



An Outpatient-based Survey about the Recognition of Locomotive Syndrome and the Results of the Loco-check at a University Hospital in Tokyo

**Taketo Okubo¹, Yoshiyuki Suehara^{1*}, Takayuki Kawasaki¹,
Keisuke Akaike¹, Midori Toda¹, Naoko Okubo², Daisuke Kubota¹,
Kenta Mukaiharu¹, Yongji Kim¹, Takafumi Kaketa¹, Yasuhiro Homma¹,
Norio Shimanouchi², Tsuyoshi Saito³, Tatsuya Takagi¹
and Kazuo Kaneko¹**

¹Department of Orthopaedic Surgery, Juntendo University School of Medicine, Japan.

²Department of Health Science, Juntendo University School of Health and Sports Science, Japan.

³Department of Human Pathology, Juntendo University School of Medicine, Japan.

Authors' contributions

This work was carried out in collaboration between all authors. Author TO designed the study, organized the data and managed the figures and Tables. Author YS designed the study, managed the study, wrote the protocol and wrote the first draft of the manuscript. Author TK performed the statistical analysis. Authors KA, MT, NO, DK, KM, YK, TK and YH collected the data. Authors NS, TS, TT and KK supervised the study and the data. All authors read and approved the final manuscript.

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ABSTRACT

Background: To prevent locomotor dysfunction, the Japanese Orthopaedic Association (JOA) proposed the concept of locomotive syndrome (LS) in 2007, and has carried out many campaigns to increase the awareness of LS. Recently, the JOA reported that 26.6% of people recognized LS in internet based surveys. However, a survey of the recognition of LS using outpatient (hospital-based) cohorts has never been performed. Therefore, we surveyed the recognition of LS, the prevalence of LS and any correlations between LS and

*Corresponding author: Email: ysuehara@juntendo.ac.jp;

the clinical data in the outpatient cohort.

Methods: To investigate the recognition of LS and prevalence of LS, we conducted a questionnaire survey including the “loco-check” in 1010 (429 male and 581 female) orthopaedic outpatients at Juntendo University Hospital (Tokyo, Japan) from April to June 2013.

Results: Only 24.6% of the patients knew about the concept of LS. In terms of the media sources from which the patients had received information about LS, 49.5% received LS information from TV. With regard to the prevalence of LS, 43.8% was classified into the LS group. The prevalence of LS was 32.9% in males and 51.8% in females. When the relationship between LS and orthopaedic disease was examined, 50 of 55 (90.9%) knee osteoarthritis (OA) patients, 21 of 26 (80.8%) hip OA patients and 98 of 151 (64.9%) lumbar spondylosis patients had statistically significant correlations with LS ($p < 0.0001$).

Conclusion: This study confirmed the rate of recognition of LS indicated by the JOA survey. Our studies also revealed that LS score was related to orthopaedic disorders. Our outpatient-based surveys may help provide a better understanding of the effects and trends of the campaigns to promote the recognition of LS.

Keywords: Locomotive syndrome; orthopedics; health promotion; loco-check.

1. INTRODUCTION

In 2007, the Japanese Orthopaedic Association (JOA) proposed the term ‘locomotive syndrome’ to designate a condition in high-risk groups with musculoskeletal diseases who are highly likely to require nursing care [1-3]. Locomotive syndrome (LS) is caused by weakening of the musculoskeletal organs, such as the bones, joints and muscles [1-3]. The loss of function in these organs leads to walking or self-transportation disabilities [1-3]. These conditions force people suffering from this syndrome to require outside care and support [1-3]. Therefore, to prevent the decline into disability, patients need to maintain their health, especially their locomotor function [1-3].

The specific characteristics of LS are largely unknown by the general population. In 2012, “Kenkou-nihon 21” planned to make efforts to promote the recognition of LS and also to achieve an 80% recognition in the general population by 2020 [4]. Therefore, the JOA and Japanese Locomo Challenge Promotion Conference (JLCPC) launched campaigns to raise awareness of LS [4]. A survey of the recognition of LS showed that the recognition rate in 2013 was 26.6% by a web-based questionnaire [4].

However, a survey of the recognition of LS in an outpatient (hospital-based) cohort has never been performed. To understand the context and trends in the recognition of LS in Japan, it is necessary to obtain information about the recognition rate using several large cohorts of patients. Therefore, we investigated the recognition rate of LS using an outpatient cohort consisting of approximately 1000 new orthopaedic patients at Juntendo University Hospital, Tokyo, Japan. We also investigated where they had received the information about LS, the prevalence rate of LS and the relationships between LS and the clinical data. Our surveys may contribute to understanding the effects and trends of the promotion campaigns and to better evaluate the concept of LS in the clinical setting.

