frequency bands: 1–4, 4–8, 8–12, 12–18 and 18–30 Hz. The average cross-spectral matrices for each subject in each condition were given as the input for sLORETA source analysis. The sLORETA yielded the spectral density of the current density at each voxel. Subject-wise normalization (which takes the total power across all frequency bands and over all the 6239 voxels of the brain volume to unity) was performed on the sLORETA solutions before statistical analysis. Good reliability of sLORETA current source density and cross-spectral matrices analysis was shown [12].

Statistical analysis

After data preprocessing, the estimated EEG cortical sources were compared between a sensorimotor congruence and a sensorimotor incongruence test using voxel-by-voxel paired *t*-tests of the normalized and log-transformed sLORETA maps in the aforementioned five frequency bands. To identify brain regions that were activated more frequently in the high-discomfort subgroup, in reference to the study in subjective pain [9], the discomfort intensity was used to assign subjects to the high- (5 > NRS) or no-discomfort (0 = NRS) subgroup. The differences between the high- and no-discomfort subgroups during sensorimotor incongruence were assessed using unpaired *t*-tests. Voxel-by-voxel *t*-values in Talairach space are displayed as statistical parametric maps.

Results

Two (11.1%) and 12 subjects (66.6%) reported discomfort in sensorimotor congruence and sensorimotor incongruence, respectively. The average discomfort intensity in sensorimotor incongruence was 3.7 (S.D. 2.7). Alpha band activity (8–12 Hz) in the right PPC (Broadman area 7) during sensorimotor incongruence was significantly lower than that of sensorimotor congruence (Table 1 and Fig. 1). Subjects were divided into two subgroups representing the high-discomfort [mean NRS rating 6.3 (S.D. 1.5)] and no-discomfort subgroups (NRS rating = 0) of the sampled population. The source activities induced in the posterior cingulate cortex (PCC; Broadman area 30) alpha band activity (8–12 Hz) and the anterior cingulate cortex (ACC; Broadman area 32) beta band activity (12–18 Hz) significantly decreased in the high-discomfort *vs* the no-discomfort subgroup (Table 1 and Fig. 1).

Discussion

The present study was a first attempt to characterize the discomfort felt during sensorimotor incongruence at the cortical level by frequency-domain EEG source localization using sLORETA. Nociceptive processing is associated with inhibition of alpha and beta rhythms in the somatosensory cortex, ACC and PCC [13]. Alpha rhythms in the PPC were found to be associated with visuospatial attention tasks [14]. Decreases in oscillatory power classically indicate increases in sensory cortical activation. In this study, decreases in oscillatory power were found in the PPC alpha band in sensorimotor incongruence compared with congruence and in the ACC beta band and PCC alpha band in the high-discomfort subgroup compared with the no-discomfort subgroup during sensorimotor incongruence.

A reduction of alpha band activity was observed (increased cortical activation) in the right PPC during sensorimotor incongruence *vs* congruence. Our results are consistent with those reported by Fink *et al.* [8]. The PPC is generally considered to be a key region for the fusion of signals from different sensory modalities, body ownership and hand–eye coordination. Fink *et al.* [8] proposed that the PPC is activated as a result of increased attentional demands for the integration of vision and proprioception. In contrast, the primary and secondary somatosensory cortex, ACC and insula are known to be pain-related regions exhibiting no statistically reliable differences in activation between sensorimotor congruence and incongruence. This was seen in the present study as well as in the study of Fink *et al.* [8]. These findings confirm that the neural correlates of discomfort induced by sensorimotor incongruence are not known by comparing between sensorimotor congruence and incongruence.

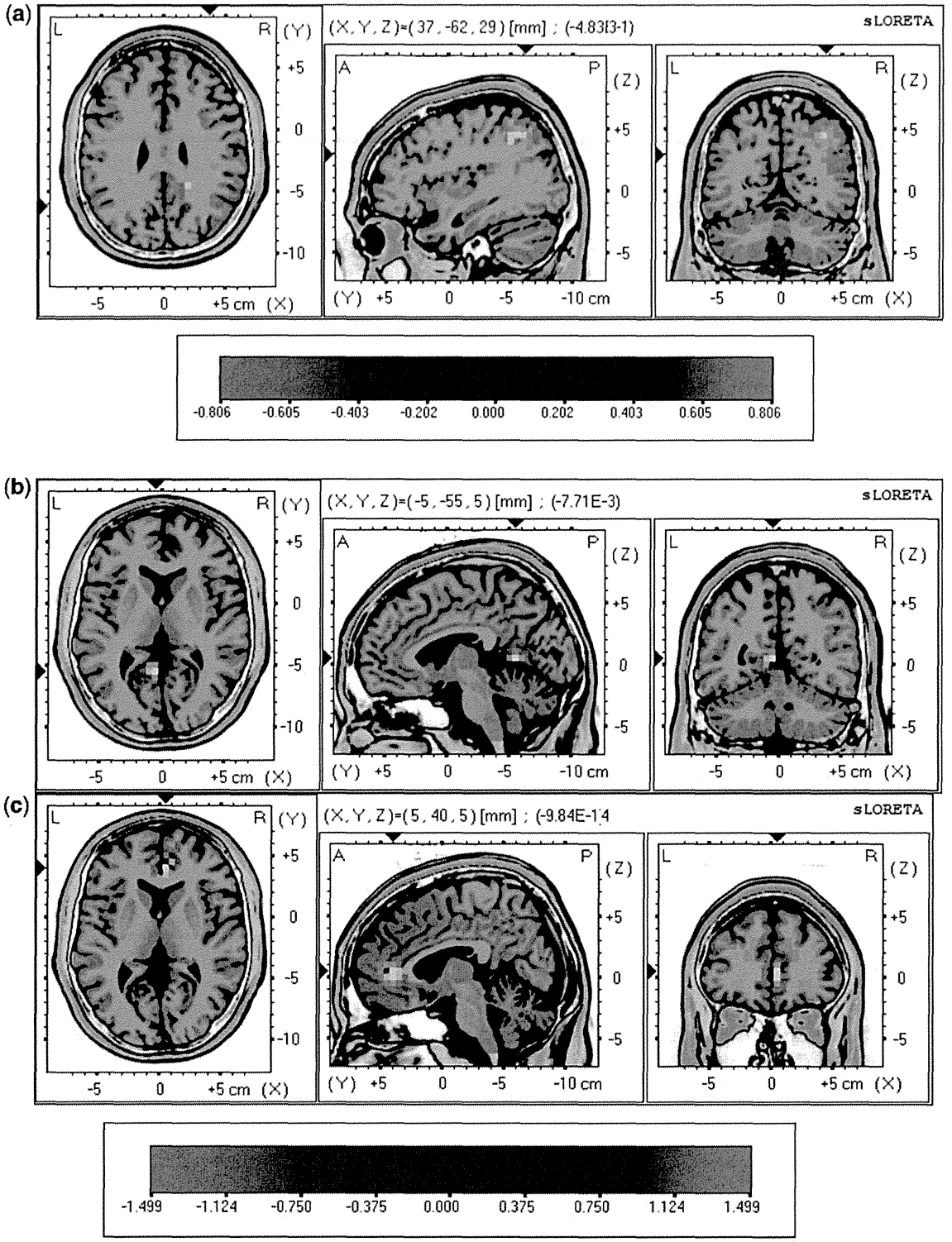
The central processing of pain within the cortex has often been referred to as the pain matrix. The primary (S1) and secondary (S2) somatosensory cortex, insula, ACC, PCC, PFC, thalamus, amygdala and brainstem are included in the pain matrix. Sensory-discriminative aspects of pain perception are often thought to be independently and specifically represented in S1, S2 and the insula, while the affective-cognitive-evaluative aspects of pain perception are represented in medial brain structures such as the ACC, PCC and PFC. In chronic pain patients, including CRPS, phantom pain and back pain,

Table 1 Significant differences in alpha and beta activity congruence *vs* incongruence and high *vs* low discomfort

			MNI coordinates, mm				
		Statistical value (*t*)	*x*	*y*	*z*	Broadman area	Region
Congruence *vs* incongruence	Alpha	0.806	29	−61	45	7	PPC
High *vs* low discomfort	Alpha	1.499	−5	−60	4	30	PCC
	Beta	1.499	5	37	2	32	ACC

MNI: Montreal Neurological Institute.

FIG. 1 Electroencephalogram activity during sensorimotor congruence and incongruence tests



sLORETA differences in the (**a**) alpha band comparing EEG activity during sensorimotor congruence and incongruence tests and in the (**b**) alpha band and (**c**) beta band for the high- and no-discomfort subgroups during sensorimotor incongruence tests.

reorganization in the primary motor and sensory homunculus maps occurs. In irritable bowel syndrome, defined by continuous or remittent abdominal pain and/or discomfort, increasing levels of discomfort and/or pain are associated with activation of the ACC, insula, parietal and ventral medial frontal regions during ramp distension.

Cerebral cortical regions such as the ACC and PPC, considered to be key pain-related regions, exhibited more activation in individuals who were highly sensitive to discomfort *vs* individuals who were insensitive to discomfort induced by sensorimotor incongruence. The ACC is an essential cerebral region in sensory cognition and the affective process of pain [15]. Brain imaging studies have revealed significant changes in pain-evoked activity within the ACC, consistent with an individual's perceived unpleasantness, while primary somatosensory cortex activation is unrelated [16]. Many studies identify a role for the PCC in negative emotion and the pathological state of pain [17, 18]. Therefore increased activation in the ACC and PCC may reflect negative emotion and incongruous physical states induced by sensorimotor incongruence.

Individuals with FM feel more discomfort during sensorimotor incongruence than healthy volunteers [5]. There is vast evidence for brain dysfunction in patients with FM, and it is possible that central plasticity is critical for chronic pain. ACC responses to sensory stimuli in FM may play a key pathophysiological role in chronic pain syndromes. Experimental temporal summation inducing hyperalgesia in FM confirmed the altered pain processing by increased activation of the ACC [19]. Positive relationships between physical activity and brain responses to experimental pain have been observed in the PPC in individuals with FM [20]. In individuals with FM, the ACC and PCC react to stimuli more easily than in healthy individuals. Our results showed that ACC and PCC activation were increased in the high-discomfort subgroup during sensorimotor incongruence. We speculate that the reason individuals with FM sense discomfort more during sensorimotor incongruence is that the ACC and PCC are easily activated by stimuli.

