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Original Article

Cognitive factors associated with locomotive syndrome in chronic pain patients: A retrospective study

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ABSTRACT

Background: Prevention and treatment for locomotive syndrome (LS) are important for extending healthy life expectancy. The 25-question geriatric locomotive function scale (GLFS-25) was developed to diagnose LS. The Fear-Avoidance model was proposed to explain pain chronicity. LS and chronic pain decrease activities of daily living; however, the relationships between LS and factors related to chronic pain in the Fear-Avoidance model are unknown. Objective of the current study was to assess the prevalence of LS and examine the factors of the Fear-Avoidance model and the GLFS-25 that affect the prevalence of LS in patients with chronic pain.

Methods: Participants included 281 patients (99 men, 182 women) aged over 40 years with chronic pain who visited our outpatient clinic for chronic pain. All participants completed the GLFS-25, numeric rating scale (NRS), pain catastrophizing scale (PCS), hospital anxiety and depression scale (HADS), and Athene insomnia scale (AIS). According to a GLFS-25 cutoff point, participants were divided into three groups (LS-2; GLFS-25 $\geq$ 16, LS-1; 7 $\leq$ GLFS-25 $<$ 16, and non-LS; GLFS-25 $<$ 7 points) and each parameter was compared among the groups, followed by multiple logistic regression analysis. Next, multiple linear regression analysis was performed to determine the factors associated with the GLFS-25.

Results: Of all 281 patients, 241 (85.8%) patients were diagnosed with LS-2. Univariate analysis revealed there were significant differences in NRS, PCS, HADS anxiety, HADS depression, and AIS among groups. Multiple logistic regression analyses showed PCS was significantly associated with LS-2 prevalence. The GLFS-25 was positively correlated with NRS, HADS depression, AIS in multiple linear regression analysis.

Conclusions: We found that patients with chronic pain in our outpatient clinic had a significant rate of LS-2. The prevalence of LS-2 was significantly correlate with pain catastrophizing, and the GLFS-25 was significantly correlated with higher pain intensity, depression, and insomnia.

1. Introduction

Japan has become a super-aging society and the number of people aged 65 years or older has increased rapidly over the years. By 2055, the elderly are expected to account for 40.5% of the Japanese population, and currently, the number of people who require nursing care services is increasing, and approximately 21.5% of such people used nursing care because of locomotive organ disorders [1]. To reduce the number of elderly people who require nursing care, the Japanese Orthopedic Association proposed a concept of Locomotive Syndrome (LS) in 2006 and LS refers to a condition present in individuals at high risk of developing a musculoskeletal disability [1–3]. Prevention and treatment for LS are important for extending healthy life expectancy. The 25-question geriatric locomotive function scale (GLFS-25) was developed for the early detection of LS [4]. The GLFS-25 is a patient-based questionnaire that measures impairment in musculoskeletal function and includes items related to ability and activities of daily living (ADL), musculoskeletal pain, mental health, and social functioning [4,5]. Many orthopedic diseases, such as rheumatoid arthritis, cervical

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myelopathy, hip osteoarthritis, knee osteoarthritis, among others, are related to LS and are assessed by the GLFS-25 [6–11].

Chronic pain, which affects 20% of the general population, is another problem which decreases ADL [12]. In fact, the International Association for the Study of Pain and the World Health Organization have recently included chronic pain in the International Statistical Classification of Diseases (ICD)-11 [13]. Once musculoskeletal pain becomes chronic, treatment becomes challenging because of the associated psychological comorbidities. To explain pain chronicity, Vlaeyen and Linton [14] proposed a cognitive behavioral model termed the Fear-Avoidance model that was modified by Asmundson et al. [15]. The revised version of this model was described in the Clinical Guidelines for Chronic Pain in 2018 [12–15]. In this model, the patient's perception of the pain experience was thought to be catastrophic and anxiety, depression and insomnia consequently disturbed daily activities, which further exacerbated the pain itself.

LS and chronic pain decrease ADL; however, the relationships between LS and the GLFS-25, and between the factors related to chronic pain in the Fear-Avoidance model are unknown. Therefore, the objective of this retrospective study was to assess the prevalence of LS in chronic pain patients and the factors focused on the Fear-Avoidance model that affect the prevalence of LS and the GLFS-25 in patients with chronic pain.

