We examined the adverse relationship between locomotive syndrome and access to social capital, life satisfaction, and self-rated health.

A questionnaire survey was conducted on 15,200 housebound elderly subjects in 46 prefectures. Valid responses were obtained from 8,301 subjects. Among them, approximately 11% of both males and females used a national nursing care insurance service, and 15.3% of males and 26.8% of females were undergoing treatment for locomotive syndrome. The subjects with locomotive syndrome showed poor evaluation on all items. Statistically significant reductions in social engagement, loss of social engagement, life satisfaction, and self-rated health were observed. Locomotive syndrome in the elderly in Japan is directly associated with reduced social engagement, which is also significantly associated with diminished life satisfaction and self-rated health.

Taking preventive measures against locomotive syndrome independently of measures to improve access to social capital may be adequate, but should be done as soon as possible, regardless of socioeconomic status, because a delay in preventing locomotive syndrome can exacerbate health disparities.

Key words: Elderly, locomotive syndrome, access to social capital, life satisfaction, self-rated health

I Introduction

Japan is the world’s leading country in terms of longevity; the life expectancy at birth is 80.21 years for males and 86.61 years for females\(^1\). People aged 65 and older comprised 26.0% of the total population\(^2\), which is the highest in the world. Japan is now facing a super-aged society. Although the second term of the National Health Promotion Movement in the twenty-first century (Health Japan 21) has aimed to improve the health and extend the life span, locomotive syndrome is seriously affecting the health of the elderly\(^3\)–\(^6\).

Locomotive syndrome refers to a condition char-
characterized by a decline in the functions of the locomotor system, including the bones, joints, and muscles. People with locomotive syndrome either require care services or are bedridden or are strongly expected to soon require care services or become bedridden. Individuals are at high risk of locomotive syndrome when they meet at least one of the following criteria: 1) cannot put on a sock while standing on one leg; 2) stumble or slip in their houses; 3) need to use a handrail when going up the stairs; 4) cannot cross the road before the traffic light changes; 5) have difficulty in walking continuously for 15 minutes; 6) have difficulty in walking home carrying a shopping bag weighing about 2 kilograms; and 7) have difficulty in doing housework that requires physical strength. Locomotive syndrome includes a broad range of symptoms and can be understood as a general term for the decline in the locomotor functions of the bones and joints. Although surveys have found no specific tendency in the prevalence of locomotive syndrome, a survey conducted on middle-aged and elderly people in a local community in Japan showed that 21.2% of the survey respondents who had the syndrome were males and 35.6% females. Across the country, 47 million people are estimated to have at least one of the following: knee osteoarthritis, lumbar spondylosis, or osteoporosis.

Preventive measures against locomotive syndrome are essential because of its high prevalence as well as the significant financial burden it imposes on afflicted patients and the difficulty in achieving a cure. The Japanese Orthopaedic Association and other related societies have proposed various training methods and strategies to prevent locomotive syndrome. Among these is the early implementation of preventive measures. A multifaceted examination of the effects of locomotive syndrome and assessment of the significance of the effects will provide critical information for disseminating the importance of taking preventive measures against locomotive syndrome.

For the elderly, experiencing difficulty in going out due to locomotive syndrome may mean losing access to social capital, which refers to the bonds the elderly have within local communities. Furthermore, the loss of access to social capital affects the health of individuals and is expected to affect their self-rated health and quality of life (QOL). Although some researchers have assessed the effects of individual diseases such as osteoporosis on patients’ social and mental health, there has been no report on the effects of locomotive syndrome, which encompasses a broad range of symptoms, among which pain in the bones and joints is one of the chief complaints. Using the Survey on Difficulty in Shopping and Current Health Conditions in Housebound Elderly conducted on housebound elderly across the country, we examined two hypotheses: 1) Access to social capital, life satisfaction, and self-rated health are diminished as a result of locomotive syndrome, and 2) life satisfaction and self-rated health are reduced as a result of reduced access to social capital.

