcium and vitamin C,

| Table 1. Comparison of the height, body mass, and daily number of steps among the different age groups for male and females. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Age | Height (cm) | Male | Mean | SD | Min | Max | Female | Mean | SD | Min | Max | ANOVA interaction |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 65 | 161.3 ± 6.9 (142.9 ~ 173.1) | 149.8 ± 5.1 (139.3 ~ 161.5) | 0.000 0.000 0.509 |
| 70 | 159.5 ± 5.6 (148.1 ~ 171.3) | 146.3 ± 5.0 (136.2 ~ 155.6) | * |
| 75 | 158.1 ± 5.8 (150.3 ~ 171.1) | 144.7 ± 6.3 (132.5 ~ 156.7) | ** |
| Body Mass | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** |
| 65 | 62.6 ± 7.7 (52.5 ~ 81.5) | 52.9 ± 7.2 (38.3 ~ 68.0) | 0.000 0.000 0.797 |
| 70 | 59.8 ± 8.7 (46.8 ~ 81.5) | 50.8 ± 7.9 (29.2 ~ 62.8) | * |
| 75 | 56.1 ± 5.8 (43.6 ~ 66.5) | 48.2 ± 6.1 (33.7 ~ 59.8) | * |
| BMI | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** |
| 65 | 24 ± 3 (19 ~ 30) | 24 ± 3 (16 ~ 29) | 0.789 0.109 0.551 |
| 70 | 23 ± 3 (18 ~ 31) | 24 ± 3 (15 ~ 29) | * |
| 75 | 22 ± 2 (18 ~ 27) | 23 ± 3 (16 ~ 27) | |
| Steps | 65 | 7895 ± 2916 (2757 ~ 14054) | 7291 ± 2299 (3075 ~ 13685) | 0.069 0.008 0.983 |
| 70 | 7768 ± 3089 (1623 ~ 16162) | 7012 ± 2364 (2672 ~ 11635) | |
| 75 | 6506 ± 3000 (2844 ~ 13646) | 5764 ± 2682 (1264 ~ 12462) | * |

Significantly different from the 65 ages (*: p<0.05, **: p<0.01)

Abbreviation: SD; standard deviation, BMI; body mass index
A. Pedometer counts

B. Grips

C. Average walking speed

D. Maximum walking speed

Fig 1. Comparison of the step categories with pedometer counts and physical fitness. We divided the subjects into quartiles according to their mean daily number of steps, with C1 indicating the lowest quartile and C4 indicating the highest. Sex- and age-adjusted mean daily pedometer counts, hand grips, average walking speed and maximum walking ability were compared by ANCOVA. The values are expressed as the mean ± SE. Significant differences are indicated by different letters (p < 0.05).

Fig 2. Comparison of the step category with the nutritional intake. We divided the subjects into quartiles according to their mean daily number of steps, with C1 indicating the lowest quartile and C4 indicating the highest. The sex- and age-adjusted nutritional intakes were then compared by ANCOVA. The values are expressed as the mean ± SE. n.s.: not significant by ANCOVA. *: statistically significant between the groups (p < 0.05).
respectively, while not between the steps and the intakes of energy, protein, fat and carbohydrate, respectively. A post hoc analysis revealed that the calcium and vitamin C intakes were significantly lower in the C1 quartile of the step counts than in the C3 quartiles. The optimal intakes were observed in the C3 quartiles (Fig. 2).

**Discussion**

In our present study, aging was observed to result in a decrease in the number of daily steps, the mean hand grip, and the mean moving ability. The intake of nutrients was higher in this study than that observed in same-aged Japanese described in the National Nutrient Survey for the Japanese. Both the meal intake and the number of daily steps were higher in the participants in our study than in the National Survey, and the higher pedometer counts were associated with a lower CV. The coefficient of inter-day variation was the smallest among those who walked the most; thus suggesting that individuals whose step counts were higher might have a regular habit of walking. It was also suggested that some relationship might exist between the daily number of steps and physical strength, based on the changes in walking speeds which increased with the mean number of daily steps. An increase in the number of daily steps in senior citizens might thus improve physical fitness.

In our present study, the maximum energy intakes after adjusting for both sex and age might occur at around 7800 steps. In addition, the energy intake after adjusting for both sex and age might decreased due to too much walking. These findings strongly suggest that an increase in walking might cause an increase in food or nutritional intake in elderly people, while walking too much may also cause an intake insufficiency in various kinds of nutrients. Although we have no direct proof based on the findings in our study, too much walking might cause the elderly some stress, thus resulting in a reduced intake of energy and so on. A suitable daily number of steps might result in their proper nutritional intake for community-dwelling elderly. Christensson et al. assessed nutritional status in elderly people newly admitted to a community resident home, and reported that psychological stress or acute disease in the previous 3 months, reduced the fluid intake, while also causing a reduction in appetite and a reduced mobility.

Wyatt et al. completed a statewide survey of walking in Colorado and reported that the average adult (mean age: 44 ± 0.42 yr) in Colorado took 6804 steps per day; about 33% reported taking fewer than 5000 steps per day, and only 16% reported taking 10,000 or more steps per day. It was also reported that significant determinants of steps per day might include increasing age (negative), and an increasing BMI (negative). While the elderly people in our study took many more steps than those in Colorado, around 7000 ~ 8000 steps per day might be average in both community-dwelling adults and elderly people.

Walking is the most common form of physical activity. Electronic pedometers are inexpensive, minimally invasive, and easy to use, and some success in increasing physical activity and physical fitness has been achieved by increasing the number of walking steps. It seems likely that the number of steps per day measured using an electronic pedometer might be a good index of physical activity, and an increasing number of steps per day might appear to be a good target for increasing the physical activity.

Recently, numerous reports have shown malnutrition in elderly people. Devine et al. investigated the effects of calcium consumption and physical activity (lifestyle management) on bone mass in an older female population. After adjustment for calcium consumption, age, weight, alcohol consumption, and cigarette smoking, high physical activity compared with medium or low physical activity was associated with higher hip bone mineral density and heel quantitative ultrasound. Morita et al. also evaluated the changes in walking ability of patients before injury over the last 10 years in Japan, and thus
found that many patients had problems in walking, and could not walk outdoors or go shopping alone before the injury, and that their bone mineral density was thus reduced. They concluded that for the prevention of hip fractures, it is important to improve the physical function to avoid falls.

Based on these results, our results suggest that efforts to increase walking up to around 8000 steps per day might induce a better food intake in elderly people while also improving their overall general health.

References


4) Christensson L, Unosson M, Ek AC. Malnutrition in elderly people newly admitted to a community re-