There is still no gold standard for the evaluation of chronic pain patients, including those with FM and CRPS. The present study may provide an important step in the implementation of an objective measurement method, although there is a long way to go. EEG measures during sensorimotor incongruence may evaluate the effectiveness of new medications and/or rehabilitation by assessing the difference in ACC and PCC activities during sensorimotor incongruence in chronic pain patients before and after treatment.

Two limitations of our study should be considered. The first limitation is that we selected only healthy female subjects for this study. We decided on this population because the mean prevalence is a female:male ratio of 3:1 in patients with FM. Those with FM feel more discomfort induced by sensorimotor incongruence than healthy volunteers. We revealed the relationship between discomfort and ACC and PCC activity in healthy women. However, our findings may not apply to patients with FM. Therefore a second study on patients with FM is needed to arrive at a definite conclusion. The second limitation is that we could not perform a functional connectivity analysis, which would allow us to understand more clearly the regulatory functionality of the cingulate cortex during sensorimotor incongruence, as more electrodes are needed in order to perform a functional connectivity analysis. Therefore, in a future study, increasing the number of electrodes from 19 to 64 may provide a more detailed analysis.

Conclusions

The present findings suggest that the ACC and PCC are more activated in the high-discomfort subgroup than in the no-discomfort subgroup during sensorimotor incongruence. These findings may provide an understanding of discomfort during sensorimotor incongruence.

Rheumatology key messages

- Neural correlates of discomfort are not known by comparing sensorimotor congruence and incongruence.
- The cingulate cortex is more activated in the high- than in the no-discomfort subgroup.
- These findings may provide an understanding of mechanisms of discomfort during sensorimotor incongruence.

Acknowledgements

We thank Shimizu Michele Eisemann and Koji Hattori for help with manuscript editing.

Disclosure statement: The authors have declared no conflicts of interest.

References

1 McCabe CS, Haigh RC, Ring EFJ *et al.* A controlled pilot study of the utility of mirror visual feedback in the treatment of complex regional pain syndrome (type 1). Rheumatology 2003;42:97–101.

2 Moseley GL. Graded motor imagery is effective for long-standing complex regional pain syndrome: a randomised controlled trial. Pain 2004;108:192–8.

3 Harris AJ. Cortical origin of pathological pain. Lancet 1999;354:1464–6.

4 McCabe CS, Haigh RC, Halligan PW *et al.* Simulating sensory-motor incongruence in healthy volunteers: implications for a cortical model of pain. Rheumatology 2005; 44:509–16.

5 McCabe CS, Cohen H, Blake DR. Somaesthetic disturbances in fibromyalgia are exaggerated by sensory-motor conflict: implications for chronicity of the disease? Rheumatology 2007;46:1587–92.

6 Daenen L, Nijs J, Roussel N *et al.* Sensorimotor incongruence exacerbates symptoms in patients with chronic whiplash associated disorders: an experimental study. Rheumatology 2012;51:1492–9.

7 Daenen L, Roussel N, Cras P *et al.* Sensorimotor incongruence triggers sensory disturbances in professional violinists: an experimental study. Rheumatology 2010;49:1281–9.

8 Fink GR, Marshall JC, Halligan PW *et al.* The neural consequences of conflict between intention and the senses. Brain 1999;122:497–512.

9 Coghill RC, McHaffie JG, Yen YF. Neural correlates of interindividual differences in the subjective experience of pain. Proc Natl Acad Sci USA 2003;100:8538–42.

10 Pascual-Marqui RD, Michel CM, Lehmann D. Low resolution electromagnetic tomography: a new method for localizing electrical activity in the brain. Int J Psychophysiol 1994;18:49–65.

11 Shao S, Shen K, Yu K *et al.* Frequency-domain EEG source analysis for acute tonic cold pain perception. Clin Neurophysiol 2012;123:2042–9.

12 Cannon RL, Baldwin DR, Shaw TL *et al.* Reliability of quantitative EEG (qEEG) measures and LORETA current source density at 30 days. Neurosci Lett 2012;518:27–31.

13 Mouraux A, Guérit JM, Plaghki L. Non-phase locked EEG responses to CO2 laser skin stimulations may reflect central interactions between A partial partial differential- and C-fibre afferent volleys. Clin Neurophysiol 2003;114: 710–22.

14 Van Der Werf J, Buchholz VN, Jensen O *et al.* Reorganization of oscillatory activity in human parietal cortex during spatial updating. Cereb Cortex 2013;23: 508–19.

15 Craig AD, Reiman EM, Evans A *et al.* Functional imaging of an illusion of pain. Nature 1996;384:258–60.

16 Rainville P, Duncan GH, Price DD *et al.* Pain affect encoded in human anterior cingulate but not somatosensory cortex. Science 1997;277:968–71.

17 Benuzzi F, Lui F, Duzzi D *et al.* Does it look painful or disgusting? Ask your parietal and cingulate cortex. J Neurosci 2008;28:923–31.

18 Freund W, Wunderlich AP, Stuber G *et al.* Different activation of opercular and posterior cingulate cortex (PCC) in patients with complex regional pain syndrome (CRPS I) compared with healthy controls during perception of electrically induced pain: a functional MRI study. Clin J Pain 2010;26:339–47.

19 Pujol J, López-Solà M, Ortiz H *et al.* Mapping brain response to pain in fibromyalgia patients using temporal analysis of FMRI. PLoS One 2009;4:e5224.

20 McLoughlin MJ, Stegner AJ, Cook DB. The relationship between physical activity and brain responses to pain in fibromyalgia. J Pain 2011;12:640–51.

J Orthop Sci (2014) 19:667–675
DOI 10.1007/s00776-014-0567-6

ORIGINAL ARTICLE

Investigation of chronic musculoskeletal pain (third report): with special reference to the importance of neuropathic pain and psychogenic pain

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Received: 29 January 2014 / Accepted: 4 March 2014 / Published online: 16 April 2014

Abstract
Background The previous epidemiological surveys conducted in Japan revealed that once the vicious cycle of chronic musculoskeletal pain begins, it is difficult to disrupt the cycle. This finding suggests the existence of problems with the conventional approaches to treatment of chronic musculoskeletal pain. The purpose of this study was to investigate the characteristics of patients with chronic musculoskeletal pain focusing on neuropathic and psychogenic pain.

Methods The questionnaire was sent again to the 660 subjects found to have persistent chronic pain in the epidemiological surveys conducted in 2011. Responses were collected from 588 subjects (response rate 90 %).
Results Of the 588 responders, 365 (62 %) complained of persistent chronic pain. Among them, 128 (35 %) were still receiving treatment and 193 (53 %) had discontinued treatment. The degree of satisfaction with the treatment was low, and 66 % of the patients had switched the medical facility that they visited to receive treatment. The cited reasons for the change in the medical facility visited and discontinuation of treatment were "treatment was ineffective," "I did not have sufficient time," "I thought I could take care of it myself," and "Treatment seemed to be unnecessary". Involvement of neuropathic pain was suggested in 20 % of all the patients with chronic pain. As the PainDETECT Score rose, the Visual Analog Scale (VAS) score became higher and the change of medical facility for treatment also increased. The Pain Catastrophizing Scale score was correlated positively with the VAS score. The Hospital Anxiety and Depression Scale score was significantly correlated with the VAS score and the duration of pain.
Discussion The results of this survey indicated that the chronic course of musculoskeletal pain may be attributable to the following factors: (1) lack of appropriate treatment of neuropathic pain and psychogenic pain, and (2) insufficient awareness/knowledge among patients about chronic musculoskeletal pain.

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Introduction

The National Livelihood Survey provides data on symptoms currently prevalent in the Japanese general

population. According to this survey, low back pain, shoulder stiffness, joint pain and other types of pain are highly ranked [1]. However, while attempting to devise countermeasures against chronic pain among Japanese people, we faced shortage of even basic information concerning the types of pain. Taking this background into account, we initiated the "longitudinal investigation of chronic musculoskeletal pain" in 2010. Until date, we have reported, based on the results of this survey, the prevalence of chronic musculoskeletal pain (15.4 %), the frequency of new onset of this type of pain (11.1 %), and the risk factors for the onset of chronic pain in the Japanese population. The investigation additionally revealed that chronic pain was frequently persistent (45.2 %), and that the risk factors for persistent pain were a VAS score of $\geq$7, duration of pain of $\geq$5 years, and pain affecting the lower back. Of the responders complaining of persistent chronic pain, more than 80 % had a history of treatment; about 30 % were still receiving treatment at the time of the investigation, while 50 % had discontinued treatment because of poor satisfaction with the outcome of treatment [2, 3]. These findings suggest that once the vicious cycle of chronic musculoskeletal pain begins, it is difficult to disrupt the cycle, and that the conventional approaches to treatment of chronic musculoskeletal pain may involve problems. The present survey was undertaken in the same subjects as those in the previously performed mail-based survey to characterize them with a chronic course of musculoskeletal pain, with emphasis laid on the possible involvement of neuropathic pain or psychogenic pain, and identification of problems with the conventional approaches to treatment.