II Methods

1. Subjects and survey procedures

This study was conducted by The Japanese Society for Dietary Health Promotion (Nihon Shokuseikatsu Kyokai) and its enrolled 170,000 dietary health-promoting volunteers in 1,411 municipalities. The volunteers, mostly housewives, are trained to acquire the knowledge and skills to follow a healthy diet under the supervision of public health centers. The system of dietary health-promoting volunteers was stipulated by a circular notice from the Ministry of Health in 1959. Volunteers receive 48-hour enrollment training and attend routine seminars four to 12 times a year. For the current study, volunteers were offered one-day
interviewer trainings in each municipal unit. The study period lasted from November 1 to December 31, 2012. The ad-hoc survey was implemented by distributing a questionnaire entitled “Survey on Dietary Environment in Relation to Difficulty in Shopping and Current Health Conditions of Household Elderly” and by trained dietary health-promoting volunteers conducting face-to-face interviews in the subjects’ homes. The sampled subjects were 15,200 housebound elderly people aged 65 and older as of November 1, 2012, from 46 prefectures, except for Tokyo. The survey was continued until the assigned number of sampling subjects had been covered in each prefecture.

2. Questionnaire items

Table 1 shows 15 items selected from the questionnaire concerning daily life, specifically in relation to health conditions, grocery shopping, eating habits, and the use of food delivery services. Those who answered “yes” to the question of whether they had diseases of the bones or joints that were being treated were determined to have locomotive syndrome. Hypertension, diabetes, and heart disease were used as covariates because these diseases seemed to be background factors

| Table 1 | Fifteen items selected from the original questionnaire for the study |
|---------|--------------------------------------------------|
| 1. Age (years old) |                      |
| 2. Gender |                      |
| 1) Male |                      |
| 2) Female |                      |
| 3. Height (cm) |                      |
| 4. Weight (kg) |                      |
| 5. Household |                      |
| 1) Living without spouse and children |                      |
| 2) Living with spouse without children |                      |
| 3) Living with children without spouse |                      |
| 4) Others |                      |
| 6. Class of nursing care insurance |                      |
| 1) Needed support 1 |                      |
| 2) Needed support 2 |                      |
| 3) Need for long-term care 1 |                      |
| 4) Need for long-term care 2 |                      |
| 5) Need for long-term care 3 |                      |
| 6) Need for long-term care 4 |                      |
| 7) Need for long-term care 5 |                      |
| 7. Main source of income |                      |
| 1) Pension |                      |
| 2) Work (including self-employment) |                      |
| 3) Others |                      |
| 8. Health condition |                      |
| 1) Good |                      |
| 2) Rather good |                      |
| 3) Moderate |                      |
| 4) Rather bad |                      |
| 5) Bad |                      |
| 9. Current disease in treatment |                      |
| 1) Hypertension |                      |
| 2) Diabetes |                      |
| 3) Diseases of the bones and joints |                      |
| 4) Heart disease |                      |
| 5) Others |                      |
| 10. Current condition of visual field |                      |
| 1) Clear |                      |
| 2) Blurred |                      |
| 3) Severely blurred |                      |
| 11. Current condition of hearing |                      |
| 1) Clear |                      |
| 2) Defective |                      |
| 3) Severely defective |                      |
| 12. Satisfaction with daily life |                      |
| 1) Satisfied |                      |
| 2) Rather satisfied |                      |
| 3) Rather dissatisfied |                      |
| 4) Dissatisfied |                      |
| 13. How do you think relationship with neighbors is necessary? |                      |
| 1) Necessary |                      |
| 2) Rather necessary |                      |
| 3) Not necessary |                      |
| 14. Do you have a relationship with neighbors? |                      |
| 1) Cordial |                      |
| 2) To the extent of greeting and chatting |                      |
| 3) Scarcely |                      |
| 15. Do you participate in community or volunteer activity? |                      |
| 1) Participate |                      |
| 2) Occasionally participate |                      |
| 3) Participated before but not now |                      |
| 4) Never |                      |
disrupting individuals’ social activities. As indices of physical conditions, vision and hearing ability were presented as binary choice (high or low) questions and used as adjustment factors for the same reason. Age (65–74, 75–84, ≥85), gender, and BMI levels (kg/m²; calculated from height and weight: <20, underweight; 20–25, normal; and ≥25, obese) were also used as covariates. Height and weight were obtained following the protocol for the unmeasurable case of the National Health and Nutrition Survey in Japan. The order of precedence was as follows: 1) those measured at the health check-up that year; 2) those measured using the interviewee’s scales, and 3) otherwise, those in the interviewee’s memory. The cutoff value of underweight for the elderly was applied from the second term of National Health Promotion Movement in the twenty first century.

