The number of load-bearing joint pains is related to locomotive syndrome. the Miyagawa study

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Abstract

Background: Locomotive syndrome (LS) is defined as a condition in which a person's movement ability is impaired due to locomotive disorders. It is presumed that pains in the load-bearing joint are involved in the decline in mobility. The purpose of this study was to evaluate the association between LS and the number of load-bearing joint pains in Japanese cohort.

Methods: We surveyed 507 participants in the 8th-11th evaluations of the Miyagawa study. LS was defined as ≥ 16 points on the GLFS-25 questionnaire. The site of the painful joint was interviewed. The ratio of complications of multiple load-bearing joint pain was investigated. Logistic regression analysis was used to assess the association between LS and load-bearing joint pains.

Results: The LS group (21.9%) had a 5.36 odds ratio [OR] for 2 pain sites and 8.96 OR for more than 3 pain sites, which was statistically significant compared to the no-LS group. 87.0% of participants with hip pain also had other load-bearing joint pain.

Conclusions: People with hip pain tend to have other load-bearing joint pain. Since pain in 2 or more load-bearing joints is significantly associated with LS, early treatment of load-bearing joint pain and to suppress the number of load-bearing joint pain might be useful in preventing LS.

Background

Japan is facing a rapidly advancing super-aging society. In 2020, the aging rate reached 28.7%, and by 2065, it is expected to reach 38.4% [1]. The difference between average life expectancy and healthy life expectancy, which quantifies the period of limitation in activities of daily life, was reported as 8.84 years for men and 12.35 years for women in the 2016 survey [1]. The challenge for Japan is how much we can shorten this period of time, and how much we can extend the healthy life span. According to the 2016 survey [1], locomotive organ disorder accounted for the majority of cases requiring long-term care, at 36.5% (12.5% for falls and fractures, 10.2% for articular diseases, and 13.8% for asthenia due to old age). The survey suggested that measures to deal with musculoskeletal diseases might be a preventive approach against the need for long-term care. In order to take preventive measures against locomotive organ disorders, the Japanese Orthopaedic Association proposed the concept of locomotive syndrome (LS) in 2007 [2]. This is a condition that makes subjects highly likely to require long-term care due to progressively decreased movement ability. Most locomotive dysfunction might be due to pain in the load-bearing joints of the spine, knee, hip, and foot and ankle. In addition, people often have multiple pain sites. Several studies have focused on the association between LS and single site pain[3–5], but few have considered the association between LS and multiple loading joint pain. The purpose of this study was to evaluate the association between LS and load-bearing joint pain, and LS and the number of pain sites in participants in the Miyagawa study.

Methods

Every 2 years since 1997, we have conducted a musculoskeletal cohort study of residents more than 50 years of age in Miyagawa village. This cohort study was initiated to investigate the natural history of osteoporosis and osteoarthritis of the knee, and we have investigated LS since the 8th examination in 2011. A total of 12 medical examinations were conducted from 1997 to 2019. In this study, data were obtained from those who participated in one or more of the examinations conducted in 2011, 2013, 2015 and 2017. Data of the first evaluation of each participant was used in this study. For example, if the participant participated in both 2011 and 2015 examinations, the data of 2011 was used in this study. This area is a mountainous area, and the main industry is forestry. In 1997, the total population was 4,196, including 1,463 inhabitants who were 65 years or older. In 2019, the total population decreased to 2,856, with 1,420 inhabitants aged 65 and over. The proportion of people aged 65 and over to the total population thus reached 49.7%. The inclusion criterion was the ability to walk to the hospital where the survey was performed. We evaluated self-reported data, and the participants understood and signed an informed consent form for study participation. The Ethics Committee for Human Research at our institution approved this study, and written informed consent was obtained from all participants before enrollment.