Methods

The questionnaire was mailed to 660 subjects who complained of persistent chronic pain in both the epidemiological surveys of 2010 and 2011 according to the mail-based survey panel maintained by Nippon Research Center, Ltd. [2, 3]. Responses were collected from 588 subjects

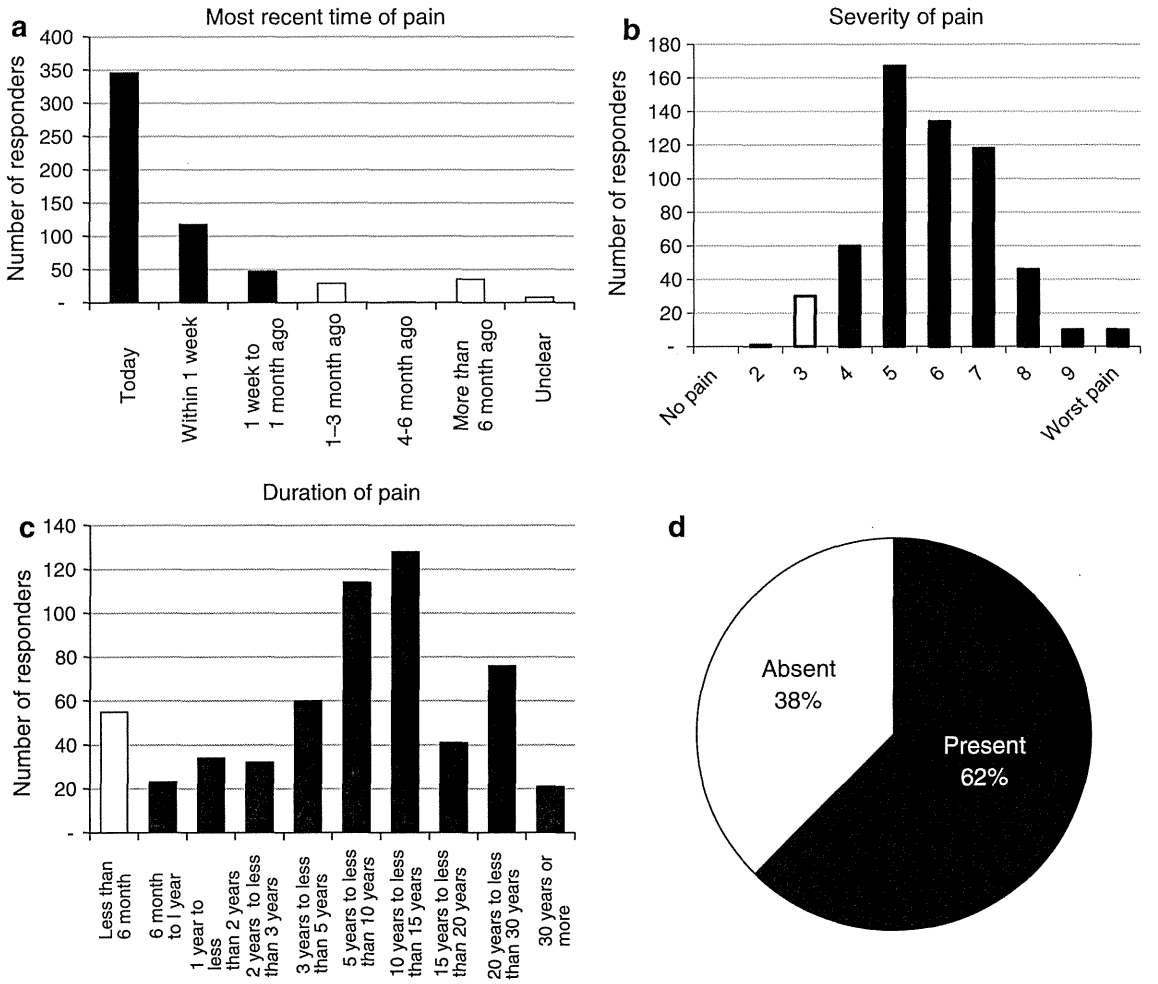

Fig. 1 **a** Most recent time of pain, **b** severity of pain (visual analog scale), **c** duration of pain, **d** prevalence of chronic musculoskeletal pain

(response rate, 90 %). The questionnaire used in this survey contained questions to determine information on the basic demographic characteristics of the subjects (gender, age, location of living, occupation, etc.), information about the chronic musculoskeletal pain (severity, location, duration, presence/absence of treatment, treating medical facility, therapeutic regimen used, treatment period, efficacy, degree of satisfaction with treatment), and information about neuropathic pain (PainDETECT score) [4] or psychogenic pain (Hospital Anxiety and Depression scale: HADS, Pain Catastrophizing Scale: PCS) [5, 6]. The subjects were divided into three categories according to the PainDETECT scores: the Non-neuropathic pain (NP) group (score of 12 or less; low likelihood of involvement of neuropathic pain), the Suspected NP group (score of 13–18; possible involvement of neuropathic pain), and the NP group (score of 19 or higher; strong suggestion of the involvement of neuropathic pain). The HADS consisted of HADS-anxiety (7 anxiety-related items: HADS-A) and HADS-depression (7 depression-related items: HADS-D). The responders were divided according to the HADS-A and HADS-D scores (21 at the maximum each) into 3 categories: score of 7 or less (no problem), score of 8–10 (possible clinical problems), and score of 11 or higher (evident clinical problems). Responders with HADS-A/D scores of 10 or less (non-anxiety group, non-depression group) and those with HADS-A/D scores of 11 or higher (anxiety group, depression group) were compared. Chronic pain was defined as pain experienced at least once in the past 30 days, with severity of 5 or more on a visual analogue scale (VAS), and persisting for 6 months or more, similar to the definition adopted in the 2010 and 2011 surveys [2, 3]. Furthermore, the age, gender, treatment period, frequency of change of the treating facility, VAS score, PainDETECT score, HADS score and PCS score in the responders with persistent chronic pain were compared among medical facilities and folk remedies. For inter-group comparison, *t* test or ANOVA was used for continuous variables and the Chi-square test or Fisher's exact test for categorical variables. This study was approved by the IRB of Keio University.

Results

Characteristics of the responders complaining of persistent chronic pain

According to the definition of chronic pain, 365 (62 %) of the 588 respondents had persistent chronic pain, while the remaining 223 respondents (38 %) no longer complained of chronic pain. A noteworthy finding was that the most frequently recorded duration of pain was 10–15 years, and the second most frequently recorded duration was 5–10 years (Fig. 1). The most frequently recorded site of pain was the low back (75 %), followed by the neck and shoulder (about 60 %), similar to the results of the previous surveys (Fig. 2a). When individual respondents were questioned about the site of the most persistent pain, the most frequent response was the lower back (33 %), followed by the neck and shoulder (Fig. 2b).

Treatment status among responders complaining of persistent chronic pain

Of the 365 responders complaining of persistent chronic pain, 128 (35 %) were still receiving treatment at the time of the survey, while 193 (53 %) had discontinued treatment. Forty-four responders (12 %) were not receiving treatment despite the presence of persistent pain (Fig. 3a). The treatment period was 1 year or longer in about 40 % of all respondents, indicating a tendency for prolonged treatment (Fig. 3b). When questioned about the outcome of

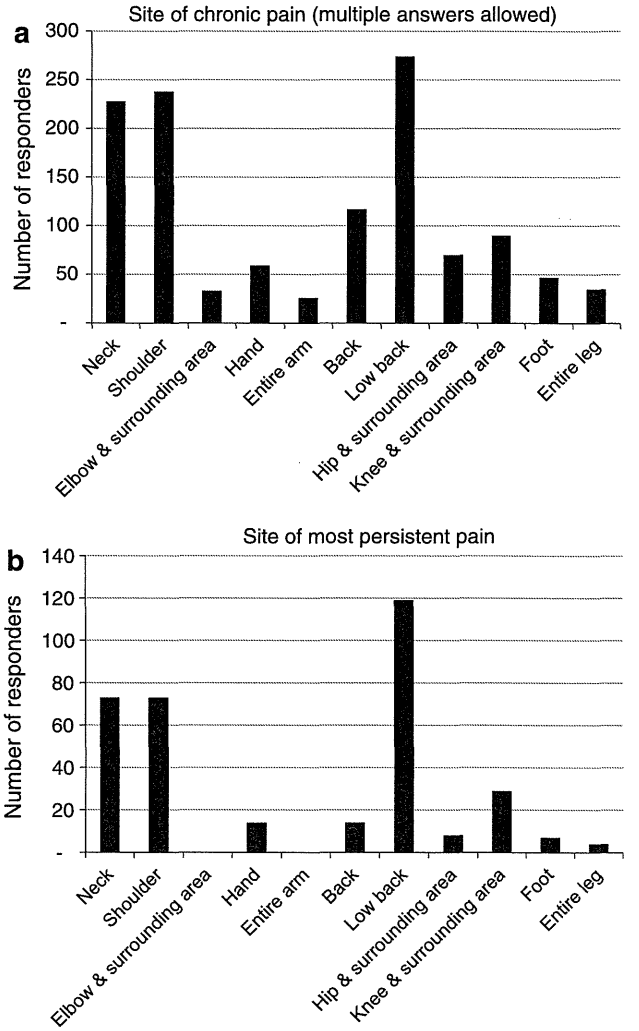

Fig. 2 **a** Site of chronic pain (multiple answers allowed), **b** site of the most persistent pain