2. MATERIALS AND METHODS

2.1 Outpatient Cohort and Clinical Information

To research the recognition of LS, the prevalence of LS and the relationship with clinical information, we conducted a questionnaire survey, including the "loco-check," using orthopaedic outpatients at Juntendo University Hospital (Tokyo, Japan). We focused on new patients who came to our department for the first time or who had new diseases, even if they had visited our department in the past. We collected the data for 1010 orthopedic patients (429 males and 581 females; age, 11-96 years; mean age, 54.2 years). Patients with dementia were excluded based on the mini mental state examinations in order to ensure that the answers were reliable. For those that did not complete the entire questionnaire, partial answers were used. Our questionnaire consisted of a "recognition" part and "loco-check" part, if the data for the loco-check part were incomplete, the recognition part was used for our analyses. Orthopaedic diseases were diagnosed by board-certified orthopaedic surgeons, and other clinical information was obtained from medical questionnaires and the medical records. This project was approved by the institutional review board of Juntendo University.

2.2 The Questionnaire Survey of the Recognition of LS

With respect to the recognition of LS, we asked the following questions: (1) Have you ever heard of LS?, (2) From which media sources did you learn about LS?, (3) Have you seen the brochure about LS?, (4) Where did you see the brochure about LS?, (5) Where should the brochure about LS be available?, (6) Could you understand the concept of LS based on the brochure? We also asked them to select one of the following: 1, poorly; 2, somewhat poorly; 3, well or 4, very well, (7) were you motivated to perform daily exercise by the brochure about LS? We also asked them to select one of the following: 1, no; 2, slightly low; 3, yes; 4, highly, (8) Do you have a habit of exercising regularly? (Table 1).

2.3 The "Loco-check" Questionnaire

The diagnosis of LS is performed by using a self-completed questionnaire called the "loco-check," which is included in the LS brochure. The "loco-check" questionnaire consists of seven statements: (as described in a previous report).³ (1) You cannot put on a pair of socks while standing on one leg. (2) You stumble or slip in your house. (3) You need to use a handrail when going up stairs. (4) You cannot get across the road at a crossing before the traffic light changes. (5) You have difficulty walking continuously for 15 min. (6) You find it difficult to walk home carrying a shopping bag weighing about 2 kg. (7) You find it difficult to do housework requiring physical strength. In this survey, participants who checked yes to one or more statements were defined as having LS (Table 1).

We noted that there have recently been several diagnostic tools reported, including the "loco-check", "GLFS-25" and physical tests. The JOA and some previously published papers described the usefulness of the "loco-check" for the early detection of locomotive dysfunction. However, the people detected to have locomotor dysfunction may not necessarily have locomotive syndrome. Therefore, the "GLFS-25", which was recommended by the JOA and some articles, may be a better diagnostic tool for locomotive syndrome. In this study, we used the "loco-check" in order to lighten the patient's workload.

Table 1. Question and loco-check list

The recognition survey

- 1) Have you known the concept of LS or the LS?
 - 2) Which media sources did you know LS by?
 - 3) Have you seen the brochure of LS?
 - 4) Where did you see the brochure of LS?
 - 5) Where do you want to take the brochure of LS at?
 - 6) Could you understand the concept of LS by the brochure of LS?
Please select one of the following: 1; poorly, 2; somewhat poorly, 3; well, 4; very well.
 - 7) Are you motivated to have daily exercise by the brochure of LS?
Please select one of the following: 1; no, 2; slightly, 3; yes, 4; highly.
 - 8) Do you have the habit of exercise continuously?
-

**Multiple answers possible (4) (5)*

Loco-check list

- 1) You cannot put on a pair of socks while standing on one leg.
 - 2) You stumble or slip in your house.
 - 3) You need to use a handrail when going up stairs.
 - 4) You cannot get across the road at a crossing before the traffic light changes.
 - 5) You have difficulty walking continuously for 15 min.
 - 6) You find it difficult to walk home carrying a shopping bag weighing about 2 kg.
 - 7) You find it difficult to do housework requiring physical strength.
-

**Participants who check one or more statements are defined as having have LS.*

2.4 Radiographic Diagnoses

With respect to the diagnoses of orthopedic diseases, we carried out imaging studies based on their chief complains and diagnosed these diseases. All radiographs were graded by two board-certified orthopaedic surgeons. If there was a disagreement in their findings, they came to a conclusion after consulting with each other. We especially focused on knee OA, hip OA, cervical spondylosis and lumbar spondylosis, because knee and hip OA are associated with degenerative changes of the load-bearing joints, while cervical spondylosis and lumbar spondylosis are associated with degenerative changes of the spine. The severity of each joint and intervertebral level was scored based on the Kellgren-Lawrence grade (K-L grade). [5] The presence of radiographic OA was defined as a K-L grade of 2, 3 or 4. Patients defined to have a K-L grade of 1 were classified into the non-OA group. In addition, the presence of radiographic spondylosis was defined based on whether K-L grade 1 or K-L grade 2, 3 and 4 was diagnosed in at least one intervertebral level.