We examined the subjects’ access to social capital using three variables: 1) recognition of the need for interactions, 2) interactions with neighbors, and 3) social engagement. Regarding 1) recognition of the need for interactions with the community (hereafter, the need for interactions), those who answered “yes” or “mostly yes” to the question “Do you feel the need for connections with neighbors and the community?” were classified into the Yes group while those who answered “no” were classified into the No group. For 2) interactions with neighbors, those who answered “having a friendly association” or “exchanging greetings or having a short conversation” to the question about interactions with neighbors were classified into the Yes group and those who answered “having little association” were classified into the No group. For 3) engagement in social activities (hereafter, social engagement), those who answered “engaged” or “sometimes engaged” to the question about engagement in social and volunteer activities were classified into the Yes group and those who answered “engaged in the past but not currently” or “never engaged” were classified into the No group. The option “engaged in the past but not currently” indicates a change in the respondent’s engagement status; therefore, we conducted an ancillary analysis of the loss of social engagement by setting the option “engaged in the past but not currently” as “having lost social engagement”, “never engaged” as “missing value”, and other answers as “no change”.

We used two variables to examine the subjects’ health: 1) life satisfaction and 2) self-rated health. For life satisfaction, those who answered “satisfied” or “rather satisfied” to the question, “Are you satisfied with your current life?” were classified into the high-satisfaction group (hereafter, high group) and those who answered “rather dissatisfied” and “dissatisfied” were classified into the low-satisfaction group (hereafter, low group). For self-rated health, those who answered “good”, or “rather good” to the five-scale questions about current health conditions were classified into the high group and those who answered “moderate”, “rather poor” or “poor” were classified into the low group. The power of explanation of self-rated health was maximized in the case where the moderate condition was categorized into the low group.

Based on the answers to the question about household composition, the subjects were classified into three groups: single household, including bereaved or divorced; married-couple household, or bereaved or divorced and living with children. The subjects with “others”, including married-couple household with children were excluded from the analysis because of uncertainty and the limited number of samples. The answers concerning the use of national long-term care insurance services were used in the analysis. Those who answered that their pension was their current major...
source of income were included as the subjects of analysis, and those who selected “work (including self-employment)” or “others” as their source of income were excluded from the analysis. Those with missing data on any of the items other than the loss of social engagement were excluded from the analysis.

3. Statistical analyses
The results for the analyzed items were classified according to gender, and the significance of differences was determined using the chi-square test. Age is presented as a mean value, and the significance of difference was determined using Student’s t-test. A cross-tabulation of locomotive syndrome, need for interactions, interactions with neighbors, social engagement, loss of social engagement, life satisfaction, and self-rated health was constructed. The significance of association was determined by the odds ratio (OR) and its 95% confidence interval (95% CI) using logistic regression models, setting the presence of locomotive syndrome as the independent variable. The covariates applied in multivariate analysis were gender, age, use of national long-term care insurance services, household composition, degree of obesity, hypertension, diabetes, heart disease, vision abnormality, and hearing abnormality (Model 1). An ancillary analysis was conducted by adjusting the ORs for life satisfaction and self-rated health considering the interaction with neighbors and social engagement (Model 2). The levels of statistical significance were set at p<0.05.

The statistical tests were conducted using Stata 13 (StataCorp, 2013).18

4. Ethical considerations
This survey was carried out in accordance with the Declaration of Helsinki and the Ethical Guidelines for Epidemiological Research of the Ministry of Education, Culture, Sports, Science and Technology, and the Ministry of Health, Labour and Welfare, Japan. As subjects were asked about their households and personal affairs, we took all possible measures to protect and manage the subjects’ personal data and to dispel the subjects’ fears regarding the protection of privacy. The interviewers obtained the subjects’ consent after fully explaining the purpose of the study, the methods employed, and that participation in the survey was voluntary. The survey and analysis were conducted with the approval of the Ethics Committee of Tokiwa University.

III Results
The responses with missing data (2,556), the household composition being uncertain (901), and the source of income being uncertain (1,024) were excluded. Consequently, valid responses (8,301) were used for the analysis (valid response rate: 54.6%). The number of males was 1,734 (20.9%); the number of females was 6,567 (79.1%). The young-old (aged 65-74) and old-old (aged 75-84) accounted for more than 40% of both males and females. The mean ages were 75.8 (standard deviation [SD], 7.0) years for males and 76.0 (SD, 7.0) years for females. Student’s t-test (P=0.625) showed the difference was not significant.