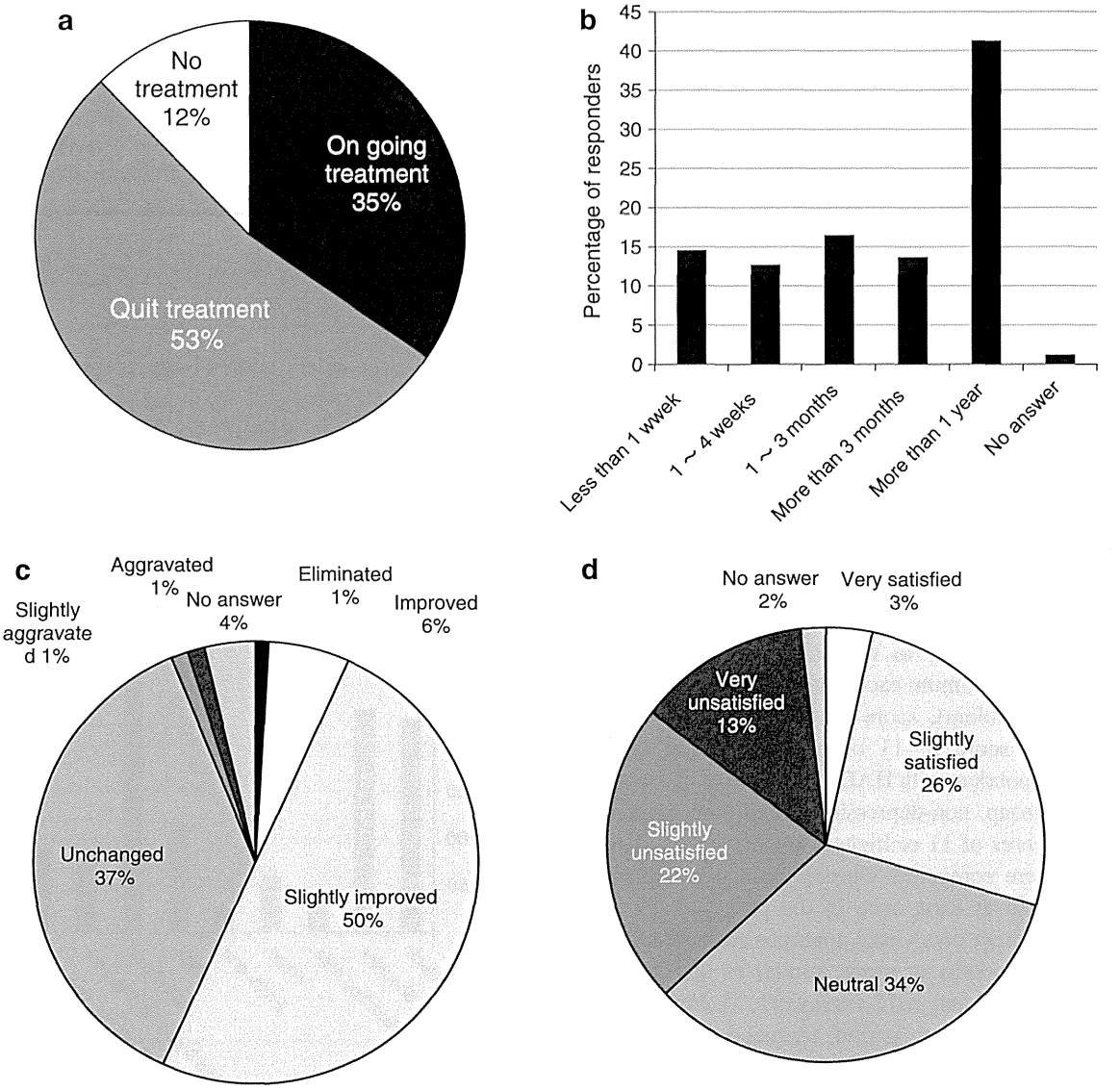

Fig. 3 Treatments received for persistent, chronic pain: **a** treatment circumstances, **b** duration of treatment, **c** efficacy of first treatment, **d** degree of satisfaction with first treatment

treatment at the first treating facility, the responses were "disappeared, improved or slightly improved" in 57 %, and "unchanged, slightly aggravated or aggravated" in 39 % (Fig. 3c). The degree of satisfaction with treatment was "very satisfied or slightly satisfied" in only 29 %, and "neutral, slightly unsatisfied or very unsatisfied" in as many as 69 % of the cases (Fig. 3d).

As a result, the responders often changed the treating facility (66 %), with the frequency of change being once in 40 %, twice in 3 %, three times in 11 %, and 4 times or more in 18 % of the cases (Fig. 4a, b). In a further analysis of the changes in the treating facility, the type of facility providing the initial treatment was most frequently orthopedics (185 responders, 58 %), followed in frequency by a chiropractic/osteopathy (82 responders, 26 %). However, when asked about the type of facility visited as the second treating facility, a smaller number of responders answered "orthopedics" (84 responders) and a larger number of responders answered "chiropractic/osteopathy" (87 responders), with scarce change in the number of responders answering "massage/acupuncture." When asked about the type of facility visited as the third and subsequent treating facility, the number of responses for each type of facility decreased to a similar degree (Fig. 4c).

The most frequent reason for changing the treating facility was "treatment was ineffective" (35 %), followed by "I did not have sufficient time" (30 %), "I thought I could take care of it myself" (10 %), and "it was economically unaffordable" (10 %) (Fig. 5a). The reason for not receiving any treatment was "efficacy was not

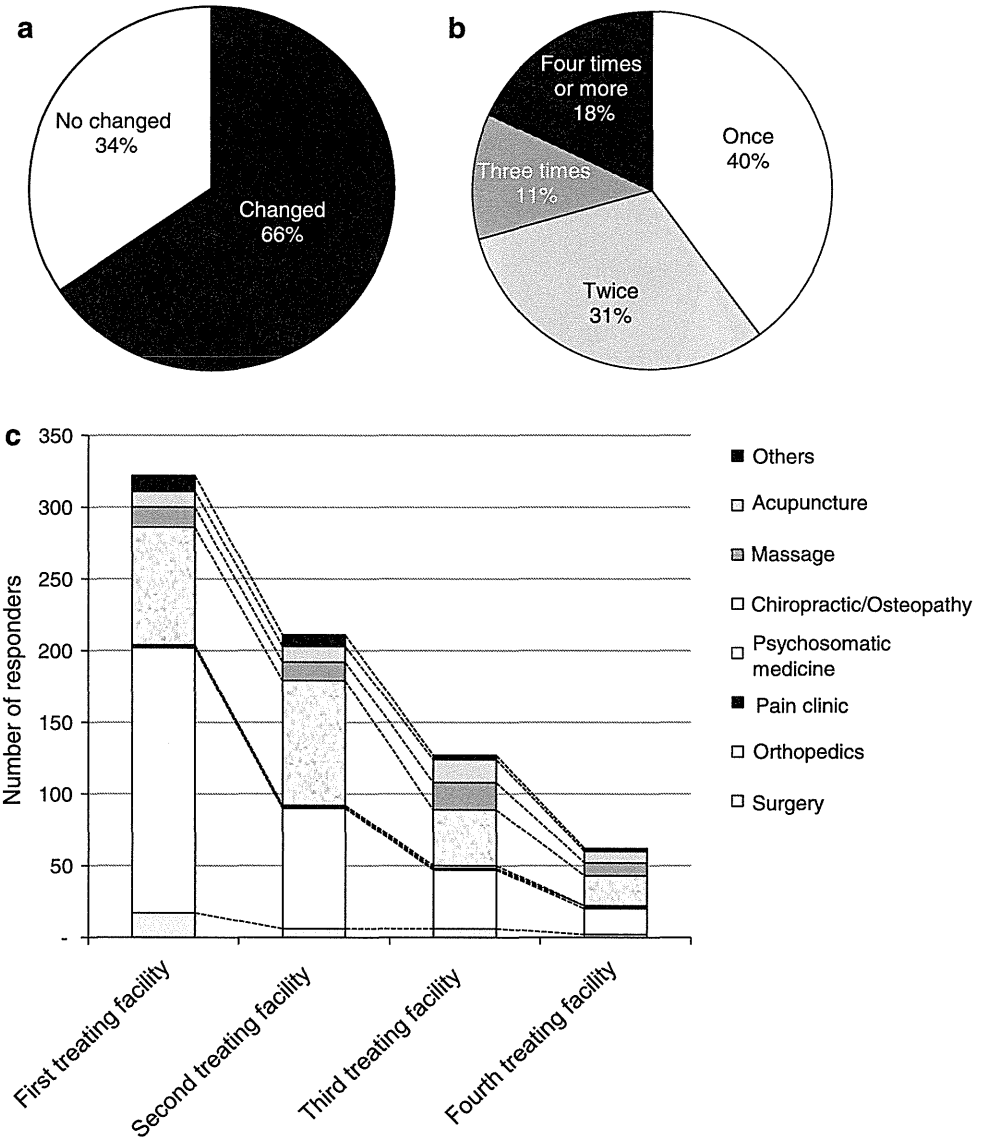

Fig. 4 Circumstances of changes in treatment facility: **a** whether changed, **b** frequency of change, **c** history of change of the treatment facility

expected" (29 %), "I thought it may be possible to deal with the pain by myself" (27 %), "I wanted to receive treatment, but could not receive it" (18 %), and "treatment seemed to be unnecessary" (11 %) (Fig. 5b).

Involvement of neuropathic pain in persistent chronic pain

Involvement of neuropathic pain in the responders complaining of persistent chronic pain was investigated through analysis of the PainDETECT scores. The percentage of responders classified into the NP group was 7 %, and that of responders classified into the Suspect NP group was 13 % (Fig. 6a). In an analysis of the relation to gender, involvement of neuropathic pain was seen more frequently in males than in females with a marginal significance ($p = 0.06$) (Fig. 6b). In the analysis of the relationship between the VAS score and PainDETECT score, the VAS scores differed significantly among the three groups divided according to the involvement of neuropathic pain. There were significant differences in VAS scores between the non-NP and Suspect-NP groups ($p = 0.043$), and between the non-NP and NP groups ($p < 0.001$, Bonferroni post-hoc test) (Fig. 6c). There was a significant difference in the frequency of change of the treating facility among the three groups ($p < 0.05$). Even after removing the influence of VAS score, covariance analysis revealed that the frequency of change of the treating facility was lower in the non-NP group compared to the NP group with a marginal significance ($p = 0.056$) (Fig. 6d).

Involvement of psychogenic pain in persistent chronic pain

The involvement of psychological factors in chronic musculoskeletal pain was investigated through analysis of the correlation between the VAS scores and PCS scores. This

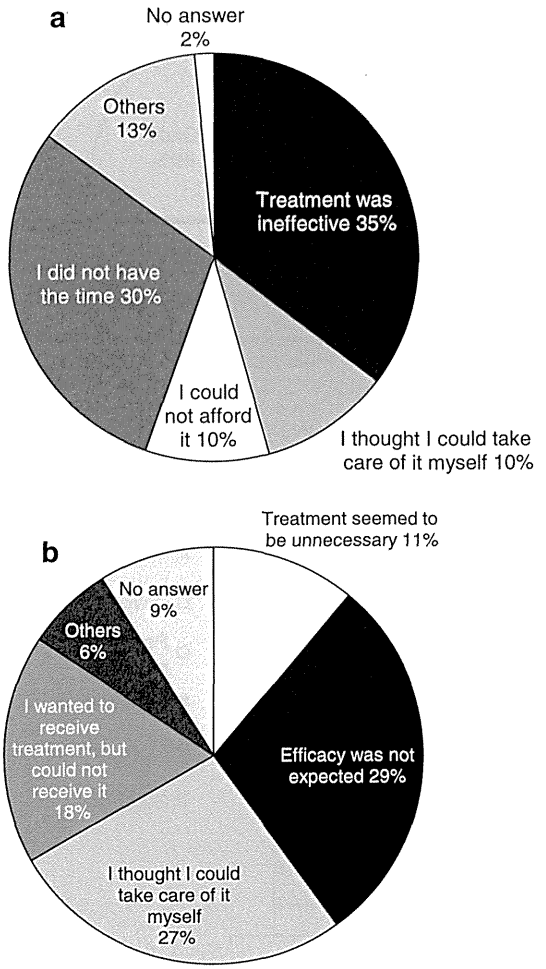

Fig. 5 **a** Reason for discontinuation of treatment, **b** reason for seeking no treatment

analysis revealed a weak but statistically significant positive correlation between the VAS and PCS scores (Spearman's correlation coefficient = 0.224, $p < 0.001$) (Fig. 7a). When analyzed in relation to the HADS-A score, the VAS score was significantly higher in the responders classified into the anxiety group than in the responders classified into the non-anxiety group, while the duration of pain did not differ significantly between the two groups. When analyzed in relation to the HAD-D score, the duration of pain was significantly longer in the depression group than in the non-depression group ($p = 0.019$, covariance analysis with VAS score), while the VAS score did not differ significantly between the two groups (Fig. 7b).