2.5 Statistical Analysis

The statistical analyses of our study were performed with the SPSS software package for Windows, version 19.0 (SPSS, Chicago, IL, USA). All the tests were 2-sided and a p value <0.05 was considered to be significant in all analyses. The primary analysis was focused on the relationship between the incidence of LS and each of the variables, including age, sex, orthopedic disease and non-orthopedic disease. The secondary analysis was performed on the same subjects to assess the relationship between the presence of LS and the exercise habits. Data were assessed by the χ^2 test calculating odds ratio (OR) with 95% confidential

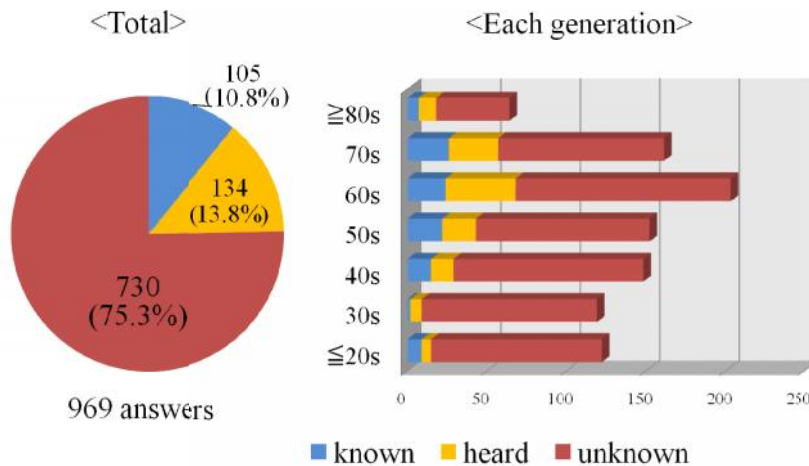
interval (CI). These results were adjusted by the variables that were sex and age using the Mantel-Haenszel procedure.

3. RESULTS

A total of 239 of 969 (24.6%) patients knew about the concept of LS (969 of 1010 people answered this question). The recognition of LS was 16.4% in males and 30.7% in females. In the age-specific analyses of the recognition of LS, the older people had a tendency to have a higher recognition in comparison to younger people (Fig. 1A). With respect to the age-related distributions in males and females, the older people also had a tendency to have a higher recognition in comparison to younger people in both genders (Fig. 1B)

With respect to the media sources from which they received information about LS (239 patients provided 321 answers to this question), 159 (49.5%) of the 321 answers indicated that the patient had learned about the concept of LS from TV (Fig. 2). And 60 (18.7%) of 321 answers had received LS information from newspapers and 36 (11.2%) of 321 from magazines (Fig. 2). In our cohort, TV was the most common source of LS information in patients of all ages. Regarding the brochure about LS (964 of 1010 patients answered this question), 47 (4.9%) of 964 patients had seen the brochure, and 59.6% of the patients who had seen the brochure had seen it in the hospital (Fig. 3). In terms of where the subjects thought the brochure about LS should be available, our survey revealed that 41.9% of people thought it should be provided at the hospital, 22.1% in shops and 16.3% in the city hall (Fig. 4). With respect to their level of understanding the concept of LS based on the brochure (946 of 1010 patients answered this question), 855 (90.3%) of 946 patients could understand the concept of LS based on the brochure (Fig. 5). We also researched whether the brochure encouraged people to engage in exercise (954 of 1010 people answered this question), and found that 874 (91.6%) of 954 people were motivated by the brochure (Fig. 6). Additionally, we investigated the incidence of a regular exercise habit, and 538 (53.3%) of 1010 people reported that they had a habit of performing regular exercises before the survey (Fig. 7).

(A)



(B)

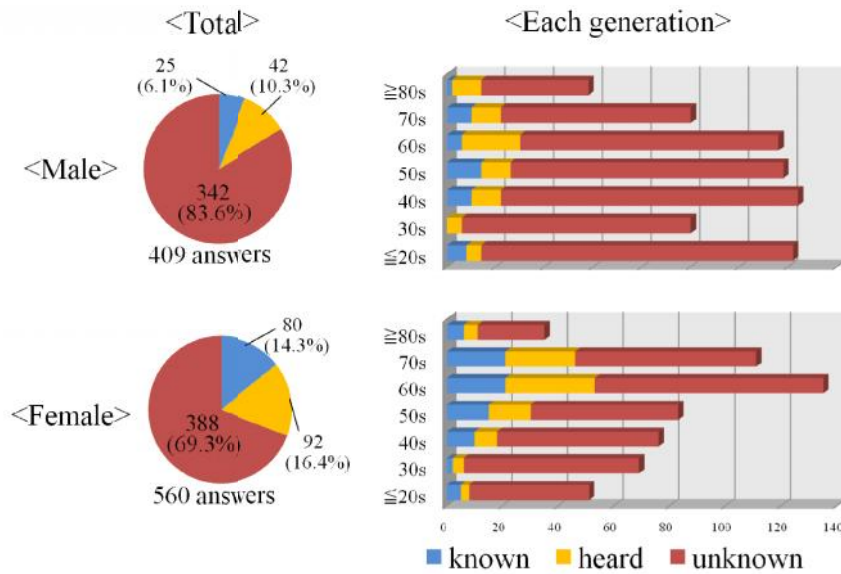


Fig. 1. A) The recognition of LS. 969 of 1010 patients answered this question. A total of 24.6% of the subjects recognized the concept of LS. B) The age-related distributions in males and females regarding the recognition of LS

