

Assessing daily physical activity using a pedometer among middle aged and older people in Dundee, Scotland

Takahiro MITSUI, Kiyoshi SHIMAOKA

Abstract

Obesity has been increasing in Westernized countries probably because decreased daily physical activities. In addition, inactive lifestyle is considered closely associated with obesity. Pedometer has been recognized as a useful tool in assessing daily physical activities, but there is no available data on pedometer determined physical activities among the resident of Scotland, which is reported lower than that of other nations. We measured steps/day among apparently healthy 129 people in Dundee aged from 40 to 79 years using a pedometer (EM-180, YAMASA, TOKYO) for a week. Questioner was used to ask their age, gender, height, body weight, occupation, and exercise habit. The average number of steps/day was 7796 ± 496 (SE) in men and 8660 ± 402 in women. These values seem not to be lower than that of other nations reported previously. Steps/day by obese people with $BMI \geq 30$ was significantly lower than that of the normal with $BMI < 24.9$ (6899 ± 724 vs 9050 ± 437 , $P=0.026$), which is consistent with previous studies.

KEY WORDS

Pedometer, daily physical activity, obesity, Scotland

Introduction

Obesity has been increasing rapidly in Westernized countries in the last two decades and it increase the risk of type 2 diabetes, cardiovascular diseases, and some cancer¹. In spite of the progress of our understanding of the factor that contribute to obesity, the cause of this prevalence is unclear. Reduced total daily physical activity is thought to be the most important factor contributing to the increase in body weight in Westernized countries because the gene pool does not change rapidly and energy intake have reduced in these decades²⁻⁴. Measuring daily physical activity accurately is difficult. Questionnaire has been traditionally and widely used for assessing physical activity, but it tends to overestimate higher intensity activities such as organized sports and underestimate lower intensity activities like

walking, occupation and housekeeping⁵. On the other hand, a pedometer, mechanical motion sensor, records the acceleration and deceleration of movement in one direction, is sensitive to walking suggested to be effective for estimating daily physical activity⁵⁻⁷.

Scotland has been the highest national coronary heart disease (CHD) mortality rate in the world⁸. Combined with Scottish foods, high fat and sugar content and low fruit and vegetable content, low physical activity is considered a possible cause of its high incidence of CHD^{9,10}. However, to our knowledge, physical activity data assessed by a pedometer in this area is not available.

In the present study, we assessed physical activity using a pedometer and examine the relationship between daily physical activity and obesity among middle aged and older

Research Center of Health, Physical Fitness and Sports, Nagoya University,
Furocho, Chikusaku, Nagoya, 464-8601, Japan

All correspondence concerning this paper should be addressed to:
Professor Kiyoshi Shimaoka
Research Center of Health, Physical Fitness and Sports, Nagoya University,
Furocho, Chikusaku, Nagoya, 464-8601, Japan
Tel 81-52-789-3951 Fax 81-52-789-3957
e-mail kshimaoka@hotai.htc.nagoya-u.ac.jp

Table 1. The physical characteristics, steps/day, and incidence of those exercising regularly.

age	gender	number	height (cm)	weight (kg)	BMI (kg/m ²)	steps/day	% of those who exercise regularly
40-49	M	16	179.0±1.7	87.1±3.5	27.1±0.8	8684±651	12.5
	F	34	161.6±0.8	65.1±2.0	25.1±0.8	9290±566	29.4
50-59	M	18	175.2±1.8	76.7±1.4	25.2±0.8	7984±768	38.9
	F	36	160.4±1.2	66.0±2.1	25.8±0.9	8531±523	36.1
60+	M	12	173.7±2.4	79.1±3.7	26.3±1.1	6331±1229	16.7
	F	13	160.8±2.0	65.0±2.4	25.2±0.8	7366±1547	38.5

Table 2. The steps/day and incidence of those exercising regularly classified by BMI of the participants.

	Number (M/F)	Age (yrs)	BMI (kg/m ²)	Steps/day	% of those who exercise regularly
Normal (BMI<25)	62 (16/46)	52.6±1.2	22.5±0.2	9050±437	35.5
Overweight (25≤BMI<30)	51 (25/26)	52.2±1.2	27.0±0.2	7960±524	27.5
Obese (BMI≥30)	16 (5/11)	52.8±2.4	34.0±1.3	6899±724*	12.5

*P<0.05 vs Normal

people in a local town in Scotland.