Characteristics of the responders complaining of persistent chronic pain, analyzed by the type of the first treating facility

The characteristics of the responders complaining of persistent chronic pain were compared between the two groups divided by the type of the first treating facility, i.e., the group which received the first treatment at a medical facility (medical facility group) and the group which received the first treatment at a folk remedy (folk remedy group). The male-to-female ratio did not differ significantly between the medical facility group and the folk remedy group, however, the age of the responders was significantly higher in the medical facility group than in the folk remedy group. There was no significant difference in terms of the treatment period or the frequency of change of the treating facility between the two groups. The VAS score did not differ between the two groups either. The PainDETECT score tended to be higher in the medical facility group (8.3) than in the folk remedy group (6.4), although the difference was not statistically significant ($p = 0.06$). The PCS score was significantly higher in the medical facility group (26.5) than in the folk remedy group (23.2) ($p < 0.01$, Table 1).

Discussion

Current status of responders complaining of persistent chronic musculoskeletal pain

Of the responders who complained of chronic musculoskeletal pain at the time of the survey in 2010, 45 % continued to complain of chronic pain in the 2011 survey, and the percentage of responders still complaining of chronic pain rose to 62 % in the survey of 2012. This result suggests that relief from chronic musculoskeletal pain becomes more difficult as the duration of chronic pain increases. In the present survey, the mean VAS score was higher than the score recorded in the 2010 survey, and the most frequent site of pain was the low back (70 %), suggesting the possibility that many of the responders complaining of chronic pain in this survey had intractable low back pain. This finding is consistent with the results of the longitudinal epidemiological survey of 2011, in which the pain in the "low back" as the site of pain and pain for "5 years or longer" as the duration of pain were suggested as risk factors for the persistence of chronic pain [3]. Past reports have also suggested that lower back pain is associated with a high risk of relapse and a chronic course [7–11]. Therefore, approaches for dealing with the high-risk group will become more important when countermeasures against chronic musculoskeletal pain are discussed.

Problems with treatment of persistent chronic pain and countermeasures

Slightly more than 80 % of all responders complaining of persistent chronic pain had a history of treatment, with the treatment still continuing in 30 % of the respondents at the

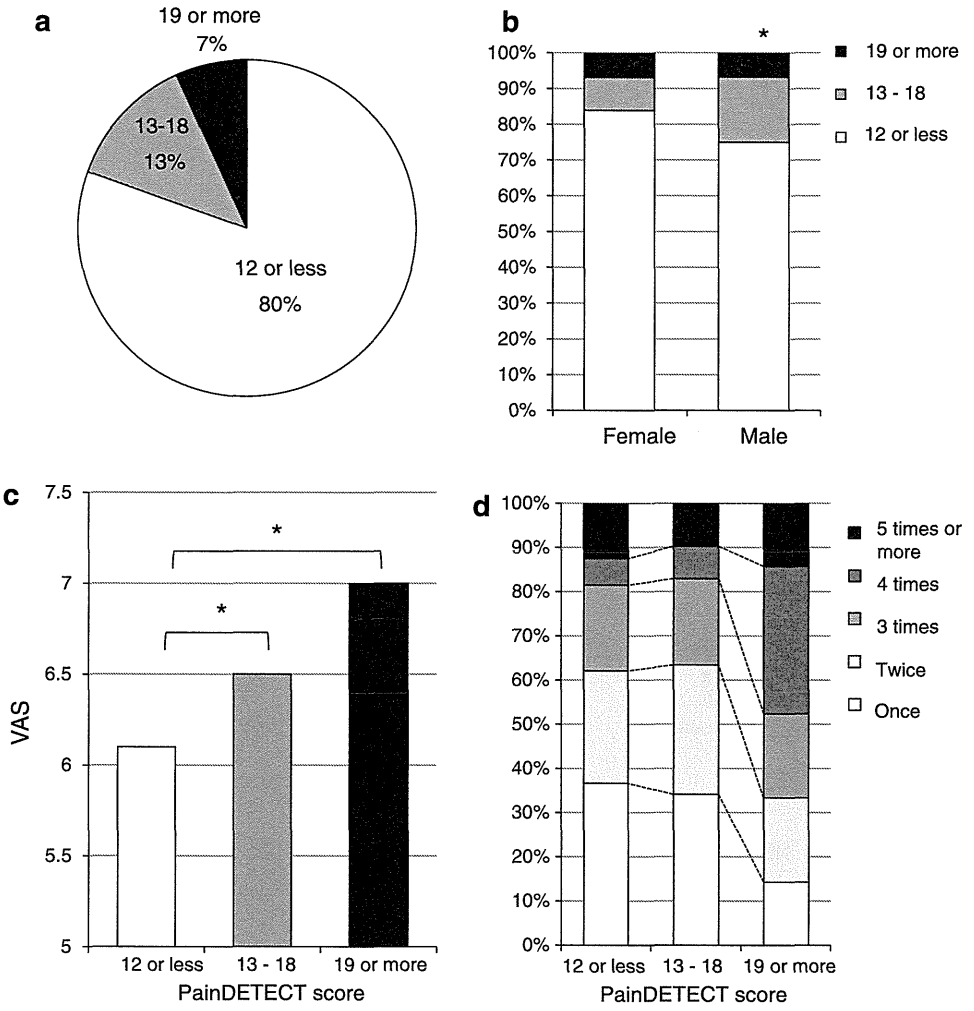

Fig. 6 Influence of neuropathic pain on chronic pain: **a** distribution of the painDETECT scores, **b** comparison of painDETECT scores between males and females ($*p = 0.06$), **c** correlation between painDETECT scores and VAS scores ($*p < 0.05$), **d** influence of painDETECT score on frequency of change of the treatment facility

time of the present survey. The remaining 50 % were no longer receiving treatment despite persistent pain. When asked about the efficacy of treatment, about 40 % answered "unchanged" or "aggravated," with the degree of satisfaction with the treatment being "neutral," "slightly unsatisfied" or "quite unsatisfied" in about 70 %. This tendency was similar to that seen in the 2011 survey. Thus, 66 % of respondents complaining of chronic pain changed the treating facility, with the frequency of change being once or twice in about 70 % of the responders who changed the treating facility. To our surprise, 30 % of the responders changed their treating facility three or more times, suggesting that the percentage of responders engaging in so-called "doctor shopping" cannot be ignored. When changes in the type of the treating facility were analyzed, the first treating facility was an orthopedics in slightly more than 60 % of all responders, while the share of orthopedics as the treating facility decreased to about 50 % after the first change of the treating facility. There was, however, no marked change in the share of folk remedies as the treating facility. This result is consistent with the finding from the survey of 2011, which revealed that the degree of satisfaction with treatment at medical facilities was lower than that at folk remedies [3], suggesting that the initial treatment provided at medical facilities may not be adequate. However, there was no marked difference between medical facilities and folk remedies in terms of the tendency towards subsequent changes of the treating facility. The most frequent reason for changing the treating facility or discontinuing treatment was "treatment was ineffective," indicating that the current approach for treating chronic musculoskeletal pain may not be sufficiently effective. To identify the factors possibly underlying this finding, we investigated the involvement of neuropathic pain and psychogenic pain in persistent chronic musculoskeletal pain.

This analysis suggested possible involvement of neuropathic pain in about 20 % of all responders complaining of chronic pain. It was additionally revealed that the VAS score rose significantly and the frequency of change of the

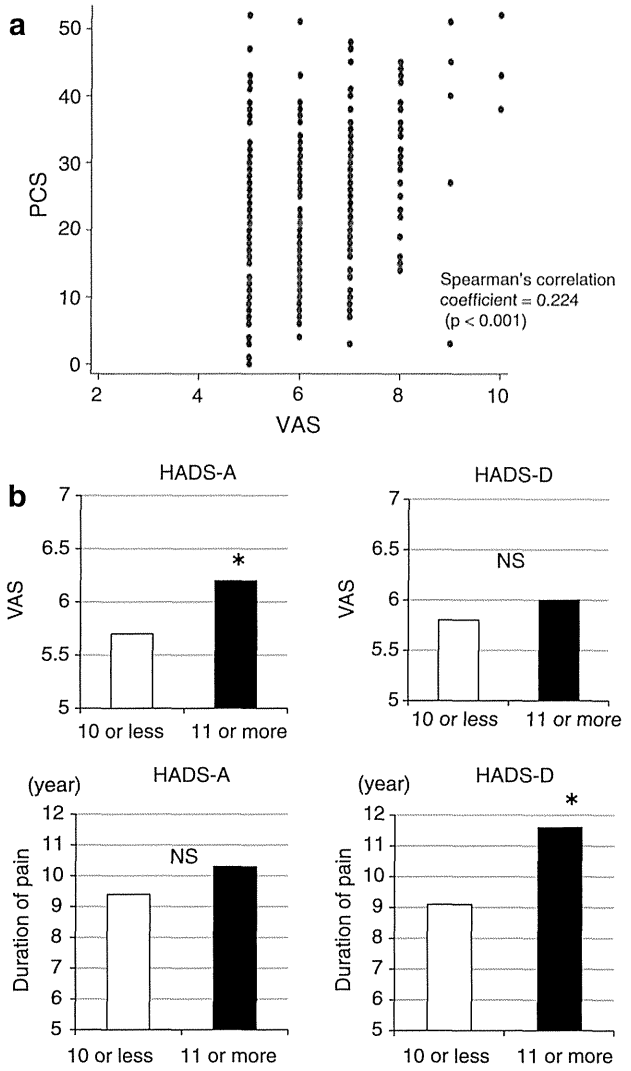

Fig. 7 Influence of psychogenic pain on chronic pain: **a** correlation between PCS and VAS scores, **b** influence of HADS-A (anxiety) and HADS-D (depression) scores on the VAS score and duration of pain (*$p < 0.05$)

Table 1 Characteristics of the responders with chronic pain, analyzed by the type of the first treating facility