2. Materials and methods

2.1. Participants

This retrospective study was conducted at the authors' institution. Participants included 281 patients (99 men, 182 women) with chronic pain who visited our outpatient clinic for chronic pain between February 2014 and February 2020. The inclusion criteria for this study were patients over 40 years old who had suffered pain for longer than three months and agreed to complete written self-report questionnaires. The exclusion criteria were as follows: ongoing litigation, dementia, delirium, or other conditions that made completing questionnaires difficult. Questionnaires for LS and pain-related assessment were obtained and evaluated at the first outpatient clinic visit. Ethical approval was obtained from the hospital board of ethics. This study was conducted in accordance with the Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans.

2.2. Assessment of locomotive syndrome and exercise habits

The GLFS-25, developed by Seichi et al. [4], is a self-administered, comprehensive measure, consisting of 25 items that includes four questions regarding pain, 16 questions regarding ADL, three questions regarding social functions, and two questions regarding mental health status during the last month. These 25 items are graded with a five-point scale, from no impairment (0 points) to severe impairment (4 points), and then arithmetically added to produce a total score (minimum = 0, maximum = 100). Thus, a higher score is associated with worse locomotive function [4]. LS stage 2 (LS-2) was defined as GLFS-25 $\geq$ 16, and LS stage 1 (LS-1) was defined as 7 $\leq$ GLFS-25 < 16 [16], and the participants were divided into three groups based on this cutoff point. Questions about exercise habits were included in the questionnaire used in our outpatient clinic. Exercise habits were defined as a habit of exercising to the point of light sweating for over 30 min a time, 2 times a week, for over a year [17].

2.3. Evaluation for pain-related factors

2.3.1. Pain assessment

The Numeric Rating Scale (NRS) were obtained for evaluation of pain intensity. NRS scores range from 0 to 10, with 0 representing no pain and 10 representing the worst imaginable pain [18]. The average intensity of pain in the past seven days was obtained and evaluated.

2.3.2. Assessment of pain catastrophizing

The pain catastrophizing scale (PCS) is a 13-item questionnaire that is used to measure pain catastrophizing. It is composed of items assessing rumination, magnification, and helplessness. Rumination (items 8–11) refers to "the fact that the patient cannot get the idea of pain out of his/her head and cannot stop thinking about the pain," while magnification (items 6, 7, and 13) refers to "the exaggeration of the threatening properties of the painful stimulus," and helplessness (items 1–5 and 12) refers to "the estimation that the person is unable to do anything to influence the pain." The PCS is scored on a scale from 0 to 52, with each item rated on a five-point scale (0: not at all to 4: all the time). A higher score indicates a greater degree of pain catastrophizing [19].

2.3.3. Assessment of anxiety and depression

The Hospital Anxiety and Depression Scale (HADS) was used to assess anxiety and depression, is composed of a seven-item depression scale, and a seven-item anxiety scale, with each item scored from 0 to 3 and scores ranging from 0 to 21. A higher score indicates the presence of depression and/or anxiety [20].

2.3.4. Assessment of insomnia

The Athene Insomnia Scale (AIS) was used to assess insomnia, is composed of eight questions, with each item scored from 0 (no problem) to 3 (very serious problem), which measures awakenings during the night, early morning awakening, total sleep duration, sleep quality and sleepiness during the day. The AIS total score is the sum of the scores on each question and varies from 0 to 24. A higher score indicates the presence of insomnia [21].

2.4. Statistical analyses

Continuous variables were expressed as means (standard deviations [SDs]), and categorical variables were expressed as percentages. Patients with GLFS-25 scores less than 7 points were included in the non-LS (LS-0) group, those with 7–15 points were included in the LS stage 1 (LS-1) group, and those with greater than 16 points were included in the LS stage 2 (LS-2) group. For comparisons of the groups, one-way analysis of variance was performed for continuous variables and Fisher's exact test for categorical variables, followed by Bonferroni post hoc test. After the comparison, for dichotomous outcomes (with or without LS-2), a multiple logistic regression analysis was performed to assess odds ratios (OR) and 95% confidence intervals (CIs) for potential variables. Then, the correlation between the GLFS-25 and each variable was analyzed using Spearman's correlation coefficient for simple regression analysis. For further analysis, a multiple linear regression analysis was performed to determine the factors associated with the GLFS-25. Then, to investigate the standardized partial regression coefficient of each variable, multiple linear regression analysis for standardized variables was performed. Statistical analyses were conducted with EZR software (Saitama Medical Center Jichi Medical University, Tochigi, Japan), which is a graphical user interface for R (The R Foundation for Statistical Computing). Results were considered significant at a level of $p < 0.05$.