Method

This study was conducted in Dundee on the east coast of Scotland between June and November 2002 during an author (TM) stayed in this city. Apparently healthy 129 Caucasian, mainly Scottish and some English and Welsh, middle aged and older people aged from 40 to 79 year participated in this study after giving written informed consent. All participants were asked to be a volunteer at a university, several pubs, and a church. Questioner was used to ask their age, gender, height, body weight, occupation, and exercise habit. Those who exercise more than twice are considered exercise regularly. Participants were given a pedometer (EM-180, YAMASA, TOKYO) and instructed to position it on their belt or waistband and to record their number of steps from waking up to going to bed for a week except while doing sports or taking a bath or shower. WHO criteria was employed to classify of obesity, i.e. normal<24.9, 25.0≤overweight<30.0, and obese≥30.0¹¹.

Fisher's exact probability test was used to compare the proportion of those who exercise regularly in each group. Student's paired and unpaired t test used to compare steps per day in each group and steps of working day and holiday,

respectively. $P<0.05$ considered statistically significant.

Results

The number of participants, physical characteristics, steps/day, and incidence of those who exercise regularly in each age group are shown in Table 1. Although the differences were not statistically significant, mean steps/day decreased with ageing and women tend to accumulate slightly more steps/day than in men.

Table 2 showed the number of participants, age, BMI, steps/day, and incidence those who exercise regularly classified by WHO criteria. No significant differences were seen in the steps/day and incidence of those who exercise regularly by overweight between the normal and overweight participant. On the other hand, the steps/day by obese participants was significant fewer than that of the normal ($P=0.026$), but the difference in the incidence of those who exercise regularly was not significant.

The steps/day on working day was 9765±375 (Mean±SE), which was higher than that of on holiday, 7072±372 ($P<0.0001$) among 27 men and 56 women those who have steady job with mean age of 48.6±0.6 years.

Steps/day reported by several groups and our data was described in Table 3. Our present data was almost same

Table 3. Comparing steps/day with previous studies.

country	n	age (yrs)	stesp/day	reference
Switzerland	493	25-74	m: 11900-6700 f: 9300-7300	6
USA	96	25-70	m: 5569±2093 f: 6413±2267 (mean±SD)	7
USA	109	44.9±15.8	7370±3080 (mean±SD)	13
USA	58	49.5±15.1	7781±2807 (mean±SD)	14
Japan	9400	15+	m: 8042±4664 f: 7319±3986	12
Scotland	129	52.5±0.8	m: 7796±496 f: 8660±402 (mean±SE)	present study

level as those of Swiss⁶ and Japanese¹² and higher than three studies on US residents^{7,13,14}.

Discussion

It is unable to measure speed of walking, cycling, swimming, and upper body movement by a pedometer. But walking is the most common forms of daily physical activity⁵, thus pedometer is considered to be inexpensive useful method in assessing daily physical activity. In addition, concrete data qualified as steps/day is more convenient than questioner data especially in comparing different cultural physical activity data.

As far as we know, there are two studies assessing the relationship between physical activity and obesity^{13,15}. Both studies concluded that steps/day or pedometer determined activity decreased with increasing BMI or body weight. Tyron et al.¹⁵ observed that pedometer determined activity, a rate of distance traveled per hour, was inversely related to percentage of overweight in 127 women aged 19-55 years ranging from 14% underweight to 99% overweight ($r=-0.217$, $P<0.02$). Recently, Tudor-Locke et al.¹³ reported that steps/day was inversely correlated with BMI and percentage of body fat measured using a bioelectrical impedance analyzer ($r=-0.30$ and $r=-0.27$, respectively, both $P<0.01$). They also observed that those who have less than approximately 5000 steps/day in the obese and more than approximately 9000 steps/day in the normal were frequent. Although the relationship between BMI and steps/day was not significant

($r=0.1643$, $P>0.05$) in this study, probably due to the wide range of participant's age. However, reduced steps/day by obese participants means our data are consistent with these two previous studies. Strong association between obesity and a sedentary life style and lack of physical activity were seen in several large population questionnaire studies as well^{16,17}.

Although it was not significant, steps/day by women were higher than that of men in all age groups. Higher numbers of steps/day by men were observed in the resident of Switzerland⁶ and Japan¹², while the number of steps/day by women were higher than in men in this study and study on US residents⁷. The reduced number of steps/day on holiday, usually Sunday, was seen in this study, which is consistent with previous studies^{6,7}. Differing from previous studies on Scotland^{9,10}, our pedometer determined data by middle aged and older people in Dundee seem to be comparable to that of other nations. In addition, the incidence those who excise regularly was 31.5%, while that of Japanese were reported 30.2% in men and 27.5% in women¹².

It is essential to improve dietary habit and take moderate exercise into daily life in reducing obesity. Several studies reported that walking, by itself, is associated with a lower risk of CHD¹⁸⁻²⁰, and pedometer will help to quantify and motivate for walking. The guideline for the reduction of lifestyle-related diseases in Japan named HEALTH JAPAN 21²¹ recommend increase the average number of steps/day from current level 8201 to 9200 in men and from current level 7282 to 8300 in women by 2010.

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