Regarding the distribution of the results for the items analyzed (Table 2), those who used national long-term care insurance services accounted for approximately 11% of both males and females. The majority of males lived in married couple households (62.0%), whereas many females lived in single households (44.7%). A gender difference emerged in the degree of obesity (P<0.001). The number of subjects with diabetes, heart disease, or
hearing abnormality was significantly larger in males than in females (P<0.001). A significant gender difference was observed between the number of males with locomotive syndrome (265 [15.3%]) and the number of females with this syndrome (1,761 [26.8%]) (P<0.001). More than 90% of the subjects felt the need for interactions and interacted with neighbors. The percentage of males who felt the need for interaction was significantly lower than the percentage of females (P<0.001). The number of subjects without social engagement was significantly larger in males (P=0.039). The number of subjects having lost social engagement was larger in males, although this difference was not statistically significant (P=0.775). The number of subjects with reduced life satisfaction and self-rated health was larger in males, although there was no statistically significant difference in these items.

Table 3 shows the results of a bivariate analysis of the correlations of locomotive syndrome with social capital, life satisfaction, and self-rated health.
Subjects with locomotive syndrome showed poor evaluations in all items. Significant differences were observed in interactions with neighbors (OR, 1.33; 95% CI, 1.01–1.75), social engagement (OR, 1.65; 95% CI, 1.49–1.83), loss of social engagement (OR, 1.96; 95% CI, 1.73–2.22), life satisfaction (OR, 2.01; 95% CI, 1.70–2.36), and self-rated health (OR, 2.43; 95% CI, 2.18–2.71).

When the covariates were adjusted in the logistic regression analysis (Tables 4 and 5), the OR for locomotive syndrome with respect to the need for interactions was high but not significant (OR, 1.57; 95% CI, 0.82–2.99). No significant correlation between locomotive syndrome and interactions with neighbors (OR, 0.92; 95% CI, 0.68–1.22). However, locomotive syndrome was negatively associated with social engagement (OR, 1.22; 95% CI, 1.09–1.37), loss of social engagement (OR, 1.41; 95% CI, 1.22–1.62), life satisfaction (OR, 1.68; 95% CI, 1.41–2.00), and self-rated health (OR, 2.29; 95% CI, 2.04–2.57). Ancillary analysis was conducted by adjusting the ORs for life satisfaction and self-rated health considering the interactions with neighbors and loss of social engagement (Table 5, Model 2). However, the results were not appreciably different from those of the analysis without the adjustment.

**IV Discussion**

The presence of locomotive syndrome was associated with a reduced need for interactions, but was not significant. Similarly, there was no significant association between interactions with neighbors and locomotive syndrome. However, with locomotive syndrome, the level of social engagement was significantly low, the number of those having lost social engagement was significantly large, and life satisfaction and self-rated health were low. A gender difference was observed in the need for interactions, interactions with neighbors, and social engagement; namely, males tended to have fewer social interactions.

The results supported hypothesis 1) that access to social capital, life satisfaction, and self-rated health are reduced due to locomotive syndrome.
Logistic regression; OR: Odds Ratio; 95% CI