Data were obtained from standard questionnaires. These data included information on age, gender, and pain in the load-bearing joints of the spine, hip, knee, foot and ankle. Joint pains were defined as those lasting for over one day during the past month. LS was diagnosed using a screening tool, the 25-question Geriatric Locomotive Function Scale (GLFS-25) [6]. The GLFS-25 is a self-administered measure that comprises 4 items for pain, 16 items of daily living activities, 3 items related to social functioning, and 2 items on mental health status. Each item is graded on a 5-point scale from no impairment (0 points) to severe impairment (4 points). The total score ranges from 0 (best) to 100 (worst) points. We defined a GLFS-25 score of ≥ 16 as LS according to Seichi's report [6]. Each subject's height and body weight were measured, and body mass index was calculated as weight (kg) divided by height squared (m^2).

All statistical analysis were performed with EZR (Saitama Medical Center, Jichi Medical University, Saitama, Japan)[7], which is a graphical user interface for R (The R Foundation for Statistical Computing, Vienna, Austria). We compared differences in the values of age, height, body weight and BMI between the LS group and no-LS group using an unpaired Student's t-test. Differences in gender and the prevalence of low back pain, hip pain, knee pain, and foot and ankle pain were analyzed using Fisher's exact test. Logistic regression was conducted to investigate the relationship between LS and load-bearing joint pains and LS and the number of pain sites, after adjusting for age, gender and BMI. The level of significance was set as $p < 0.05$.

Results

A total of 507 participants (178 male, 329 female) were evaluated in the present study. Overall mean age was 71.0 ± 9.2 years, ranging from 50 to 94 years. The prevalence rate of low back pain was 41.0%, knee pain was 36.5%, hip pain was 9.1%, and that of foot and ankle pain was 8.3%. The prevalence rate of knee pain in the general population was higher in females than in males ($p < 0.05$). Low back pain was the most common complaint at all ages, followed by knee pain, with the proportion increasing with age. A total of 320 participants (63.1%) had one or more pain sites. There were 187 participants (36.9%) with one pain site, 109 participants (21.5%) with two pain sites, and 20 participants (3.9%) with three pain sites, 4 participants (0.8%) with four pain sites. The proportion of participants with no load-bearing joint pain tended to decrease with age (Fig. 1). In the case of a single pain site, 47.6% of the participants had low back pain and 40.1% had knee pain, 9.1% had foot and ankle pain, and 3.2% had hip pain. For two pain sites, the combination of low back and knee pain accounted for 73.4% of the cases. In cases with three pain sites, 45.0% of participants had hip pain in addition to low back and knee pain. Among participants with low back, knee, and foot and ankle pain, about 40% had pain at a single site, but among participants with hip pain, only 13.0% had pain at the hip joint alone, and a high percentage of participants with hip pain had pain in one or more of the other load-bearing joints (Fig. 2). A total of 111 participants (21.9%) were identified as having LS (26 males, 85 females). A greater percentage of females (34.8%) had LS than males (17.1%) ($p < 0.01$). 19.0% of males and 7.1% of females in their 50's, 5.0% of males and 10.3% of females in their 60's, 13.6% of males and 31.0% of females in their 70's, 27.6% of males and 54.5% of females in their 80's or older were diagnosed with LS. Participants with LS tended to be older, of lower height and weight, and with a history of low back, hip and knee pain (Table 1). The OR in the LS group were 5.36 for 2 pain sites, 8.96 for more than 3 pain sites, 2.99 for hip pain, 2.59 for knee pain, and 2.42 for low back pain, which were statistically significant compared to the no-LS group (Table 2,3).

Discussion

The present study examined the link between LS and load-bearing joint pains in middle-aged or elderly Japanese cohort. Knee, hip, and low back pain were significantly associated with LS. Participants with hip pain were also more likely to have other load-bearing joint pain complications. This study also found that the LS odds ratio was 5.36 for 2 pain sites and 8.96 for more than 3 pain sites. To our knowledge, this is the first study to examine the association between LS and the number of pain sites.