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3. Results

The characteristics and age-specific results for all patients are shown on Table 1. The mean age of the 281 patients was 61.5 (range: 40–92 years, SD: 13.1) years, and the mean body mass index (BMI) was 22.5 (range: 13.7–36.8, SD: 3.8) kg/m^2. The mean GLFS-25 score was 40.2 (range: 0–98, SD: 22.4) points in all patients, 37.1 (range: 2–90, SD: 20.2) points in men, and 42.2 (range: 0–98, SD: 23.6) points in women ($p = 0.09$). Of the 281 patients, 229 (86.7%) were diagnosed as LS-2. Age-specific prevalence of LS-2 was as follows; 57/68 (83.8%) of patients in the 40s, 51/59 (86.4%) in the 50s, 54/64 (84.4%) in the 60s, 56/65 (86.2%) in the 70s, 23/25 (92.0%) in the over 80s.

Table 2 shows the patient characteristics, and Table 3 shows the results of each measured variable in the three groups. The LS-2 group included 241 patients, the LS-1 group included 26 patients and the LS-0 group included 14 patients. No significant differences were found among the three groups in age, gender, BMI, exercise habits, and past history of depression ($p = 0.35$, 1.0, 057, 0.56, and 0.11, respectively). Regarding the pain site, significant differences were observed in the cranio-cervical and lower limb ($p < 0.01$ and 0.02, respectively) and no significant differences were observed in the upper limb and trunk ($p = 0.07$ and 0.21, respectively). Significant differences were found between the groups in GLFS-25, NRS, PCS, HADS anxiety, HADS depression, and AIS (all, $p < 0.01$) (Table 3). Next, for dichotomous outcomes (with or without LS-2), multiple logistic regression analyses were performed to evaluate between LS-2 prevalence and factors in the Fear-Avoidance model. The independent variables included PCS, HADS anxiety, HADS depression, and AIS. We found that PCS (OR, 1.04, $p = 0.04$) was significantly associated with prevalence of LS-2 (Table 4).

The correlation coefficient between the GLFS-25 scores and the measured variables are shown in Table 5. The GLFS-25 scores significantly correlated with age (r = 0.18), NRS (r = 0.36), PCS (r = 0.39), HADS anxiety (r = 0.32), HADS depression (r = 0.39), and AIS (r = 0.35). Based on these results, multiple linear regression analysis was performed to investigate the relationship between the GLFS-25 and the other variables. The explanatory variables included NRS, PCS, HADS anxiety, HADS depression, AIS, age, gender, and BMI. We found that GLFS-25 scores (y) were significantly correlated with NRS (x_1), HADS depression (x_2), AIS (x_3), age (x_4), gender (women) (x_5), and BMI (x_6) (Table 6). These results yielded the following prediction formula: $y = -35.54 + 2.34\,x_1 + 1.10\,x_2 + 0.69\,x_3 + 0.34\,x_4 + 5.89\,x_5 + 0.64\,x_6$. The adjusted coefficient of determination was 0.295 and all p values were <0.05, indicating that the variables chosen for analysis had good explanatory power. Next, to investigate the strength of the variables related to GLFS-25, multiple linear regression analysis was performed between the standardized GLFS-25 and the other standardized variables. The explanatory variables included standardized NRS, PCS, HADS anxiety, HADS depression, AIS, age, gender, and BMI. We found that standardized GLFS-25 scores (y) were significantly correlated with standardized NRS (x_1), HADS depression (x_2), AIS (x_3), age (x_4), gender (x_5), and BMI (x_6) (Table 7). These results yielded the following prediction formula: $y = 0.00 + 0.22\,x_1 + 0.24\,x_2 + 0.15\,x_3 + 0.20\,x_4 + 0.13\,x_5 + 0.11\,x_6$. The adjusted coefficient of determination was 0.295 and all p values were <0.05, indicating that the variables chosen for analysis had good explanatory power.

Table 1
Patient characteristics, prevalence of locomotive syndrome, and pain-related parameters by age.