|                                      | Need for interactions | Interactions with neighbors | Social engagement | Loss of social engagement |
|--------------------------------------|-----------------------|-----------------------------|------------------|--------------------------|
|                                      | OR       | 95%CI     | OR       | 95%CI     | OR       | 95%CI     | OR       | 95%CI     |
| Age                                  |          |          |          |          |          |          |          |          |
| 1 year                               | 0.96     | 0.91 – 1.00 | 1.02     | 1.00 – 1.04 | 1.08     | 1.07 – 1.09 | 1.11     | 1.09 – 1.12 |
| Female                               | 0.25     | 0.14 – 0.47 | 0.50     | 0.37 – 0.70 | 0.76     | 0.67 – 0.86 | 0.92     | 0.78 – 1.09 |
| Use of nursing-care insurance services | 3.69     | 1.83 – 7.45 | 4.53     | 3.38 – 6.08 | 3.00     | 2.55 – 3.52 | 2.97     | 2.46 – 3.58 |
| Household                            |          |          |          |          |          |          |          |          |
| Living with children                 | 1.00     | 1.00     |          |          | 1.00     | 1.00     |          |          |
| Single household                     | 1.67     | 0.75 – 3.74 | 1.08     | 0.78 – 1.49 | 0.94     | 0.82 – 1.08 | 0.92     | 0.77 – 1.10 |
| Married–couple household             | 0.51     | 0.21 – 1.28 | 0.45     | 0.30 – 0.67 | 0.61     | 0.53 – 0.71 | 0.76     | 0.63 – 0.91 |
| BMI levels                           |          |          |          |          |          |          |          |          |
| < 20                                 | 1.05     | 0.46 – 2.40 | 1.54     | 1.14 – 2.09 | 1.35     | 1.19 – 1.54 | 1.25     | 1.06 – 1.47 |
| 20–25                                | 1.00     | 1.00     |          |          | 1.00     | 1.00     |          |          |
| > 25                                 | 2.20     | 1.15 – 4.22 | 1.05     | 0.73 – 1.49 | 0.92     | 0.80 – 1.05 | 0.94     | 0.79 – 1.11 |
| Hypertension                         | 0.81     | 0.44 – 1.48 | 0.95     | 0.73 – 1.24 | 1.05     | 0.95 – 1.16 | 1.09     | 0.96 – 1.24 |
| Diabetes                             | 1.32     | 0.59 – 2.93 | 1.71     | 1.21 – 2.42 | 1.21     | 1.03 – 1.43 | 1.02     | 0.82 – 1.27 |
| Heart disease                        | 0.70     | 0.25 – 2.00 | 1.36     | 0.96 – 1.92 | 1.32     | 1.12 – 1.55 | 1.32     | 1.08 – 1.62 |
| Vision abnormality                   | 1.13     | 0.62 – 2.07 | 1.51     | 1.15 – 1.99 | 1.24     | 1.12 – 1.38 | 1.27     | 1.12 – 1.45 |
| Hearing abnormality                  | 1.15     | 0.62 – 2.16 | 1.45     | 1.11 – 1.90 | 1.23     | 1.10 – 1.37 | 1.23     | 1.07 – 1.41 |
| Locomotive syndrome                  | 1.57     | 0.82 – 2.99 | 0.92     | 0.68 – 1.22 | 1.22     | 1.09 – 1.37 | 1.41     | 1.22 – 1.62 |

Logistic regression; OR: Odds Ratio; 95% CI: 95% Confidence Interval

* Ancillary analysis of 1,381 males and 5,475 females

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**Table 4** Multivariate analysis of locomotive syndrome with access to social capital, life satisfaction, and self-rated health (N=8,301)