Yoshimura et al. reported that 5.0% of males and 6.8% of females in their 50s, 11.4% of males and 16.6% of females in their 60s, 28.2% of males and 39.0% of females in their 70s, 62.1% of males and 76.0% of females in their 80s or older scored 16 or more points on the GLFS-25 in the general population health examination[8]. In our study, LS prevalence was relatively high in their 50s and relatively low in their 60s or older. Since villagers in their 50s generally undergo health checkups at their workplaces, it is possible that this checkup tended to be taken by those in their 50s who were not confident about their health. Also, Japanese workers usually retire or the ages of 63 or 65. Most of the residents of Miyagawa village are engaged in mountain forestry, and many of them are relatively active elderly people, so the prevalence of LS is thought to have been low.

Suka et al. reported that 41.2% of the adult population in Japan has musculoskeletal pain [9]. Of the 87.9 million Japanese aged 30 or older in 2005, the study estimated that the prevalence of back, hip and knee pain was 21.4 million (24.3%), 3.2 million (3.7%), and 9.1 million (10.4%), respectively, and that the prevalence of each would rise to 26.5%, 4.4%, and 12.9%, respectively, by 2055. In our study, the prevalence of low back, hip and knee pain (41.0%, 9.1% and 36.5%, respectively) were relatively higher than those in the previous report. This could be because our study consisted of community members aged 50 years and older. Nakatoh et al. reported that 56.6% of their study subjects complained of chronic pain somewhere in their body, and 39.2% complained of two or more pain sites in an evaluation of residents aged 50 years or older [10]. In our study, the number of subjects with load-bearing joint pain increased with age, accounting for 63.1% of participants with one or more pain sites and 26.2% of participants with two or more pain sites. Since we defined pain according to the LOCOMO study [11], it was difficult to directly compare the pain rate with that in the previously mentioned study [10]. Yoshimura et al. reported that the prevalence of low back pain and knee pain was 37.7% and 32.7%, respectively, and the prevalence of complicated low back pain and knee pain was 12.2% in those with this condition from a database of the integrated cohort of the LOCOMO study [11]. In the present study, among participants with multiple load-bearing joint pain, those with concurrent low back pain and knee pain were the most common. The percentage of participants with only low back and knee pain was 15.8%. This proportion was almost the same as that in the study by Yoshimura et al [11].

Leveille et al. reported that a greater number of painful sites increased the risk of falling [12]. In addition, Eggermont et al. reported that the number of painful areas was significantly more associated with lower limb function as measured by gait speed, balance, and chair stands than pain severity [13]. In this study, the LS odds ratio was 5.36 for 2 pain sites and 8.96 for more than 3 pain sites. Pain in many areas causes the muscles to move in a way that suppresses pain, leading to decreased lower limb function and reduced mobility, i.e., the development and progression of LS. Furthermore, we examined the extent to which each of the multiple load-bearing joints had coexisting pain. Among participants with hip, knee, or foot and ankle pain, about 40% of participants had pain at only one site each, but among those with hip pain, only about 10% participants had only hip pain without any other joint pain. Participants who complained of hip pain were more likely to have other coexisting load-bearing joint pain.

This study has several limitations. First, this study was a limited regional cohort study and does not necessarily reflect the population of our country. In 2020, Japan's population aging rate was 28.7%, while the aging rate in the region covered by this study was 49.7%. However, with our country's rapidly aging population, the number of elderly is expected to increase in the future. Hence, we believe that our data has potential clinical relevance. Second, the target population might have been limited to those with the ability to travel to the screening site. In addition, it is likely that those with an interest in health were more likely to be included in the study population. Third, the diagnosis of LS was made using only the GLFS-25 and not the two-step test or stand-up test [14]. Therefore, the prevalence of LS might be lower than it would be if these tests had been used. Fourth, pain was self-reported using a binary system of "yes" and "no", and the degree of pain was not assessed. Also, we did not assess the cause of pain. Fifth, because this study was a cross-sectional study, we did not evaluate the sequence of appearance of multiple pains.