Variables	All ($n = 281$)	40 s ($n = 68$)	50 s ($n = 59$)	60s ($n = 64$)	70s ($n = 65$)	≧80 ($n = 25$)
Age (years)	61.5 ± 13.1	44.7 ± 2.5	54.2 ± 2.8	64.5 ± 2.8	74.2 ± 2.7	84.1 ± 3.4
Gender (men/women)	99/182	23/45	21/38	19/45	26/39	10/15
BMI (kg/m^2)	22.5 ± 3.8	22.5 ± 4.2	22.5 ± 4.2	22.6 ± 3.4	22.4 ± 3.3	22.5 ± 2.9
GLFS-25 (pts)	40.2 ± 22.4	35.0 ± 19.7	40.9 ± 21.4	37.1 ± 22.0	44.8 ± 23.7	48.9 ± 23.7
LS-2 (n)	241 (85.8%)	57 (83.8%)	51 (86.4%)	54 (84.4%)	56 (86.2%)	23 (92.0%)
LS-1 (n)	26 (9.3%)	6 (8.8%)	5 (8.5%)	7 (10.9%)	6 (9.2%)	2 (8.0%)
NRS (pts)	6.0 ± 2.1	5.7 ± 2.3	6.2 ± 1.9	6.1 ± 2.1	6.1 ± 2.1	6.0 ± 2.1
PCS (pts)	35.3 ± 10.9	33.6 ± 10.9	34.2 ± 11.9	36.5 ± 9.0	35.8 ± 11.4	38.3 ± 10.8
HADS anxiety (pts)	7.9 ± 4.3	8.3 ± 4.2	7.8 ± 4.1	8.3 ± 4.2	7.1 ± 4.5	7.8 ± 4.9
HADS depression (pts)	8.9 ± 4.9	9.9 ± 5.2	9.2 ± 4.5	8.6 ± 4.8	7.6 ± 4.8	10.0 ± 4.4
AIS (pts)	8.8 ± 4.8	9.3 ± 5.3	9.5 ± 4.8	8.8 ± 4.6	7.9 ± 4.8	8.5 ± 3.8

Parameter values are expressed as mean ± standard deviation or number (percentage). BMI: body mass index, GLFS-25: 25-question geriatric locomotive function scale, LS: locomotive syndrome, NRS: numeric rating scale, PCS: pain catastrophizing scale, HADS: hospital anxiety and depression scale, AIS: Athene insomnia scale.

Table 2
Patient characteristics based on the locomotive syndrome stage.

Variables	LS-2 ($n = 241$)	LS-1 ($n = 26$)	LS-0 ($n = 14$)	p-value	Post hoc test
Age (years)	61.8 ± 13.2	61.1 ± 13.5	56.6 ± 11.5	0.35	
Gender (male/female)	85/156	9/17	5/9	1.0	
BMI (kg/m^2)	22.5 ± 3.9	22.0 ± 3.3	23.3 ± 3.9	0.57	
Exercise habits	51 (21.2%)	7 (26.9%)	4 (28.6%)	0.56	
Pain site					
Cranio-cervical	41 (17.0%)	10 (38.5%)	9 (64.3%)	<0.01**	(a)*, (b)**
Upper limb	57 (23.7%)	4 (15.4%)	0 (0%)	0.07	
Trunk	95 (39.4%)	13 (50.0%)	3 (21.4%)	0.21	
Lower limb	110 (45.6%)	7 (26.9%)	2 (14.3%)	0.02*	(n.s.)
Past history of depression	25 (10.4%)	0 (0%)	0 (0%)	0.11	

Data are expressed as mean ± standard deviation or number (proportion). LS: locomotive syndrome (GLFS-25 ≥ 16 was defined as LS-2, 7 ≤ GLFS-25 < 16 was defined as LS-1 and GLFS-25 < 7 was defined as LS-0), BMI: body mass index. Age and BMI were compared with one-way analysis of variance. Gender, exercise habit, pain site, and past history of depression were compared with Fisher's exact test. Bonferroni test was used as a post hoc test: (a); significant difference between LS-2 and LS-1 groups, (b); significant difference between LS-2 and LS-0 groups, and (n.s.); not significant. Asterisks indicate statistical significance, **p < 0.01 and *p < 0.05.

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Table 3
Comparison of pain-related parameters among locomotive syndrome stages.