**Table 5** Multivariate analysis of locomotive syndrome with life satisfaction, and self-rated health (N=8,301)

|                              | Life satisfaction | Self-rated health |
|------------------------------|-------------------|-------------------|
|                              | Model 1           | Model 2           | Model 1           | Model 2           |
|                              | OR      | 95%CI   | OR      | 95%CI   | OR      | 95%CI   | OR      | 95%CI   |
| Age                          |          |         |          |         |          |         |          |         |
| 1 year                       | 1.01    | 0.99 – 1.02 | 1.00    | 0.99 – 1.01 | 1.00    | 0.99 – 1.01 | 0.99    | 0.98 – 1.00 |
| Female                       | 0.64    | 0.52 – 0.77 | 0.74    | 0.61 – 0.91 | 0.95    | 0.85 – 1.07 | 1.02    | 0.91 – 1.15 |
| Use of nursing-care insurance services | 1.82    | 1.47 – 2.25 | 1.45    | 1.17 – 1.8  | 1.89    | 1.60 – 2.23 | 1.59    | 1.34 – 1.89 |
| Household                    |          |         |          |         |          |         |          |         |
| Living with children         | 1.00    | 1.00     |          |          | 1.00    | 1.00     |          |          |
| Single household             | 1.32    | 1.06 – 1.65 | 1.42    | 1.13 – 1.78 | 0.91    | 0.80 – 1.04 | 0.92    | 0.81 – 1.06 |
| Married–couple household     | 0.88    | 0.69 – 1.11 | 0.99    | 0.77 – 1.27 | 0.89    | 0.78 – 1.01 | 0.94    | 0.82 – 1.07 |
| BMI levels                   |          |         |          |         |          |         |          |         |
| < 20                         | 1.09    | 0.89 – 1.34 | 1.01    | 0.82 – 1.24 | 1.18    | 1.04 – 1.33 | 1.12    | 0.99 – 1.27 |
| 20–25                        | 1.00    | 1.00     |          |          | 1.00    | 1.00     |          |          |
| > 25                         | 0.96    | 0.78 – 1.19 | 0.98    | 0.79 – 1.22 | 1.19    | 1.05 – 1.34 | 1.21    | 1.07 – 1.37 |
| Hypertension                 | 1.14    | 0.97 – 1.34 | 1.14    | 0.97 – 1.34 | 1.48    | 1.35 – 1.63 | 1.49    | 1.35 – 1.64 |
| Diabetes                     | 1.39    | 1.10 – 1.77 | 1.34    | 1.06 – 1.71 | 1.92    | 1.64 – 2.26 | 1.89    | 1.61 – 2.23 |
| Heart disease                | 1.47    | 1.16 – 1.85 | 1.42    | 1.12 – 1.79 | 2.39    | 2.01 – 2.86 | 2.35    | 1.97 – 2.82 |
| Vision abnormality           | 1.97    | 1.66 – 2.34 | 1.82    | 1.53 – 2.17 | 1.71    | 1.55 – 1.87 | 1.65    | 1.5 – 1.82  |
| Hearing abnormality          | 1.53    | 1.29 – 1.82 | 1.42    | 1.2 – 1.69  | 1.60    | 1.45 – 1.78 | 1.55    | 1.29 – 2.72 |
| Interaction with neighbors   | –       | 1.95    | 1.63 – 2.34 | –       | 1.75    | 1.57 – 1.95 | –       | 1.33 – 2.01 |
| Social engagement            | –       | 2.06    | 1.74 – 2.43 | –       | 1.33    | 2.01 – 2.54 | –       | 1.26 – 2.54 |
| Locomotive syndrome          | 1.68    | 1.41 – 2.00 | 1.64    | 1.37 – 1.95 | 2.29    | 2.04 – 2.57 | 2.26    | 2.01 – 2.54 |

Logistic regression; OR: Odds Ratio; 95% CI: 95% Confidence Interval

* Ancillary analysis of 1,381 males and 5,475 females
The elderly with this syndrome tend to lose the ability to interact with others and have a low level of social engagement. They may also become passive in social interactions. Because locomotive syndrome tends to persist, isolation from society may last a long time\textsuperscript{19, 20}. As a result, those suffering the syndrome might come to accept a substantial decrease in their interaction with others. Furthermore the mostly forced changes in their activities may lead to changes in their attitudes that guide most of their activities. If this happens, they will fall into an undesirable situation.

When the ORs for the associations of locomotive syndrome with life satisfaction and self-rated health were adjusted by considering the interactions with neighbors and social engagement, no change occurred in the significance of OR for locomotive syndrome. This result did not support hypothesis 2), that life satisfaction and self-rated health are reduced as a result of the reduction of access to social capital. Because locomotive syndrome is linked directly to life satisfaction and self-rated health, it may be adequate to take preventive measures against locomotive syndrome independently of measures to improve access to social capital.

Although interactions with neighbors, such as greeting each other, were not reduced by locomotive syndrome, social engagement, including volunteer and social activities was significantly reduced. When we focused on those who have lost social engagement, a significant difference in the loss of social engagement was found. Because social activities are based on individual’s activeness, they are directly affected by locomotive syndrome. Socially engaged young and old people would be an effective resource in the advent of the superaged society\textsuperscript{21}, but locomotive syndrome is considered to be a barrier to such social engagement. Although this was a cross-sectional study, the finding that the elderly with locomotive syndrome have decreased social engagement, life satisfaction, and self-rated health will be valuable in raising awareness of the risks of locomotive syndrome for those who have not yet developed it. Considering the particularly high prevalence of locomotive syndrome as well as the significant medical financial burden it imposes on patients, taking preventive measures against this syndrome is important. Rehabilitation treatment and assistive devices for severe locomotive syndrome tend to be very costly. Socioeconomic disparities generate differences in health conditions (health disparities)\textsuperscript{13}, a delay in the prevention of locomotive syndrome may further widen these health disparities. Measures should be taken to inform the public of the importance of preventing locomotive syndrome regardless of socioeconomic status.