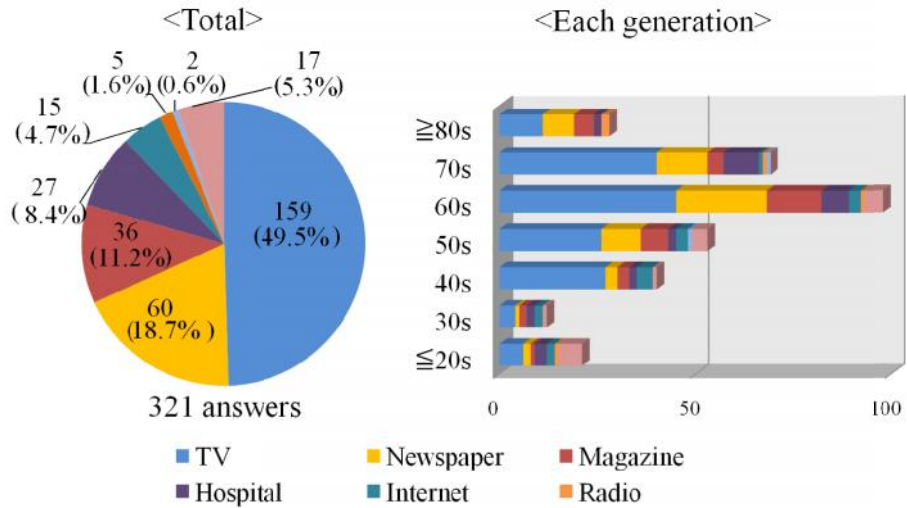


Fig. 2. The media sources of LS information (multiple answers possible). 239 patients provided 321 answers in this question

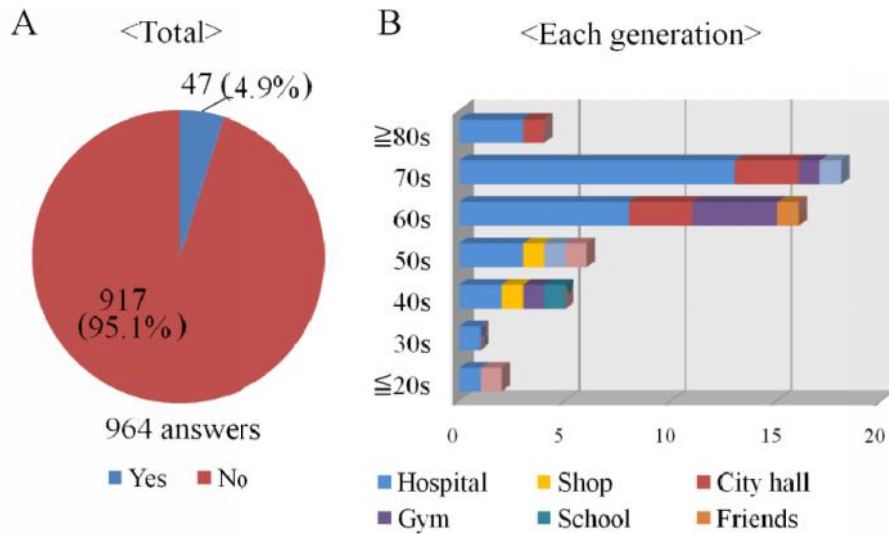


Fig. 3. The brochure about LS. (A) We surveyed the recognition rate of the brochure about LS, and (B) where the subjects had seen the brochure (multiple answers possible). (A) 964 of 1010 people answered this question. (B) In 47 patients, these results showed that most subjects saw the brochure at the hospital

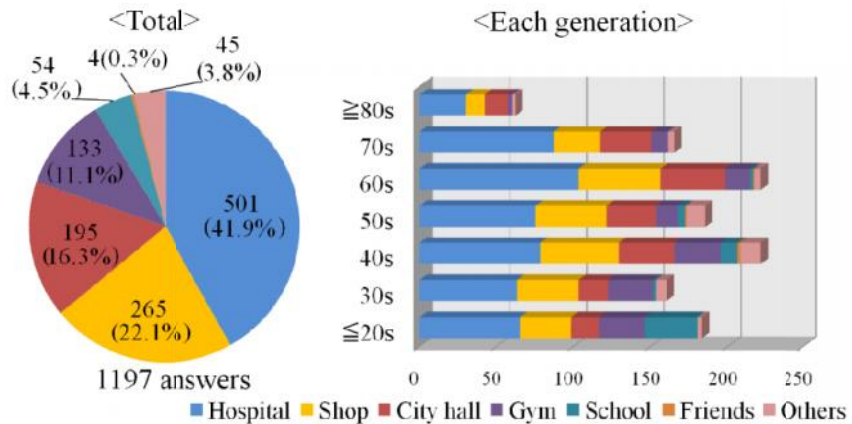


Fig. 4. The place where subjects recommended that the brochure should be available (multiple answers possible). 771 patients provided 1197 answers in this question

