Research Letter

Monitoring of elderly for deriving tourism activity ability

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Abstract
The population of elderly people aged 70 and over is expected to continue increasing until around the year 2048 in Japan, and this population group is considered to be important for the domestic travel market. However, the number of overnight trips of the elderly is lower than the average. The main reasons for not going on overnight trips for the entire population are economic limitations and time constraints. However, health reasons are statistically significantly higher in people aged 70 years and older. The authors are carrying out research on travel promotion by deriving tourism activity ability. We define it as the ability to enjoy sightseeing without feeling fatigue from the previous day. In this study, monthly activities of 21 Japanese people aged 65 to 81 years old were monitored. Then, the relationship between the number of steps and the walking ability was analysed. As a result, four male subjects and one female subject reached the recommended target value of daily number of steps specified by Health Japan 21 (second term). There was a statistically significant negative correlation between age and step length. However, no statistically significant correlation was observed between average daily number of steps and walking ability.

Keywords
tourism activity ability, elderly, number of steps, monitoring, walking ability

1. Introduction

The world will age rapidly in the next half century, and the elderly population is expected to be the most important segment in the tourism industry [Alén et al., 2014; Wijaya et al., 2018]. In Japan as well, the importance of targeting the elderly for domestic travel has been pointed out because the population of people 70 years old and older will continue to increase until around 2048. According to 2019 States and Trends of Tourism [Japan Travel and Tourism Association, 2020], the average number of overnight trips in 2019 was 2.58 per person. By age, it was highest at 2.92 for the 25-29-year-old group and 2.78 for 40-49 year olds. However, it decreases to 2.24 for the group of 70 years and older. The main reasons for not going on overnight trips for the entire population are economic limitations and time constraints. However, health reasons are statistically significantly higher in people aged 70 years and older.

In previous studies on walking by elderly people, the characteristics of vital signs are measured and the possibility of staying healthy by walking is shown [Oyabu et al., 2016]. It is also shown that problems occur among elderly people at their travel destinations since they walk for longer hours than usual and thus they are too tired to enjoy the rest of their trip [Oyabu et al., 2017].

On the basis of these findings of previous studies, the authors are carrying out research on travel promotion by deriving the ability of the elderly to partake in tourist activity. Figure 1 shows the entire research process. The research consists of the following four parts.

(1) Subject's monthly activity is monitored. Subject's walking ability is measured.
(2) Objective indicators such as number of steps, heart rate and activity, and subjective evaluation such as the level of fatigue are measured during a sightseeing tour.
(3) We define tourism activity ability of the elderly as the ability to enjoy sightseeing without feeling fatigue from the previous day. The ability is derived in three stages on the basis of the data of (2). Factors influencing the ability are

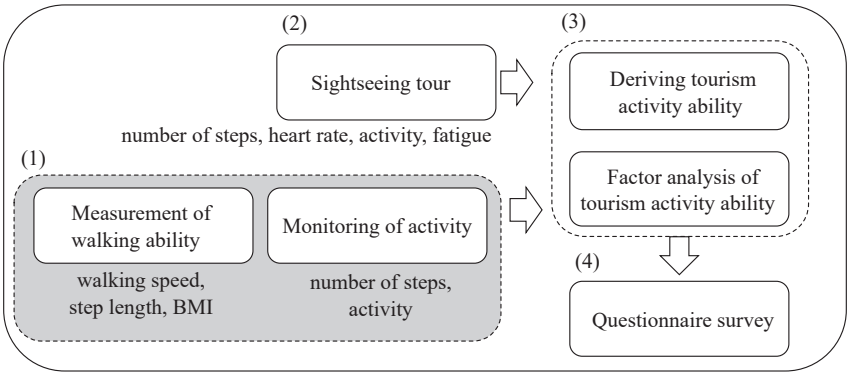

Figure 1: The entire research process

analyzed using the data of (1).

(4) Subjects are presented their tourism activity ability with main factors. Then the questionnaire survey is performed to reveal whether understanding own tourism activity ability leads to increased motivation to go on a sightseeing trip.