The finding that locomotive syndrome may affect not only social interactions but also life satisfaction and self-rated health offers a clear warning of the dangers of underestimating the effects of locomotive syndrome. Moreover, as this syndrome is prevalent in the elderly, it is difficult to cure and will likely recur, and become chronic. Considering these characteristics, it is important to consider implementing not only primary preventive measures but also secondary and tertiary preventive measures. Light-load exercises, such as standing on one leg with eyes open and squatting, are suggested as primary preventive measures\textsuperscript{8}, and are referred to as “locomotion training” by the Japanese Orthopaedic Association. For elderly people who experience back pain or arthralgia, the association recommends seeking medical attention instead of light-load exercises\textsuperscript{8}. Moreover, support from the family and local communities is required in order for the elderly to continue their training. To combat locomotive syndrome, the elderly should set an immediate goal of implementing pre-
ventive measures and establish long-term goals such as continuing training and participating in leisure and social activities that lead to a fulfilling life. In the coming superaged society, it will also be necessary to eliminate factors that reduce social engagement among the elderly by promoting barrier-free environments at the community level and creating elder-friendly events, houses, cities, and towns. Efforts are being made to improve the social infrastructure and create a society in which the elderly can live an active life and play active roles as human resources.

**Limitations of this study**

In this cross-sectional study, the causal correlations remained speculative. Moreover, the questionnaire items were not reviewed for scale validity. Weight and height data were obtained through interviews. Such values are unreliable; however, the differences between self-reported and measured weight and height data were expected to become smaller the older the subjects were. The external validity of the results was limited because the subjects were not randomly selected from the general population. Ad-hoc sampling may induce a sampling bias due to oversampling of those who tend to have interactions in the community. This bias may cause an overestimation of the results. As for the household composition of the subjects, the majority of males lived in married-couple households, whereas many females lived in single households; these results seemed to reflect the household composition of the general elderly population as males die earlier than females, leaving many females to live by themselves. Aged people whose cognitive functions are impaired tend to omit answers when responding; the exclusion of responses with missing data as well as subjects whose household composition was uncertain, and those who have a source of income might induce bias. Despite these limitations, this study offer value as unique research on 8,301 elderly subjects in Japan. A significant association in the analyses using prefecture level variables was not indicated in the current study (results were not shown).

In this study, those who answered “yes” to the question about being currently treated for bone and joint diseases were identified as having locomotive syndrome. However, the severity of the syndrome was not clarified in the questionnaire. Because the prevalence of locomotive syndrome in this study was 10% less than that in the study of Sasaki et al., the subjects of our study were not considered to include elderly with severe locomotive syndrome, causing the ORs to be underestimated.

Further research is necessary to apply a diagnostic questionnaire, such as the 25-question Geriatric Locomotive Function Scale, to quantify the assessment of locomotive syndrome.

**Conclusions**

In this study of the elderly in Japan, locomotive syndrome was found to be significantly correlated with reduced social engagement, life satisfaction, and self-rated health.

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The Adverse Relationship of Locomotive Syndrome on Access to Social Capital, Life Satisfaction, and Self-Rated Health among Retired Household Elderlies

Survey on Dietary Environment in Relation to Difficulty in Shopping and Current Health Conditions of Household Elderly

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和文抄録

本研究では、ロコモティブシンドロームとソーシャルキャピタルへのアクセスや生活満足度、主観的健康感との負の関係性について検討した。

この質問紙調査は、46都府県在宅高齢者15,200名を対象に実施した。

有効回答数は8,301名、介護保険給付者は男女とも約11%、ロコモティブシンドローム治療者は男性15.3%、女性26.8%であった。すべての項目でロコモティブシンドロームを有する者の状態は悪かった。社会参加、社会参加（喪失）、生活満足感、主観的健康感を阻害する方向で有意差がみられた。全国高齢者のロコモティブシンドロームは、社会参加を低下させ、生活満足感や主観的健康感の評価と有意に関連していることが示され、直接的に生活満足感に結びついていた。

このことから、ソーシャルキャピタルへのアクセスとは独立して、ロコモティブシンドロームの予防を講じても良いと考えられた。また予防の遅れは、健康格差を拡大させる可能性があることから、社会経済的な差にかかわらず、予防の重要性を広める手段を講じる必要があると考えられた。