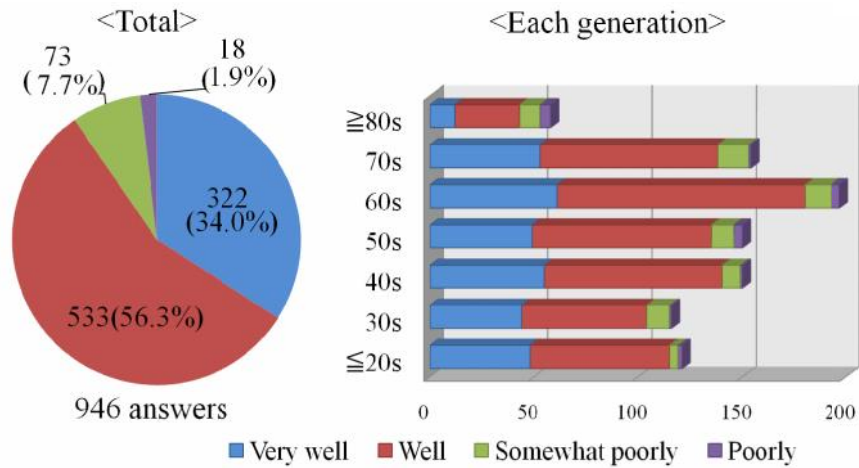


Fig. 5. The level of understanding of LS based on the brochure.946 of 1010 patients answered this question

A total of 442 (43.8%) of the 1010 patients were considered to have LS based on the “loco-check”. The prevalence rate of LS was 51.8% in females, which was significantly higher than that in males (32.9%) ($p < 0.001$, Table 2). In the age-specific analyses, the prevalence rate of LS tended to increase with age in both males and females (Table 2, $p < 0.001$). The mean age of the LS and non-LS patients were 62.3 and 47.9 (predominant age: 70’s and 20’s).

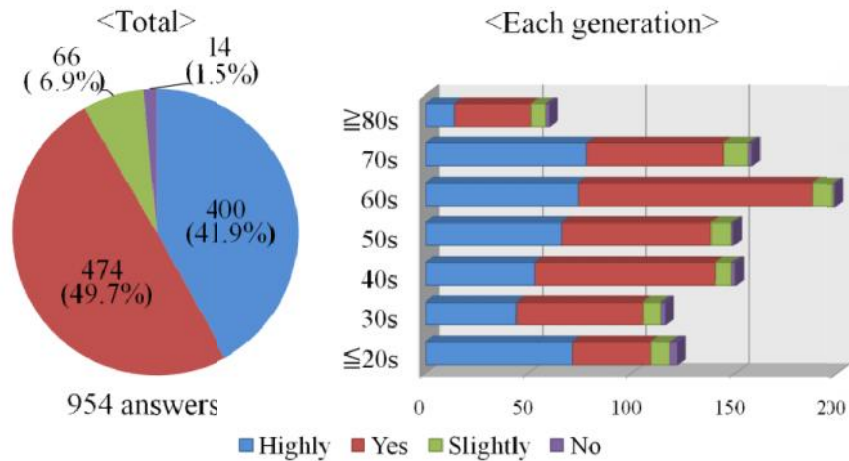


Fig. 6. The motivation of people to perform daily exercise based on the brochure.954 of 1010 patients answered this question

In terms of the association between orthopaedic disease and LS, 50 of 55 (90.9%) knee OA patients were considered to have LS, and 21 of 26 (80.8%) hip OA, 98 of 151 (64.9%) lumbar spondylosis, 13 of 27 (48.1%) cervical spondylosis and 20 of 31 (64.5%) osteoporosis patients had LS. In our cohorts, knee OA, hip OA, and lumbar spondylosis had statistically significant association with LS (Table 2, $p < 0.001$).