This study is carried out as (1) in Figure 1, and the relationship between the number of steps and the walking ability of people 65 years old and older is examined.

2. Experimental method

2.1 Subjects

The subjects of this study were 21 Japanese people aged 65 to 81 years old living in Kanazawa City. In recruiting subjects, we explained the purpose to the staff of the community center in Kanazawa city and requested them to recruit people who are 65 years old or older and whose daily activity is not biased. Among the 10 male subjects, two, six, and two were in their 60s, 70s, and 80s, respectively. Among the 11 female subjects, three, six, and two were in their 60s, 70s, and 80s, respectively. This study was approved by the research ethics committee of Hokuriku Gakuin University on 31 July 2019.

2.2 Measurement of walking ability

A 16 m plastic tape was laid down in a straight line in the campus of Hokuriku Gakuin University. Subjects were instructed to walk along the tape at a normal outdoor walking speed. The number of steps and the time required for them to walk 10 m were measured, excluding the data for the first and last 3 m. On the basis of these measurements, the step length (m/step), walking speed (m/s), and pace (steps/s) were calculated and used as data of walking ability [Kimura et al., 1998].

2.3 Monitoring of activity

There are three main types of wearable activity meters: a wristwatch type, a wristband type, and a clip type [Japan Foundation for Aging and Health, 2019]. The wristwatch type is linked with smartphone function. The wristband type is more compact than the wristwatch type, and many are equipped with a sleep meter that can measure sleep time and depth of sleep. In this study, the clip type (Omron, HJA-306) is adopted because it has simple functions and is easy to operate. The photograph is shown in Figure 2. It is 7.8 cm wide, 3.3 cm high, and 1 cm thick, and weighs 25 g. Subjects were given the activity meter that was initially set according to each user's height, step length and so on.

Figure 2: Activity meter used for monitoring

Subjects were instructed on how to use the activity meter at the experiment briefing. Subjects were asked to measure the daily number of steps and calorie consumption themselves every day in October 2019. Subjects kept the activity meter in their pockets or on an over-the-shoulder strap from the time of awakening to when they went to bed.

3. Results

3.1 Number of steps

Figure 3 shows the daily number of steps in one month for the male subjects. The highest average daily number of steps was 12,242 of subject M3. He participated in a walking event on 5 October and the number of steps reached ~30,000 on that day. The lowest average daily number of steps was 2,898 of subject M5.

Figure 4 shows the daily number of steps in one month for the female subjects. The highest average daily number of steps was 7,229 of subject F2. She participated in a walking event and assisted in a cultural festival at a community center on 17 October and the number of steps reached ~20,000 on that day. The lowest average daily number of steps was 477 of subject F4.

According to 2019 National Health and Nutrition Survey [Ministry of Health, Labour and Welfare, 2020], the average daily numbers of steps of males and females age 65 years old and older were 5,396 and 4,656 steps, respectively. The target values of daily number of steps for males and females age 65 years old and older specified by Health Japan 21 (second term) established by Ministry of Health, Labour and Welfare (a basic directive for comprehensive implementation of the national health promotion) are 7,000 and 6,000 steps, respectively. Among the male subjects, the daily number of steps of six subjects was higher than the average (5,396 steps) and four of these subjects reached the recommended target value. Among the female subjects, the daily number of steps of three subjects was higher than the average (4,656 steps) and only one subject reached the recommended target value.

3.2 Physical constitution and walking ability

Table 1 shows a summary of the mean and standard deviation of age, physical constitution, walking ability, and average daily number of steps of male and female subjects. A *t*-test was carried out to determine the difference between the data of male and female subjects. A statistically significant difference was observed for height; however, no statistically significant difference was observed for other parameters between male and female subjects.