Variables	LS-2 ($n = 241$)	LS-1 ($n = 26$)	LS-0 ($n = 14$)	p-value	Post hoc test
GLFS-25 (pts)	45.5 ± 19.7	11.4 ± 2.6	3.7 ± 2.1	<0.01**	(a)**, (b)**
NRS (pts)	6.2 ± 2.0	5.2 ± 2.4	3.6 ± 2.1	<0.01**	(a)**, (b)**
PCS (pts)	36.7 ± 9.9	26.3 ± 13.5	27.9 ± 12.7	<0.01**	(a)**, (b)**
HADS anxiety (pts)	8.4 ± 4.3	5.4 ± 3.4	3.6 ± 2.9	<0.01**	(a)**, (b)**
HADS depression (pts)	9.6 ± 4.7	5.2 ± 4.2	5.3 ± 4.4	<0.01**	(a)**, (b)**
AIS (pts)	9.3 ± 4.7	6.7 ± 5.5	4.9 ± 3.6	<0.01**	(a)*, (b)**

Data are expressed as mean ± standard deviation. LS: locomotive syndrome, GLFS-25: 25-question geriatric locomotive function scale, NRS: numeric rating scale, PCS: pain catastrophizing scale, HADS: hospital anxiety and depression scale, AIS: Athene insomnia scale. All parameters were compared with one-way analysis of variance. Bonferroni test was used as a post hoc test: (a); significant difference between the LS-2 and LS-1 groups and (b); significant difference between the LS-2 and LS-0 groups. Asterisks indicate statistical significance, **p < 0.01 and *p < 0.05.

Table 4
Multiple adjusted odds ratios for locomotive syndrome stage 2.

	Odds ratio	95% CI	p-value
PCS	1.04	1.00–1.08	0.04*

CI: confidence interval, PCS: pain catastrophizing scale. Asterisks indicate statistical significance, *p < 0.05.

4. Discussion

The results of this study revealed that 85.8% of the patients with chronic pain over 40 years old were diagnosed LS-2. Interestingly, LS-2 was significantly associated with pain catastrophizing and the GLFS-25 scores were related to pain intensity, depression, and insomnia. Furthermore, multiple linear regression analysis revealed that depression was the most related to the GLFS-25.

The overall mean prevalence of LS was 10.2% in a nationwide cross-sectional survey in Japan [22]. Another study revealed an estimated prevalence of LS in the Japanese population by age, as follows: 4.6% in the 40s, 7.8%, in the 50s, 12.0% in the 60s, and 24.5% in the 70s [23]. In contrast, our results showed relatively higher prevalence of LS in patients with chronic pain over 80% in each age. The prevalence of LS was much higher in our study than in previous study [23], which indicated that chronic pain patients had an earlier risk of developing LS. Our findings suggested that chronic pain patients need to be treated not only for pain but also for decreased physical function.

Many types of pathologies, such as lumbar spondylosis, lumbar canal stenosis, and knee osteoarthritis, are related to LS [10,11]. This study targeted patients with intractable chronic pain, and each patient had a completely different background. Moreover, this study included patients with multi-site pain, or patients without abnormalities of the pain sites on the imaging tests. Consequently, we consider that it is difficult to provide background pathologies of the patients included in this study. Therefore, we examined the “pain site” that was diagnosed through medical examinations in this study. Patients with LS-2 showed a significantly higher prevalence of lower limb pain; on the other hand, patients without LS-2 showed a significantly higher prevalence of cranio-cervical pain. These results indicated that lower limb pain reduced the movement ability compared with cranio-cervical pain. Not only physical factors, but also mental factors, such as depression, are reportedly related to LS [24]. Our results suggested that pain catastrophizing was a factor related to the prevalence of LS-2 in patients with chronic pain. In addition, the GLFS-25 was significantly correlated with not only pain intensity, but also depression, and insomnia, all of which were included in the Fear-Avoidance model [12–15]. In addition, among these factors, depression was the most related to the GLFS-25. In the Fear-Avoidance model, pain may induce pain catastrophizing, anxiety, depression and insomnia which may further provoke ADL disabilities and consequently worsens pain itself. As the GLFS-25 was used as a scale for ADL disability due to

Table 6
Multiple linear regression analysis of factors associated with the GLFS-25.

Variables	Partial regression coefficient	95% CI		p-value
		Lower	Upper	
NRS	2.34	1.12	3.57	<0.01**
HADS depression	1.10	0.40	1.80	<0.01**
HADS anxiety	−0.11	−0.90	0.69	0.79
PCS	0.22	−0.05	0.49	0.12
AIS	0.69	0.13	1.25	0.02*
Age	0.34	0.16	0.51	0.02*
Gender (women)	5.89	1.14	10.63	0.02*
BMI	0.64	0.03	1.24	0.04*
Constant term	−35.54	−55.70	−15.38	<0.01**

CI: confidence interval, GLFS-25: 25-question geriatric locomotive function scale, NRS: numeric rating scale, HADS: hospital anxiety and depression scale, PCS: pain catastrophizing scale, AIS: Athene insomnia scale, BMI: body mass index. Asterisks indicate statistical significance, *p < 0.05, **p < 0.01.