Table 2. The patient characteristics and a comparison of the prevalence of LS

Variables	Subcategory	LS (%LS)	Non-LS	%LS (rank)	Odds ratio (95%CI)	p	Adjusted OR	p
Sex	Female (n=581)	301	280	51.8%	2.2 (1.7, 2.8)	<.001	2.1 (1.6, 2.7)	<.001
	Male (n=429)	141	288	32.9%	1.0 (Reference)	-	1.0 (Reference)	-
Age	≥80s (n=65)	52	13	80.0%	29.3 (13.0, 66.1)	<.001	27.2 (12.0, 61.5)	<.001
	70s (n=177)	119	58	67.2%	15.0 (8.1, 28.1)	<.001	13.3 (7.1, 25.0)	<.001
	60s (n=211)	103	108	48.8%	7.0 (3.8, 12.8)	<.001	6.1 (3.3, 11.3)	<.001
	50s (n=156)	71	85	45.5%	6.1 (3.3, 11.4)	<.001	5.7 (3.1, 10.9)	<.001
	40s (n=154)	52	102	33.8%	3.7 (2.0, 7.1)	<.001	3.5 (1.8, 6.7)	<.001
	30s (n=122)	30	92	24.6%	2.4 (1.2, 4.7)	<.001	2.1 (1.1, 4.2)	0.045
	≤20s (n=125)	15	110	12.0%	1.0 (Reference)	-	1.0 (Reference)	-
Ortho-disease	Knee OA (n=55)	50	5	90.9% (1)	20.0 (7.9, 50.8)	<.001	13.7 (5.0, 37.0)	<.001
	Hip OA (n=26)	21	5	80.8% (2)	8.4 (3.1, 22.6)	<.001	7.0 (2.5, 19.6)	<.001
	Lumbar spondylosis (n=151)	98	53	64.9% (3)	3.7 (2.6, 5.3)	<.001	2.5 (1.7, 3.7)	<.001
	Cervical spondylosis (n=27)	13	14	48.1%	1.9 (.9, 4.0)	0.110	1.2 (0.6, 2.8)	0.754
	Osteoporosis (n=31)	20	11	64.5%	3.6 (1.7, 7.7)	<.001	2.0 (0.9, 4.3)	0.131
	Others (n=720)	240	480	33.3%	1.0 (Reference)	-	1.0 (Reference)	-
Other (non-orthopedic) diseases**	Parkinson's disease (n=13)	13	0	100% (1)	NA†	-	NA†	-
	Heart disease (n=28)	20	8	71.4% (2)	3.8 (1.7, 8.8)	0.001	2.1 (0.8, 5.5)	0.186
	Respiratory disease (n=23)	15	8	65.2% (3)	2.9 (1.2, 6.8)	0.013	2.7 (1.0, 7.6)	0.111
	Malignant tumor (n=65)	42	23	64.6%	2.8 (1.6, 4.7)	<.001	1.7 (0.9, 3.1)	0.113
	Diabetes (n=60)	38	22	63.3%	2.6 (1.5, 4.5)	<.001	2.0 (1.1, 3.8)	0.043
	Hypertension (n=67)	38	29	56.7%	2.0 (1.2, 3.3)	0.006	1.3 (0.7, 2.4)	0.415
	Gastrointestinal disease (n=22)	11	11	50.0%	1.5 (.7, 3.6)	0.324	1.2 (0.4, 3.5)	0.893
	Others (n=815)	322	493	39.5%	1.0 (Reference)	-	1.0 (Reference)	-

Statistical analyses using the χ^2 test.

** Multiple answers possible, the total number of patients.

Superscript values in parentheses are the 3 most common disease in each category

† NA: not applicable (one of the values is zero).

Adjusted OR: These results were adjusted by the variables that were sex and age using the Mantel-Haenszel procedure

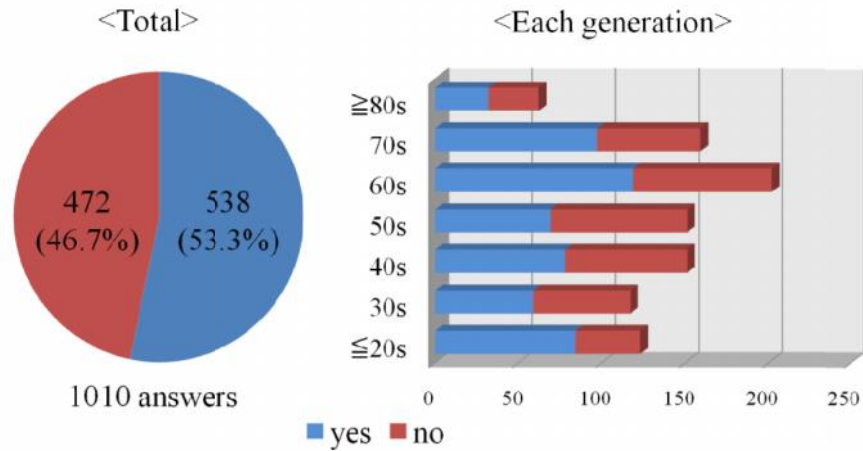


Fig. 7. The exercise habits of the study participants. All patients answered this question

In addition, we investigated the association between the LS score and non-orthopaedic disease to check the availability and limitations of the “loco-check” (the 1010 patients provided 1093 answers in this question). These results showed that a history of diabetes was association with a classification of LS (Table 2, $p < 0.05$).

Furthermore, we also researched the relationship between exercise habits and LS. These results revealed that 538 of 1010 (53.3%) patients regularly exercised and 199 of 538 (37.0%) people who regularly exercised were classified as having LS (Table 3). There were significant relationships between LS and exercise habits (Table 3, $p < 0.001$). In the elder cohort (over 65 years), There was also a significant relationship between LS and exercise habits (Table 3, $p < 0.001$).

Table 3. Comparison of the prevalence of LS and exercise habits

Total							
Variables	Subcategory	LS (%LS)	Non-LS	Odds ratio (95%CI)	p	Adjusted OR	p
Exercise	Exercise habit (-)	243 (51.5%)	229	1.4 (1.2, 1.6)	<.001	2.0 (1.5, 2.6)	<.001
	Exercise habit (+)	199 (37.0%)	339	1.0 (Reference)	-	1.0 (Reference)	-
≥ 65 years old							
Variables	Subcategory	LS (%LS)	Non-LS	Odds ratio (95%CI)	p	Adjusted OR	p
Exercise	Exercise habit (-)	118 (74.3%)	41	1.2 (1.1, 1.4)	0.006	1.8 (1.4, 2.3)	<.001
	Exercise habit (+)	113 (60.1%)	75	1.0 (Reference)	-	1.0 (Reference)	-

Statistical analyses using the χ^2 test.