		Medical facility ($n = 213$)	Folk remedy ($n = 108$)	p value*
Sex				
Female	Number (column %)	129 (60.3)	75 (69.4)	0.11
Male		85 (39.7)	33 (30.6)	
Age	Average (SD)	54.8 (14.8)	46.2 (13.8)	<0.01
Duration of treatment (years)	Average (SD)	10.3(9.0)	10.4 (7.2)	0.91
Frequency of change in the treatment facility	Number (column %)			
1		77 (36.0)	34 (31.5)	0.65
2		51 (23.8)	33 (30.6)	
3		43 (20.1)	22 (20.4)	
4		18 (8.4)	6 (5.6)	
5 or more		25 (11.7)	13 (12.0)	
VAS	Average (SD)	6.1 (1.1)	6.4 (1.1)	0.13
PainDETECT score	Average (SD)	8.3 (6.7)	6.8 (5.9)	0.06
PainDETECT				
12 or less	Number (column %)	146 (76.4)	86 (83.5)	0.34
13–18		29 (15.2)	12 (11.7)	
19 or more		16 (8.4)	5 (4.9)	
PCS score	Average (SD)	26.5 (10.3)	23.2 (9.9)	<0.01

* t test, χ^2 test, Fisher's exact

treating facility also increased as the likelihood of involvement of neuropathic pain became higher. Regarding psychogenic pain, a significant positive correlation was noted between PCS and VAS scores, an increase in HADS-A score was associated with an increase of the VAS score, and an increase in the HADS-D score was associated with a longer duration of pain. In regard to chronic low back pain, which was the most frequent type of pain recorded in the present survey, the previously reported important role of psychogenic factors [12–16] was also endorsed by the results of the present survey. Interestingly enough, analysis of the characteristics of the responders complaining of chronic pain in relation to the type of the first treating facility revealed that medical facilities more frequently managed patients of advanced age and with a stronger likelihood of involvement of neuropathic pain and psychogenic pain than folk remedies. These factors may explain, at least partially, the relatively low satisfaction level of responders with the treatment at medical facilities. However, caution is needed while interpreting the results as to psychogenic pain, in view of the possibility that treatment may result in progression of catastrophic thinking or depressive mood.

Taken together, these results suggest that many of the patients complaining of chronic musculoskeletal pain seek treatment at the orthopedic clinic/department first, but tend to show low levels of satisfaction with the treatment because of insufficient efficacy, and that neuropathic pain and psychogenic pain may be involved in the poor responses of these patients to treatment. Lack of adequate assessment for neuropathic and psychogenic pain during the initial treatment of chronic

musculoskeletal pain and the resultant absence of appropriate treatment seem to lead to "doctor shopping" by patients. A past report also pointed out the close involvement of neuropathic pain with chronic low back pain [17]. To resolve this issue, it will be important to assess the involvement of neuropathic pain on the basis of the PainDETECT score and neuropathic severity score before treatment is started in individual patients complaining of chronic musculoskeletal pain. Furthermore, the results of the present survey suggest that if treatment is provided in a manner tailored to the status of involvement of psychogenic pain rated by the HADS and PCS, it may become possible to reduce the intensity of pain and shorten the duration of pain.

Many previous reports have shown that chronic musculoskeletal pain can impair not only physical health, but also mental health, which may have a large impact on the daily living and social activities of the patients [2, 18]. However, the awareness among patients about chronic pain does not seem to be sufficient, considering the finding from this survey that patients often decided to discontinue treatment or seek no treatment for chronic pain persisting for 3 years or more, on grounds such as "I did not have sufficient time," "I thought I could take care of it myself" and "I thought treatment was unnecessary." At present, the actual status of chronic musculoskeletal pain is not sufficiently well understood by the people in Japan. Dissemination of information through various media to deepen the understanding of the people is important for ensuring a sufficient level of awareness among the people of Japan about the significance of chronic musculoskeletal pain treatment.

This study was conducted as a 2011 Ministry of Health, Labour and Welfare: Health Labour Sciences Research Grant for Comprehensive Research on Disability Health and Welfare (Survey study of chronic musculoskeletal pain).

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Conflict of interest The authors declare that they have no conflict of interest.

References

1. Annual Statistical Report of National Health Conditions. 2010/2011 p. 72–3, Health and welfare statistics association. Japanese.
2. Nakamura M, Nishiwaki Y, Ushida T, Toyama Y. Prevalence and characteristics of chronic musculoskeletal pain in Japan. J Orthop Sci. 2011;16:424–32.
3. Nakamura M, Nishiwaki Y, Ushida T, Toyama Y. Prevalence and characteristics of chronic musculoskeletal pain in Japan: a second survey of people with or without chronic pain. J Orthop Sci. 2014;19:339–50.
4. Matsubayashi M, Takeshita K, Sumitani M, Oshima Y, Kato S, Ohya J, Oichi T, Okamoto N, Tanaka S. Validity and reliability of the Japanese version of the PainDETECT questionnaire: a multicenter observational study. PLoS ONE. 2013;8:e68013.
5. Zigmond AS, Snaith RP. The hospital anxiety and depression scale. Acta Psychiatr Scand. 1983;67:361–70.
6. Sullivan MJL, Bishop SR, Pivik J. The Pain Catastrophizing Scale: development and validation. Concerns the construction and validation of the Pain Catastrophizing Scale (PCS), the most comprehensive assessment instrument to date of the catastrophizing construct. The authors demonstrate a three-factor hierarchical structure for the PCS, including magnification, helplessness and rumination dimensions. Psychol Assess. 1995;7:524–32.
7. Carey TS, Garrett JM, Jackman A, Hadler N. Recurrence and care seeking after acute back pain: results of a long-term follow-up study. North Carolina Back Pain Project. Med Care. 1999;37:157–64.
8. Pengel L, Herbert R, Maher CG, Refshauge KM. Acute low back pain: a systematic review of its prognosis. BMJ. 2003;327:323–7.
9. Von Korff M. Studying the natural history of back pain. Spine. 1994;19:2041S–6S.
10. Von Korff M, Deyo RA, Cherkin DC, Barlow W. Back pain in primary care: outcomes at 1 year. Spine. 1993;18:855–62.
11. Stanton TR, Latimer J, Maher CG, Hancock M. Definition of recurrence of episode of low back pain: a systematic review. Spine. 2009;34:E316–22.
12. Ehrlich GE. Low back pain. Bull World Health Organ. 2003;81:671–6.
13. Iles RA, Davidson M, Taylor NF. Psychosocial predictors of failure to return to work in non-chronic non-specific low back pain: a systematic review. Occup Environ Med. 2008;65:507–17.
14. Matsudaira K, Konishi H, Miyoshi K, Isomura T, Takeshita K, Hara N, Yamada K, Machida H. Potential risk factors for new onset of back pain disability in Japanese workers: findings from the Japan epidemiological research of occupation-related back pain study. Spine. 2012;37:1324–31.
15. Linton SJ. Psychological risk factors for neck and back pain. In: Nachemson AJ, Jonsson E, editors. Neck and back pain: the scientific evidence of causes, diagnosis and treatment. Philadelphia: Lippincott Williams & Wilkins; 2000. p. 57–78.
16. Kopec JA, Sayre EC. Work-related psychosocial factors and chronic pain: a prospective cohort study in Canadian workers. J Occup Environ Med. 2004;46:1263–71.
17. Freynhagen R, Baron R, Tölle T, Stemmler E, Gockel U, Stevens M, Maier C. Screening of neuropathic pain components in patients with chronic back pain associated with nerve root compression: a prospective observational pilot study (MIPORT). Curr Med Res Opin. 2006;22:529–37.
18. Yamada K, Matsudaira K, Takeshita K, Oka H, Hara N, Takagi Y. Prevalence of low back pain as the primary pain site and factors associated with low health-related quality of life in a large Japanese population: a pain-associated cross-sectional epidemiological survey. Mod Rheumatol 2014;24:343–8.

J Orthop Sci (2014) 19:339–350
DOI 10.1007/s00776-013-0525-8

ORIGINAL ARTICLE

Prevalence and characteristics of chronic musculoskeletal pain in Japan: A second survey of people with or without chronic pain

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Received: 7 April 2013 / Accepted: 16 December 2013 / Published online: 7 February 2014

Abstract
Background An epidemiological survey conducted in Japan in fiscal year 2010 revealed a high prevalence of chronic musculoskeletal pain, low patient satisfaction with treatment, a high incidence of protracted treatment lasting a year or more, and reduced quality of life. To improve the current system for treating chronic musculoskeletal pain, it is important to identify risk factors, including patient characteristics, for developing chronic pain. Thus, we sought to determine the incidence of new chronic pain in the Japanese population, as well as the persistence rate, associated factors, and current state of treatment of chronic pain, by repeating a postal survey in a nationwide representative sample group first surveyed in 2010.
Methods Among 11,507 participants in the 2010 epidemiological survey, 1,717 reported chronic pain and 6,283 reported no chronic pain. A repeat questionnaire, mailed to subjects in these 2 groups in fiscal year 2011, received replies from 85 % of those who reported pain and 76 % of those without pain in 2010.
Results The incidence of new chronic pain was 11.1 %. Risk factors for developing chronic pain included working in a professional, managerial, or clerical/specialist occupation, being female, having a BMI ≥25; currently using alcohol or cigarettes; and having completed an education level of vocational school or higher. Persistent chronic pain was reported by 45.2 % of respondents. Those with severe (VAS score ≥7) and constant lower-back pain lasting more than 5 years had the highest risk of the pain persisting. More than 80 % respondents with persistent chronic pain had a history of treatment, and while about 30 % were still receiving treatment at the time of the survey, the other 50 % had discontinued treatment despite the persistence of pain because of a low degree of satisfaction with treatment.
Discussion We identified risk factors related to the development of new chronic pain and the persistence of chronic pain. Countermeasures to prevent chronic pain could be especially important for the high-risk populations for understanding the pathology of chronic pain.

Introduction

The National Livelihood Survey found motor-organ pain in the form of low back pain, stiff shoulders, and arthralgia to be the most common symptoms [1] suffered by the Japanese public. However, we do not know enough about these symptoms, even at a basic level, to create effective strategies to counteract chronic pain in our country. The Survey Study on Chronic Musculoskeletal Pain, conducted in Japan in 2010, found that chronic musculoskeletal pain had a symptom prevalence of 15.4 % and that 42 % of people reporting chronic musculoskeletal pain had received treatment. The treatment period became protracted, lasting a year or more, in 70 % of those who were treated, and patient satisfaction with treatment was low. We also found that chronic musculoskeletal pain strongly impacted the

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sufferer's life through both a loss of social activity and a long-term increase in the degree of assistance needed in daily life and also strongly affected the lives of people around the one suffering pain in Japan [2]. This emphasizes the importance of identifying the characteristics and risk factors of patients whose pain becomes chronic, and establishing preventive measures. In the present study, we repeated a postal survey of a representative nationwide sample to examine the incidence of new chronic pain, the chronic pain persistence rate, factors associated with chronic pain, and the actual state of treatment for those with persistent, chronic pain in Japan.