In conclusion, 2 pain sites (OR 5.36), more than 3 pain sites (OR 8.96), low back pain (OR 2.42), hip pain (OR 2.99) and knee pain (OR 2.59) were statistically related to LS. Participants who complained of hip pain were more likely to have other coexisting load-bearing joint pain. Controlling load-bearing joint pain from an early stage and suppressing the number of load-bearing joint pain might lead to prevention of LS.

Abbreviations

BMI: Body mass index; GLFS-25: the 25-question Geriatric Locomotive Function Scale; LS: Locomotive syndrome; OR: Odds ratio

Declarations

Ethics approval and consent to participants

The study was approved by Mie University Graduate School of Medicine in Tsu (U2018-022). Written informed consent was obtained from all the participants in the study. The ethics committee confirmed that all methods were performed in accordance with the relevant guidelines and regulations.

Consent for publication

Not applicable.

Availability of data and materials

The data supporting our findings are provided within this manuscript.

Competing interests

The authors declare that they have no competing interests.

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Author's contributions

YK, AN, YS and AS conceived of the study and participated in the acquisition of data. YK, AN participated in the whole design and coordination of the study, performed the statistical analysis and helped to draft the manuscript. All authors read and approved the final manuscript.

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Tables

Table 1. Demographic data of patients divided according to the presence or absence of LS

Variables	Male		Female		Total	
	LS (n=26)	No-LS (n=152)	LS (n=85)	No-LS (n=244)	LS (n=111)	No-LS (n=396)
Gender					M, 26; F, 85**	M, 152; F, 244
Age (years)	74.7±10.8***	70.4±8.8	76.9±8.2***	68.8±8.5	76.4±8.9***	69.4±8.6
Height (cm)	159.8±5.3***	163.4±7.6	146.7±6.4***	151.3±5.9	149.7±8.3***	155.6±8.5
Weight (kg)	58.2±10.2*	61.5±10.2	50.5±10.1	51.9±7.9	52.3±10.6**	55.6±10.0
BMI (kg/m^2)	22.7±3.3	23.2±2.8	23.4±3.8	22.7±3.2	23.2±3.7	22.9±3.0
Low back pain (%)	61.5*	38.2	63.5***	32.8	63.1***	34.8
Hip pain (%)	23.1**	5.3	15.3	7.8	17.1**	6.8
Knee pain (%)	50.0**	21.7	64.7***	34.4	61.3***	29.5
Foot & Ankle pain (%)	7.7	7.2	8.2	9	8.1	8.3
Number of pain sites	1.42±1.0***	0.72±0.7	1.52±1.0***	0.84±0.9	1.50±0.96***	0.80±0.82

LS: locomotive syndrome. *p<0.05; **p<0.01; ***p<0.001 vs. no LS group

Table 2. Results of logistic regression analysis of the relationship between LS and load-bearing joint pains after adjustment for age, gender and BMI

	LS (n=111)	No-LS (n=396)	OR	95%CI	p value
Age (years)	76.4±8.9	69.4±8.6	1.10	1.07-1.13	<0.001
Gender	M, 26; F, 85	M, 152; F, 244	1.91	1.11-3.27	0.0186
BMI (kg/m^2)	23.2±3.7	22.9±3.0	1.01	0.94-1.09	0.739
Low back pain (%)	63.1	34.8	2.42	1.49-3.92	<0.001
Hip pain (%)	17.1	6.8	2.99	1.42-6.29	0.00385
Knee pain (%)	61.3	29.5	2.59	1.57-4.25	<0.001
Foot & Ankle pain (%)	8.1	8.3	0.94	0.37-2.39	0.896

LS: locomotive syndrome; OR: odds ratio; 95% CI: 95% confidence interval.