Adjusted OR: These results were adjusted by the variables that were sex and age using the Mantel-Haenszel procedure

4. DISCUSSION

The JOA proposed a new concept, “locomotive syndrome”, to designate middle-aged and elderly people at high risk of needing care service because of problems of the locomotive organs since 2007. [1-3] LS has been featured many times as part of a health program or a current issue on TV by the NHK and other commercial broadcasting stations, and several medical journals have published a special issue on the concept. It also appears frequently in local government public relations news. [1-4]

Additionally, since 2012, the “Kenkou-nihon 21” plan was developed to promote the recognition of LS and the plan is that reach there will be 80% recognition in 2020. [4] A survey of the recognition of LS (performed by the JOA) revealed that the recognition rate in March 2013 had reached 26.6% by a web-based questionnaire. [4] In comparison to the survey performed in 2012 (the recognition rate was 17.3% in 2012), the rate has been dramatically increasing, suggesting that the goal of 80% may be reached. [4]

However, there had been no previous survey of the recognition of LS in an outpatient cohort. We therefore conducted this survey of the recognition of LS using an 1000 outpatient cohort, because such results are critical information to understand the trends in the recognition of LS, and is also useful to promote the campaigns. We also investigated where the subjects had received the information about LS. This information is also useful, because it can help show where the JOS and JLSPC should choose as a point of focus for their campaigns.

In our study, to investigate the recognition of LS, we conducted a questionnaire survey including the “loco-check” in approximately 1000 new orthopaedic outpatients at Juntendo University Hospital (Tokyo, Japan), from April to June in 2013. This study found that 24.6% of the subjects knew about LS. This was similar to the results of the JOA internet-based survey (26.6%), so our cohort confirmed the accuracy of their internet-based cohorts. Our results also demonstrated that older age and female gender were associated with higher recognition rates than those in subjects of a younger age and male subjects. These results also confirmed the JOA cohort studies.

Before our survey, we supposed that orthopaedic outpatients would have higher recognition of LS than people who did not have orthopaedic symptoms, however, there were no significant differences between the two cohorts (with/without symptoms) in the present study. Additionally, we also supposed that people living in the Tokyo area would have a higher rate of recognition than people who were living outside of the Tokyo area, since people living in the capital sphere usually have a tendency to receive more information than people living in the other, more rural, areas of Japan. However, we did not find any significant differences between the two cohorts. As noted above, the older subjects had higher recognition of LS than younger subjects. We believe that this might be because the older people might have already suffered from orthopaedic disease or locomotive disabilities, and they might have had more opportunities to receive information about LS. We are planning to survey the recognition of LS in 2014 to check whether there is an increasing trend in the recognition.

Recently, the JOA and JLCPC have been trying to use mass media to promote the enlightenment of the population about LS. [3,4] Therefore, we wondered where people had obtained their information about LS. To investigate which media sources most frequently provided the LS information to people, we asked the patients which media source provided the information about LS that they had obtained. Our survey showed that TV was the most common media where people had obtained the LS information. We also performed the age-

specific analyses of the media source question, and the results indicated that both the older and younger subjects had most frequently received the information about LS from TV. These data suggest that we should focus on using TV to promote the enlightenment about LS more efficiently.

With respect to the LS brochure, we surveyed where the subjects thought the brochure should be available. The surveys revealed that the hospital is the preferred place to obtain the LS brochure and was also the place where subjects recommended that the brochure should be available. Even though the JOA has already engaged in handing out the LS brochure in the hospital [3,4], the JOA promotion should be expanded to further increase the recognition of LS.

To determine the prevalence of LS, as evaluated by the "loco-check" in an outpatient cohort in Tokyo, and to analyze the relationship between orthopaedic disease, including knee OA, hip OA, lumbar spondylosis, cervical OA, osteoporosis and LS, we included the "loco-check" in the questionnaire survey and obtained clinical data for all patients, including those about orthopaedic diseases. The results demonstrated there is a significant relationship between orthopaedic disease, including knee OA, hip OA and lumbar spondylosis, and LS. Sasaki et al. reported that they investigated the relationship between OA and LS using the "loco-check". Their results showed that the positive rates for all LS items, except for "You cannot put on a pair of socks while standing on one leg," "You cannot get across the road at a crossing before the traffic light changes" and "You have difficulty walking continuously for 15 min" were significantly higher in the OA group than in the non-OA group [8]. Other previous studies also reported a relationship between orthopaedic disease, especially knee OA and spondylosis, and LS. [6-8] Therefore, our results confirmed the previous reports of correlations between orthopaedic disease and LS, and also validated the utility of the "loco-check".

Additionally, our results regarding exercise habits revealed that the patients who exercised tended to be less likely to have non-LS diseases. Our study and previous reports seem to indicate that both avoiding LS and having good exercise habits may prevent locomotive disabilities, including orthopedic diseases, and this might support the concept of LS [2].