Methods

The original survey group, a nationwide, randomly selected sample, was chosen in 2010 through the Mail-in Survey Panel maintained by the Nippon Research Center [2]. The Panel is based on a randomly selected address-based sample with gender and age distributions similar to those in the national population census. To create a mailing address sample that reflected the demographic composition of the Japanese population, subjects were specified as being residents of Japan who were 18 or more years of age, and quotas were set for gender, age, and regional distribution to correspond to the population as a whole. The 2010 survey included 11,507 subjects, of which 1,770 reported chronic pain and the others reported no chronic pain. We mailed a repeat questionnaire to these 2 groups in 2011, and obtained replies from 1,460 of those who had reported chronic pain (reply rate 82.5 %) and 4,797 of those who did not have chronic pain (reply rate 76 %) at the time of the 2010 survey. Besides such basic information as gender, age, location of residence, and occupation, our questionnaire asked about the severity, location, and duration of chronic musculoskeletal pain, whether the pain was treated, and about the facility where treatment was received, the nature of the treatment, the treatment period and effectiveness, and the patient's degree of satisfaction. In both the 2010 and 2011 surveys, musculoskeletal pain was defined as pain associated with bone, muscle, joints, or nerves at each of 11 anatomical sites (neck, back, low back, shoulder, elbow, wrist/hand, arm, hip, knee, ankle/foot and leg) (Fig. 1), and chronic pain was also defined as pain experienced at least once in the past 30 days, with a severity score of 5 or more on a visual analogue scale (VAS), and persisting for 6 months or more. We calculated the incidence rate of new chronic pain based on the 4,797 persons who did not have chronic pain in fiscal 2010, and the chronic pain persistence rate based on the 1,460 persons who had reported chronic pain in fiscal 2010. Incidence rates and persistence rates were

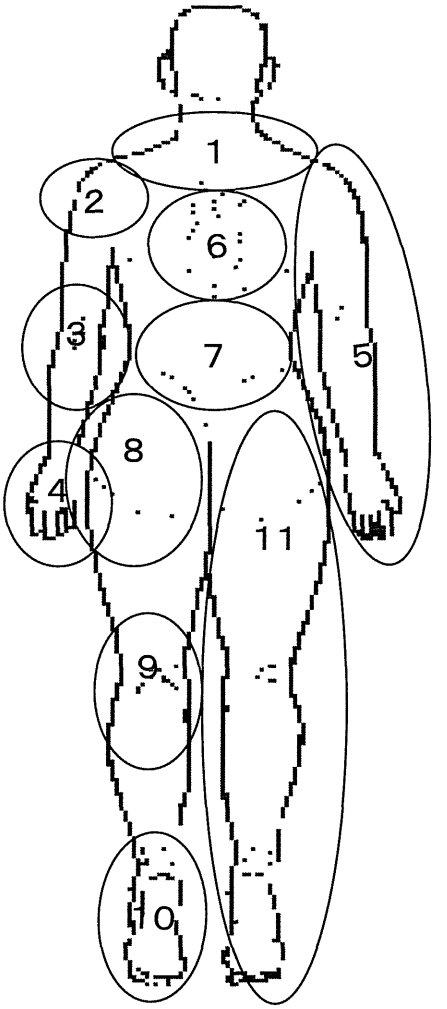

Fig. 1 The full-body manikin used in the pain-associated epidemiological survey. *1* neck, *2* shoulder, *3* elbow, *4* wrist/hand, *5* arm, *6* back, *7* low back, *8* hip, *9* knee, *10* ankle/foot, *11* leg

calculated according to the individual factors such as gender, area of residence, and urban size, and occurrence rates were compared by the χ^2 test. In addition to gender and age, significantly associated factors identified by the crude odds ratio ($p < 0.1$) were ultimately included in multivariate analysis (logistic regression analysis), and adjusted odds ratios were calculated. Factors for which the crude odds ratio did not find an association were also incorporated into the final model, one by one, to check their effect.

We evaluated the treatment circumstances in detail for respondents who reported persistent chronic pain, including whether the pain was treated, the type of treating facility, the nature and effectiveness of the treatment, the subject's degree of satisfaction, and whether the patient changed treatment facilities. This study was approved by the IRB of Keio University.

Table 1 Incidence of chronic pain by factors

	Number	Incidence (%)	Crude OR (95 % CI)	*p* value	Multivariate-adjusted OR[a] (95 % CI)	*p* value
All	531/4797	11.1				
Gender						
Men	220/2110	10.4	1		1	
Women	311/2687	11.6	1.12 (0.94–1.35)	0.209	1.47 (1.17–1.85)	0.001
Age						
20–29	54/496	10.9	1		1	
30–39	100/733	13.6	1.29 (0.91–1.84)	0.153	1.07 (0.73–1.63)	0.728
40–49	113/794	14.2	1.36 (0.96–1.92)	0.083	1.11 (0.76–1.63)	0.595
50–59	92/794	11.6	1.07 (0.75–1.53)	0.700	0.92 (0.62–1.37)	0.692
60–69	93/1044	8.9	0.80 (0.56–1.14)	0.218	0.80 (0.54–1.20)	0.282
70–79	72/854	8.4	0.75 (0.52–1.09)	0.136	0.89 (0.58–1.35)	0.571
80–	7/82	8.5	0.76 (0.33–1.74)	0.522	0.71 (0.27–1.88)	0.496
Area						
Hokkaido	27/211	12.8	1		1	
Touhoku	32/295	10.9	0.83 (0.48–1.43)	0.501	0.86 (0.50–1.50)	0.602
Kanto	204/1837	11.1	0.85 (0.55–1.31)	0.462	0.80 (0.51–1.23)	0.307
Chubu	55/553	10.0	0.75 (0.46–1.23)	0.256	0.74 (0.45–1.23)	0.246
Hokuriku	17/205	8.3	0.62 (0.32–1.17)	0.138	0.64 (0.33–1.23)	0.182
Kinki	101/855	11.8	0.91 (0.58–1.44)	0.694	0.90 (0.56–1.42)	0.644
Chugoku	38/295	12.9	1.01 (0.59–1.71)	0.977	1.09 (0.63–1.87)	0.760
Shikoku	8/127	6.3	0.46 (0.20–1.04)	0.063	0.52 (0.22–1.19)	0.122
Kyushu	49/419	11.7	0.90 (0.55–1.49)	0.689	0.80 (0.48–1.36)	0.414
City size						
500,000≦	180/1390	13.0	1		1	
150,000≦	163/1521	10.7	0.81 (0.64–1.01)	0.062	0.83 (0.66–1.05)	0.122
<150,000	142/1360	10.4	0.78 (0.62–1.00)	0.041	0.83 (0.65–1.06)	0.134
County	39/401	9.7	0.72 (0.50–1.04)	0.084	0.78 (0.54–1.14)	0.201
No answer	7/125	5.6	0.40 (0.18–1.01)	0.021	0.47 (0.20–1.10)	0.082
Occupation						
Others[b]	346/3427	10.1	1		1	
Professional, manager, clerical, and skill	183/1345	13.6	1.41 (1.16–1.70)	<0.001	1.36 (1.08–1.71)	0.010
Marital status						
Divorced/widowed/single	100/1038	9.6	1		1	
Married	427/3702	11.5	1.22 (0.97–1.54)	0.086	1.27 (0.98–1.64)	0.073
Living condition						
Alone	28/324	8.6	1			
Not alone	497/4417	11.3	1.34 (0.90–2.00)	0.150		
BMI category						
−18.49	48/400	12.0	1.15 (0.83–1.58)	0.395	1.03 (0.74–1.44)	0.864
18.5–24.9	368/3469	10.6	1		1	
25.0–	108/857	12.6	1.22 (0.97–1.53)	0.095	1.28 (1.01–1.62)	0.038
Alcohol drinking[c]						
Never	197/2033	9.7	1		1	
Ex-drinker	49/365	13.4	1.45 (1.03–2.02)	0.031	1.4 (0.98–1.98)	0.061
Current drinker	282/2344	12.0	1.27 (1.05–1.55)	0.014	1.23 (1.00–1.52)	0.050
Smoking[c]						
Never	335/3155	10.6	1		1	
Ex-drinker	74/753	9.8	0.92 (0.70–1.20)	0.524	0.92 (0.69–1.22)	0.567

Table 1 continued

	Number	Incidence (%)	Crude OR (95 % CI)	*p* value	Multivariate-adjusted OR[a] (95 % CI)	*p* value
Current drinker	119/841	14.2	1.39 (1.11–1.74)	0.004	1.32 (1.03–1.69)	0.031
Education						
High school or lower	241/2457	9.8	1		1	
Technical or higher	287/2316	12.4	1.30 (1.08–1.56)	0.005	1.24 (1.02–1.51)	0.030
Income						
−3,990,000	188/1752	10.7	1			
4,000,000–7,990,000	226/2022	11.2	1.05 (0.85–1.29)	0.662		
8,000,000–9,990,000	60/461	13.0	1.24 (0.91–1.70)	0.167		
10,000,000–	48/432	11.1	1.04 (0.74–1.46)	0.820		

[a] adding to age category and sex, variables which had a statistically significant influence on odds ratio were included in the model

[b] agriculture, forestry, and fisheries/independent business/part-time worker/full-time homemaker/student/inoccupation

[c] alcohol drinking and smoking were categorized into three categories [never, ex (used to), and currently smoking] based on the questionnaire

Results

Incidence rate and risk factors for new chronic pain

Among the 4,797 people who did not have chronic pain in 2010, 531 reported newly developed chronic pain in the 2011 survey; the incidence rate was 11.1 %. Table 1 shows the incidence rates according to individual factors. Crude analysis suggested associations between the development of chronic pain and age, area, city size, occupation, marital status, BMI category, alcohol use, smoking, and education history. Multivariate analysis identified statistically significant associations with gender (female), occupation (professional, managerial, clerical/specialist), a BMI ≥25, current alcohol or cigarette use, and a highest-completed education level of vocational school or higher (Table 1).