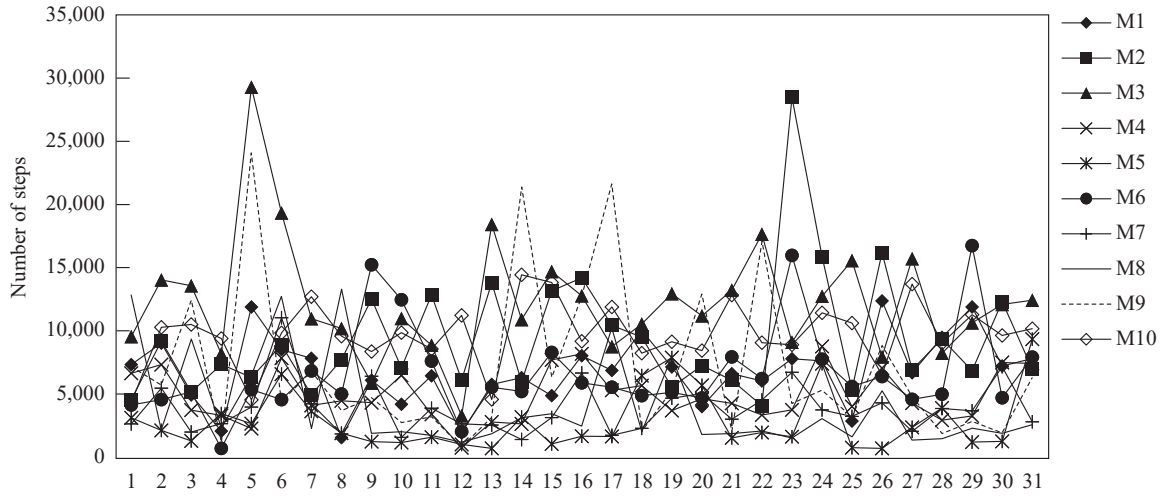

Figure 3: Daily number of steps in one month for male subjects

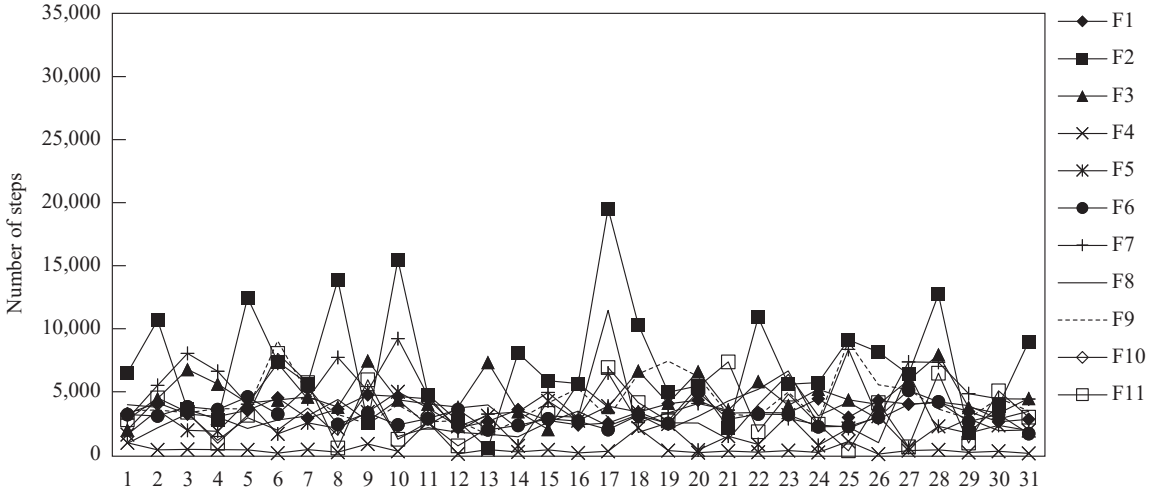

Figure 4: Daily number of steps in one month for female subjects

Table 1: Age, physical constitution, walking ability, and daily number of steps of subjects

	Male	Female	Gender difference
Age (years old)	74 ± 5.33	73.09 ± 6.04	
Height (cm)	166.6 ± 5.10	153.18 ± 4.21	**
BMI	22.01 ± 2.90	22.73 ± 2.52	
Step length (m/step)	0.71 ± 0.09	0.64 ± 0.09	
Walking speed (m/s)	1.33 ± 0.25	1.34 ± 0.24	
Pace (steps/s)	1.86 ± 0.13	2.09 ± 0.18	
Average daily number of steps (steps/d)	6773.5 ± 2978.47	3672.45 ± 1693.31	

Notes: Mean ± SD, ** $p < 0.01$, * $p < 0.05$.