Table 3. Results of logistic regression analysis of the relationship between LS and number of pain sites after adjustment for age, gender and BMI

	LS (n=111)	No-LS (n=396)	OR	95%CI	p value
Age (years)	76.4±8.9	69.4±8.6	1.10	1.07-1.14	<0.001
Gender	M, 26; F, 85	M, 152; F, 244	1.91	1.12-3.26	0.0178
BMI (kg/m^2)	23.2±3.7	22.9±3.0	1.02	0.94-1.10	0.667
1 pain sites (%)	29.7	38.9	1.53	0.81-2.89	0.188
2 pain sites (%)	42.3	15.7	5.36	2.79-10.3	<0.001
More than 3 pain sites (%)	10.8	3.0	8.96	3.28-24.5	<0.001

LS: locomotive syndrome; OR: odds ratio; 95% CI: 95% confidence interval.

Figures

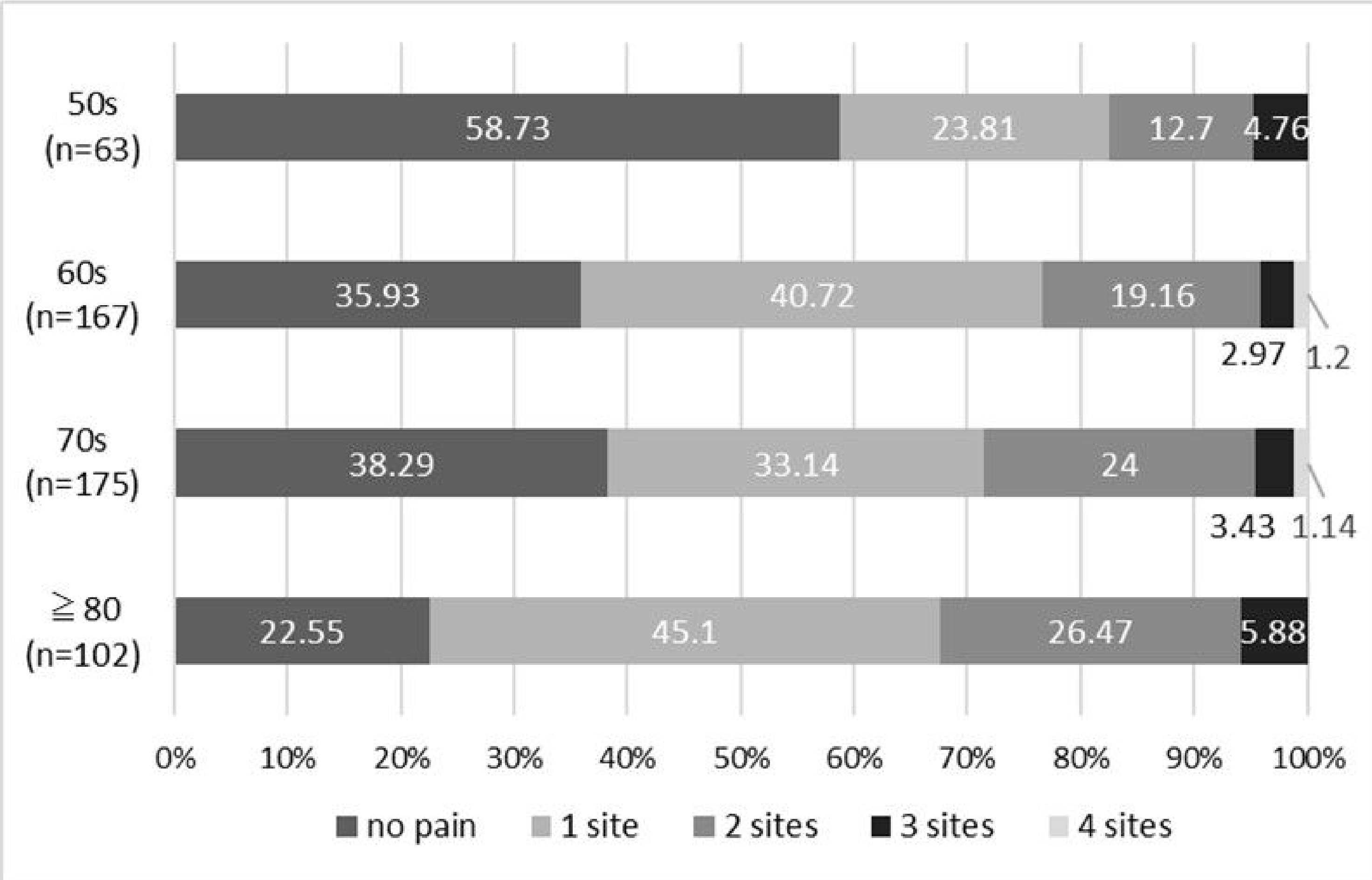

Figure 1

Number of load-bearing joint pains by age

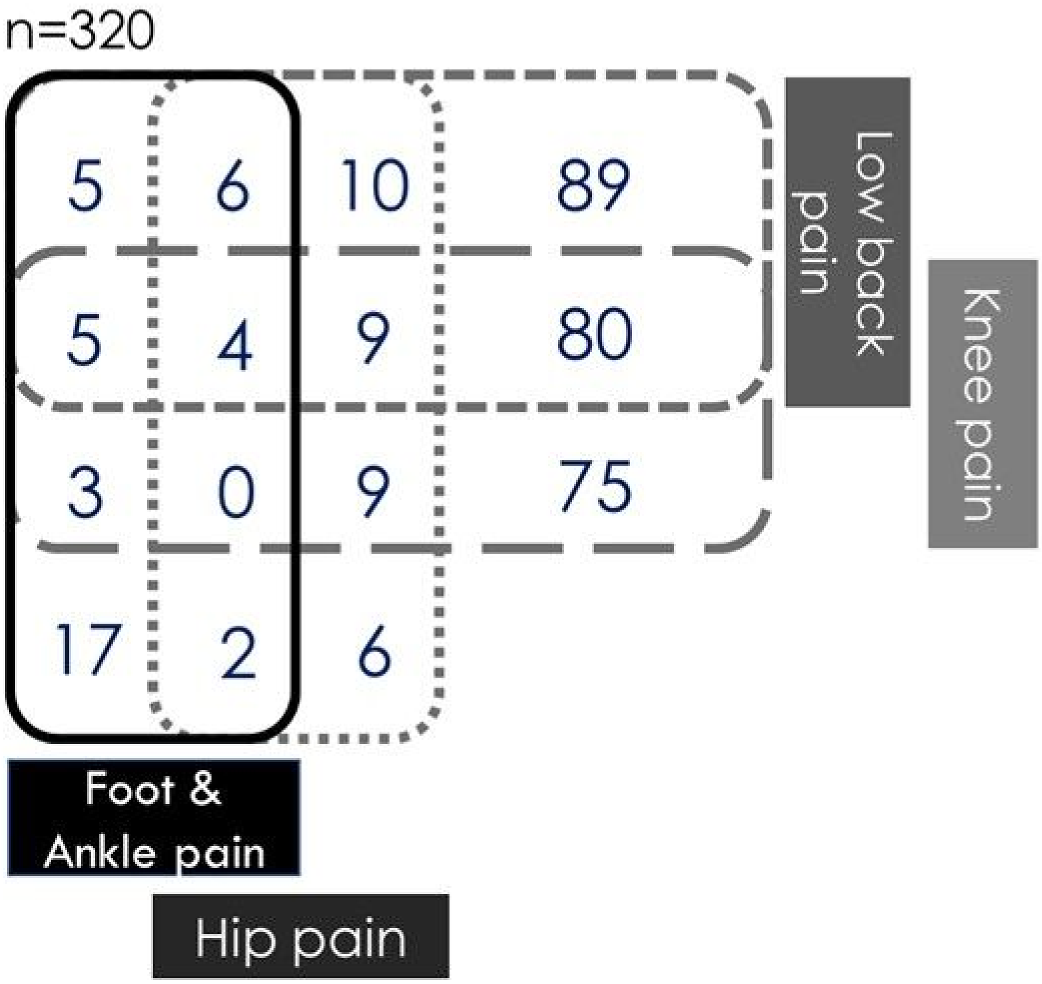

Figure 2

Aggregate relationship of pain sites