The JOA developed a self-assessment checklist for LS called the "loco-check" in 2007. [1-3,7,8] According to the JOA criteria, an individual answering in the affirmative to any of the seven statements in the checklist may have LS. The "loco-check" has been reported to be an acceptable instrument to detect the early stage of locomotive disability for LS in middle-aged and elderly people. [1-3,7,8] Recently, however, the JOA reported that the "loco-check" might not detect LS in younger subjects. [4] Therefore, a precise, quantitative and evidence-based screening tool, called the 25-question Geriatric Locomotive Function Scale (GLFS-25) has been developed to measure the presence and degree of LS affecting an individual, and its validity and reliability have been confirmed. [4,6,9-11] It is a questionnaire composed of 25 questions regarding a person's difficulty in performing the physical motions required for daily living, each of which is scored from 0 to 4 points, with the total score ranging from 0 to 100 points. [4,6,9-11] A person with a GLFS-25 score of 16 points or higher is diagnosed to have LS. [4,6,9-11] Recently, to detect LS for all age groups, the JOA recommended the "locom degree test" that consisted of three tests, including the "standing-test", "two-step-test" and GLFS- 25 [4]. The JOA is currently working on campaigns to enlighten people about the concept of LS, including the "locom degree test." These campaigns are expected to contribute to preventing locomotive disabilities and orthopaedic disease.

There were several possible limitations associated with our study. In our cohort, we employed the "loco-check" to detect the LS. The usefulness of the "loco-check" for the early detection of locomotive dysfunction has been well demonstrated, however, the people detected to have locomotor dysfunction may not necessarily have locomotive syndrome. The JOA and related associations demonstrated that the "GLFS-25" is a better diagnostic tool for LS. In this study, we used the "loco-check" in order to lighten the patient's workload. In addition, in the present study, orthopedic diseases were diagnosis based on the physical examinations and imaging studies performed based on the chief complains. Therefore, one patient was classified to have one orthopedic disease, even if they had the other orthopedic diseases (multiple orthopedic diseases). We did not exclude people who had other non-orthopedic diseases. Additionally, we did not compare our data with those of healthy people. Nevertheless, we believe that our data provide critical information that can help to develop the concept of LS and we plan to modify our future studies of LS to address these limitations.

5. CONCLUSION

We investigated the recognition of LS, prevalence of LS and the relationships between LS scores and clinical data using an outpatient cohort from the Tokyo area. This study confirmed the recognition of LS by the JOA internet-based survey, and demonstrated that the recognition rate of LS was still relatively low. Our studies also revealed that the LS score (from the "loco-check") was related to the presence of orthopaedic disorders. This study indicated that the promotion of the awareness of LS is critical to help prevent locomotor dysfunction. Our outpatient-based survey may help understand the effects and trends of promoting LS.

CONSENT

This is not case report, but I can add "All authors declare that written informed consent was obtained from patients for publication of this study and this project was approved by the institutional review board of Juntendo University.

ETHICAL APPROVAL

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Nakamura K. A "super-aged" society and the "locomotive syndrome". *J Orthop Sci.* 2008;13:1-2.
2. Nakamura K. Locomotive syndrome: Disability-free life expectancy and locomotive organ health in a "super-aged" society. *J Orthop Sci.* 2009;14:1-2.
3. Nakamura K. The concept and treatment of locomotive syndrome: Its acceptance and spread in Japan. *J Orthop Sci.* 2011;16:489-91.
4. Iwamoto Y. Japanese Orthopaedic Association News. 2013;94:1-2.

5. Kellgren JH, Lawrence JS. Radiological assessment of osteo-arthritis. *Ann Rheum Dis.* 1957;16:494-502.
6. Hirano K, Imagama S, Hasegawa Y, Ito Z, Muramoto A, Ishiguro N. The influence of locomotive syndrome on health-related quality of life in a community-living population. *Mod Rheumatol Electric-pub*; 2012.
7. Hirano K, Imagama S, Hasegawa Y, Wakao N, Muramoto A, Ishiguro N. Impact of back muscle strength and aging on locomotive syndrome in community living Japanese women. *Nagoya J Med Sci.* 2012;75:47-55.
8. Sasaki E, Ishibashi Y, Tsuda E, Ono A, Yamamoto Y, Inoue R, et al. Evaluation of locomotive disability using loco-check: A cross-sectional study in the Japanese general population. *J Orthop Sci.* 2013;18:121-9.
9. Muramoto A, Imagama S, Ito Z, Hirano K, Ishiguro N, Hasegawa Y. Physical performance tests are useful for evaluating and monitoring the severity of locomotive syndrome. *J Orthop Sci.* 2012;17:782-8.
10. Muramoto A, Imagama S, Ito Z, Hirano K, Tauchi R, Ishiguro N, et al. Threshold values of physical performance tests for locomotive syndrome. *J Orthop Sci Electric-pub*; 2013.
11. Seichi A, Hoshino Y, Doi T, Akai M, Tobimatsu Y, Iwaya T. Development of a screening tool for risk of locomotive syndrome in the elderly: The 25-question Geriatric Locomotive Function Scale. *J Orthop Sci.* 2012;17:163-72.

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