3.3 Correlations between walking ability and age, physical constitution, and average daily number of steps

Table 2 shows a summary of the correlation coefficients between walking ability and age, physical constitution, and average daily number of steps for male and female subjects. There were positive correlations between height and step length as well as between height and walking speed. For male subjects, there was a positive correlation between height and pace. In contrast, for female subjects, there was a negative correlation between height and pace. There were statistically significant correlations between height and step length as well as between height and walking speed for male subjects; and between

Table 2: Correlation between walking ability and age, physical constitution, and average daily number of steps

	Male			Female		
	Step length	Walking speed	Pace	Step length	Walking speed	Pace
Age	–.744*	–.640*	–0.332	–0.552	–0.572	–0.260
Height	.670*	.705*	0.629	.603*	0.294	–0.330
BMI	0.220	0.183	0.060	–.773**	–0.572	0.060
Average daily number of steps	0.181	0.158	0.067	0.394	0.235	–0.119

Notes: ** $p < 0.01$, * $p < 0.05$.

Table 3: Correlation between walking ability and age, physical constitution, and average daily number of steps (control variable: height)

	Male			Female		
	Step length	Walking speed	Pace	Step length	Walking speed	Pace
Age	–.732*	–0.591	–0.153	–.688*	–0.597	–0.277
BMI	–0.104	–0.192	–0.303	–0.616	–0.535	–0.250
Average daily number of steps	0.098	0.062	–0.046	0.318	0.176	–0.042

Note: * $p < 0.05$.

height and step length for female subjects.

Table 3 shows a summary of partial correlation coefficients with the effect of height removed. For both male and female subjects, there were statistically significant negative correlations between age and step length. No statistically significant correlation was observed between average daily number of steps and walking ability.

Figure 5 shows the relationship between age and average daily number of steps for male and female subjects. The average daily number of steps tended to decrease with increasing age for male subjects. In contrast, it tended to increase with increasing age for female subjects. However, no statistically significant correlation was observed.

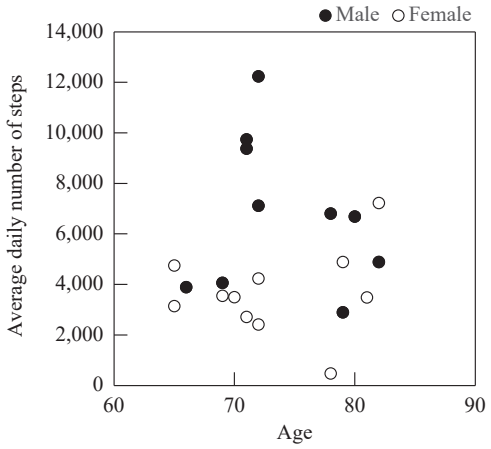

Figure 5: Relationship between age and average daily number of steps

4. Conclusions

In this study, the activity of elderly people in their daily lives was monitored to determine their tourism activity ability. Among the 21 subjects, only four male subjects and one female subject satisfied the recommended target value of the daily number of steps specified by Health Japan 21 (second term). There was a statistically significant negative correlation between age and step length. However, no statistically significant correlation was observed between average daily number of steps and walking ability. In addition, no statistically significant correlation was observed between age and average daily number of steps, revealing a large variation among the individuals.

In future studies, objective indicators such as heart rate and subjective evaluation such as the level of fatigue felt will be measured during a sightseeing tour involving the subjects in this study. Then tourism activity ability will be derived on the basis of the results of a sightseeing tour.

The results obtained in this study will be used to analyze factors that influence tourism activity ability. If it becomes clear that the higher average number of steps per day, the higher tourist activity ability, it will be possible to have goals for the number of steps per day. For example, people with low tourism activity ability make daily walking a habit, and people with high tourism activity ability maintain the current number of steps.

Acknowledgements

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