Table 5
Spearman's correlation coefficients between measured variables.

	Age	BMI	NRS	PCS	HADS anxiety	HADS depression	AIS
GLFS-25 (pts)	0.18**	−0.03	0.36**	0.39**	0.32**	0.39**	0.35**
Age (years)	1.0	0.02	0.05	0.14*	−0.06	−0.10	−0.09
BMI (kg/m^2)		1.0	−0.14*	−0.02	−0.15**	−0.16**	−0.12
NRS (pts)			1.0	0.43**	0.24**	0.31**	0.36**
PCS (pts)				1.0	0.54**	0.50**	0.39**
HADS anxiety (pts)					1.0	0.72**	0.51**
HADS depression (pts)						1.0	0.50**
AIS (pts)							1.0

GLFS-25: 25-question geriatric locomotive function scale, BMI: body mass index, NRS: numeric rating scale, PCS: pain catastrophizing scale, HADS: hospital anxiety and depression scale, AIS: Athene insomnia scale.
Asterisks indicate statistical significance, *p < 0.05, **p < 0.01.

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Table 7
Multiple linear regression analysis of factors associated with the standardized GLFS-25.

Standardized variables	Standardized partial regression coefficient	95% CI		p-value
		Lower	Upper	
NRS	0.22	0.10	0.34	<0.01**
HADS depression	0.24	0.09	0.39	<0.01**
HADS anxiety	−0.02	−0.17	0.13	0.72
PCS	0.11	−0.03	0.24	0.12
AIS	0.15	0.03	0.27	0.02*
Age	0.20	0.10	0.30	<0.01**
Gender	0.13	0.02	0.23	0.02*
BMI	0.11	0.01	0.21	0.04*
Constant term	0.00	−0.10	0.10	0.99

CI: confidence interval, GLFS-25: 25-question geriatric locomotive function scale, NRS: numeric rating scale, HADS: hospital anxiety and depression scale, PCS: pain catastrophizing scale, AIS: Athene insomnia scale, BMI: body mass index. Asterisks indicate statistical significance, *p < 0.05, **p < 0.01.

locomotive organ dysfunction [25], our results showed that chronic pain patients showed ADL disability due to impairment of locomotive organs, and the score of GLFS-25 correlated with pain chronicity in patients with chronic pain.

Tetsunaga et al. reported that the main goal of treatment in the pain liaison outpatient clinic was not pain relief but rather improved ADL and quality of life [26]. As for improving ADL in chronic pain patients due to musculoskeletal disorders, a previous report suggested that physical therapy improved post-treatment pain intensity and disability [27]. Multidisciplinary biopsychosocial rehabilitation was reportedly more effective than usual rehabilitation [26,28]. Recent studies have found that a lack of exercise is related to LS [6,29]. Furthermore, multidisciplinary therapeutic self-managed exercise improved ADL in chronic pain patients [30]. In this study, the proportion of patients with exercise habits was low in all groups. No significant differences in the prevalence of patients who had exercise habits were observed among the groups. A more detailed assessment of the physical function of each patient who experiences chronic pain, such as the stand-up and two-step tests, which are commonly used to screen for LS, would be needed to understand the ADL disability and for the performance of multidisciplinary therapeutic self-managed exercise for chronic pain patients. While it offers some significant benefits to the field, this study also has some limitations which warrant discussion. First, patients were evaluated only at a single time point, and the treatment effect remains unknown. Second, because LS was diagnosed only by questionnaires and physical assessments, the stand-up and two-step tests were not conducted. Third, in this study, it was difficult to evaluate LS stage 1, because most of the patients with chronic pain were diagnosed as LS stage 2; therefore, the sample size of patients with LS stage 1 was small. Further study is needed to evaluate the relationships between LS-1 and other factors in chronic pain patients. Fourth, because this study was a retrospective study, it was difficult to evaluate chronological order between LS and mental problems, such as depression. Based on these limitations, further prospective studies would be needed to explore the relationship between LS and pain-related outcomes after multidisciplinary treatment in patients with chronic pain.

In conclusion, this study demonstrated a high prevalence of LS-2 in patients with chronic pain, and that the prevalence of LS-2 was significantly correlated with pain catastrophizing. In addition, the GLFS-25 scores were significantly correlated with increased pain intensity, depression, and insomnia.

Declaration of competing interest

The authors declare that they have no conflicts of interest.

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