Persistence rate for chronic pain, and risk factors for persistence

Of the 1,460 persons who reported chronic pain in 2010, 660 reported its persistence in the 2011 survey (45.2 %). Table 2 shows persistence rates according to individual factors. Crude analysis suggested associations between pain persistence and age, area, occupation, marital status, and household income, and the pain site, severity, frequency and duration and change of practice as reported on the 2010 survey. Multivariate analysis identified statistically significant associations with the following factors in the 2010 survey: a pain VAS score of 7–8, constant pain, pain persistence for 5 years or more, and a pain site in the lower back (Table 2). Although the *p* value for the crude analysis of change of practice was 0.082, it is not included in the multivariate analysis because this greatly reduced the sample size. Even if we forcibly included this variable of the model, it did not show a statistically significant result ($p = 0.299$).

The state of treatment for persistent chronic pain

Characteristics of initial treatment

Although 31.7 % of the people with persistent chronic pain reported ongoing treatment for pain, 50.6 % had received treatment in the past but were no longer being treated, and 15.3 % had never received treatment (Fig. 2a). Approximately 60 % of those with persistent chronic pain and a history of treatment were initially treated at a medical facility such as an orthopaedic surgery department or surgery department, and the others were initially treated with folk medicines such as chiropractic, osteopathy, massage, or acupuncture/moxibustion (Fig. 2b). The most common type of initial treatment was physical therapy (28 %), followed by massage (26 %), medication (22 %), and orthotic treatment (8 %) (Fig. 2c). The most common treatment frequencies were once and several times weekly (approximately 30 % each), followed by once every 2 weeks or less, and daily (Fig. 3a). The most common treatment duration, reported by 40 %, was a year or longer (Fig. 3b).

Effectiveness of initial treatment and degree of patient satisfaction

Of the respondents who were initially treated at a medical facility, the pain was improved in 7 %, somewhat improved in 54 %, unchanged in 33 %, somewhat aggravated in 2 %, and aggravated in 1 % by the treatment received (Fig. 4a). Only 6 % reported that they were very satisfied with the treatment received; 28 % were somewhat satisfied, 35 % were neither satisfied nor dissatisfied, 20 %

Table 2 Continuance rate of pain by factors

	Number	Continuance rate	p value for χ^2 test	Crude OR (95 % CI)	p value	Multivariate-adjusted OR[a] (95 % CI)	p value
All	660/1460	45.2 %					
Gender							
Men	248/564	44.0 %	$p = 0.452$	1		1	
Women	412/896	46.0 %		1.08 (0.88–1.34)	0.452	1.23 (0.94–1.61)	0.124
Age							
20–29	78/138	56.5 %	$p < 0.001$	1		1	
30–39	125/270	46.3 %		0.66 (0.44–1.00)	0.051	0.74 (0.44–1.24)	0.255
40–49	159/309	51.5 %		0.82 (0.54–1.22)	0.322	1.14 (0.68–1.90)	0.628
50–59	121/269	45.0 %		0.63 (0.42–0.95)	0.028	0.80 (0.47–1.36)	0.411
60–69	101/256	39.5 %		0.5 (0.33–0.76)	0.001	0.76 (0.44–1.33)	0.340
70–79	72/194	37.1 %		0.45 (0.29–0.71)	0.001	0.71 (0.40–1.27)	0.246
80–	4/24	16.7 %		0.15 (0.05–0.47)	0.001	0.37 (0.10–1.30)	0.120
Area							
Hokkaido	32/65	49.2 %	$p = 0.519$	1		1	
Touhoku	41/86	47.7 %		0.94 (0.49–1.79)	0.850	0.96 (0.44–2.07)	0.910
Kanto	264/590	44.8 %		0.84 (0.5–1.39)	0.491	0.64 (0.35–1.18)	0.155
Chubu	85/180	47.2 %		0.92 (0.52–1.63)	0.781	0.81 (0.41–1.60)	0.554
Hokuriku	28/53	52.8 %		1.16 (0.56–2.39)	0.697	0.74 (0.31–1.77)	0.498
Kinki	101/231	43.7 %		0.80 (0.46–1.39)	0.431	0.70 (0.36–1.36)	0.294
Chugoku	33/83	39.8 %		0.68 (0.35–1.31)	0.250	0.55 (0.25–1.21)	0.136
Shikoku	12/39	30.8 %		0.46 (0.2–1.06)	0.067	0.38 (0.14–1.07)	0.067
Kyushu	64/133	48.1 %		0.96 (0.53–1.73)	0.883	0.86 (0.43–1.71)	0.659
City size							
500,000≦	220/460	47.8 %	$p = 0.605$	1			
150,000≦	206/474	43.5 %		0.84 (0.65–1.09)	0.181		
<150,000	173/385	44.9 %		0.89 (0.68–1.17)	0.401		
County	52/114	45.6 %		0.91 (0.61–1.38)	0.672		
Occupation							
Others[b]	491/1139	43.1 %	$p = 0.002$	1		1	
Professional, manager, clerical, and skill	169/319	53.0 %		1.49 (1.16–1.91)	0.002	1.33 (0.96–1.85)	0.086
Marital status							
Divorced/widowed/single	156/287	54.4 %	$p = 0.001$	1		1	
Married	503/1166	43.1 %		0.64 (0.49–0.83)	0.001	0.72 (0.51–1.01)	0.061
Living condition							
Alone	36/70	51.4 %	$p = 0.292$	1			
Not alone	622/1382	45.0 %		0.77 (0.48–1.25)	0.294		
BMI category							
−18.49	63/139	45.3 %	$p = 0.838$	1.02 (0.71–1.46)	0.913		
18.5–24.9	438/977	44.8 %		1			
25.0–	156/334	46.7 %		1.08 (0.84–1.38)	0.552		
Alcohol drinking[c]							
Never	253/591	42.8 %	$p = 0.240$	1			
Ex-drinker	83/169	49.1 %		1.29 (0.92–1.82)	0.146		
Current drinker	322/693	46.5 %		1.16 (0.93–1.45)	0.189		
Smoking[c]							
Never	413/922	44.8 %	$p = 0.640$	1			
Ex-drinker	101/228	44.3 %		0.98 (0.73–1.31)	0.893		

Table 2 continued

	Number	Continuance rate	p value for χ^2 test	Crude OR (95 % CI)	p value	Multivariate-adjusted OR[a] (95 % CI)	p value
Current drinker	145/304	47.7 %		1.12 (0.87–1.46)	0.378		
Education							
High school or lower	317/715	44.3 %	$p = 0.540$	1			
Technical or higher	339/738	45.9 %		1.07 (0.87–1.31)	0.540		
Income of family							
−3,990,000	220/511	43.1 %	$p = 0.185$	1		1	
4,000,000–7,990,000	280/618	45.3 %		1.1 (0.87–1.39)	0.448	1.00 (0.75–1.34)	0.997
8,000,000–9,990,000	63/149	42.3 %		0.97 (0.67–1.4)	0.867	0.86 (0.55–1.35)	0.510
10,000,000–	80/152	52.6 %		1.47 (1.02–2.11)	0.038	1.14 (0.73–1.78)	0.554
Strength of pain (VAS)							
5–6	412/984	41.9 %	$p = 0.001$	1		1	
7–8	228/433	52.7 %		1.54 (1.23–1.94)	<0.001	1.43 (1.10–1.87)	0.008
9–10	20/43	46.5 %		1.21 (0.65–2.23)	0.547	1.33 (0.63–2.85)	0.455
Frequency of pain							
2–3 times/week	141/404	34.9 %	$p < 0.001$	1		1	
Once/day	100/270	37.0 %		1.1 (0.80–1.51)	0.571	1.34 (0.91–1.96)	0.135
Always	419/786	53.30 %		2.13 (1.66–2.73)	<0.001	2.40 (1.79–3.23)	<0.001
Duration of pain							
<3 years	152/432	35.2 %	$p < 0.001$	1		1	
3–5 years	89/214	41.6 %		1.31 (0.94–1.84)	0.114	1.45 (0.97–2.17)	0.073
5–10 years	145/270	53.7 %		2.14 (1.57–2.91)	<0.001	2.13 (1.47–3.08)	<0.001
10 years–	274/544	50.4 %		1.87 (1.44–2.42)	<0.001	1.76 (1.29–2.42)	<0.001
Site of pain							
Others	81/201	40.3 %	$p = 0.001$	1		1	
Neck	131/252	52.0 %		1.6 (1.1–2.33)	0.013	1.33 (0.87–2.02)	0.188
Shoulder	115/257	44.8 %		1.2 (0.83–1.74)	0.340	1.02 (0.68–1.54)	0.920
Low back	207/393	52.7 %		1.65 (1.17–2.33)	0.004	1.62 (1.11–2.37)	0.012
Knee	32/93	34.4 %		0.78 (0.47–1.3)	0.335	0.81 (0.47–1.39)	0.443
Treatment							
None	342/780	43.9 %	$p = 0.553$	1			
At hospital/clinic	134/289	46.4 %		1.11 (0.84–1.45)	0.462		
At folk remedy	139/295	47.1 %		1.14 (0.87–1.49)	0.336		
Both	26/50	52.0 %		1.39 (0.78–2.46)	0.262		
Change of practice							
No	126/290	43.5 %	$p = 0.082$	1			
Yes	144/284	50.7 %		1.34 (0.96–1.86)	0.082[d]		

[a] adding to age category and sex, variables which had a statistically significant influence on odds ratio were included in the model

[b] agriculture, forestry, and fisheries/independent business/part-time worker/full-time homemaker/student/inoccupation

[c] alcohol drinking and smoking were categorized into three categories (never, ex (used to), and currently smoking) based on the questionnaire

[d] p for crude analysis of change of practice was 0.082, but not included in the multivariate analysis because this reduced sample size

were somewhat dissatisfied, and 10 % were very dissatisfied (Fig. 4b). When compared by the type of treatment provider, 20 % of those treated at medical facilities such as an orthopaedics or surgery department reported being very or somewhat satisfied; however, 50 % of those who used folk medicine such as chiropractic, osteopathy, massage, or acupuncture/moxibustion, reported being very or somewhat satisfied (Fig. 5). Thus, the degree of satisfaction with folk medicine treatments was higher than with treatments received at medical facilities.

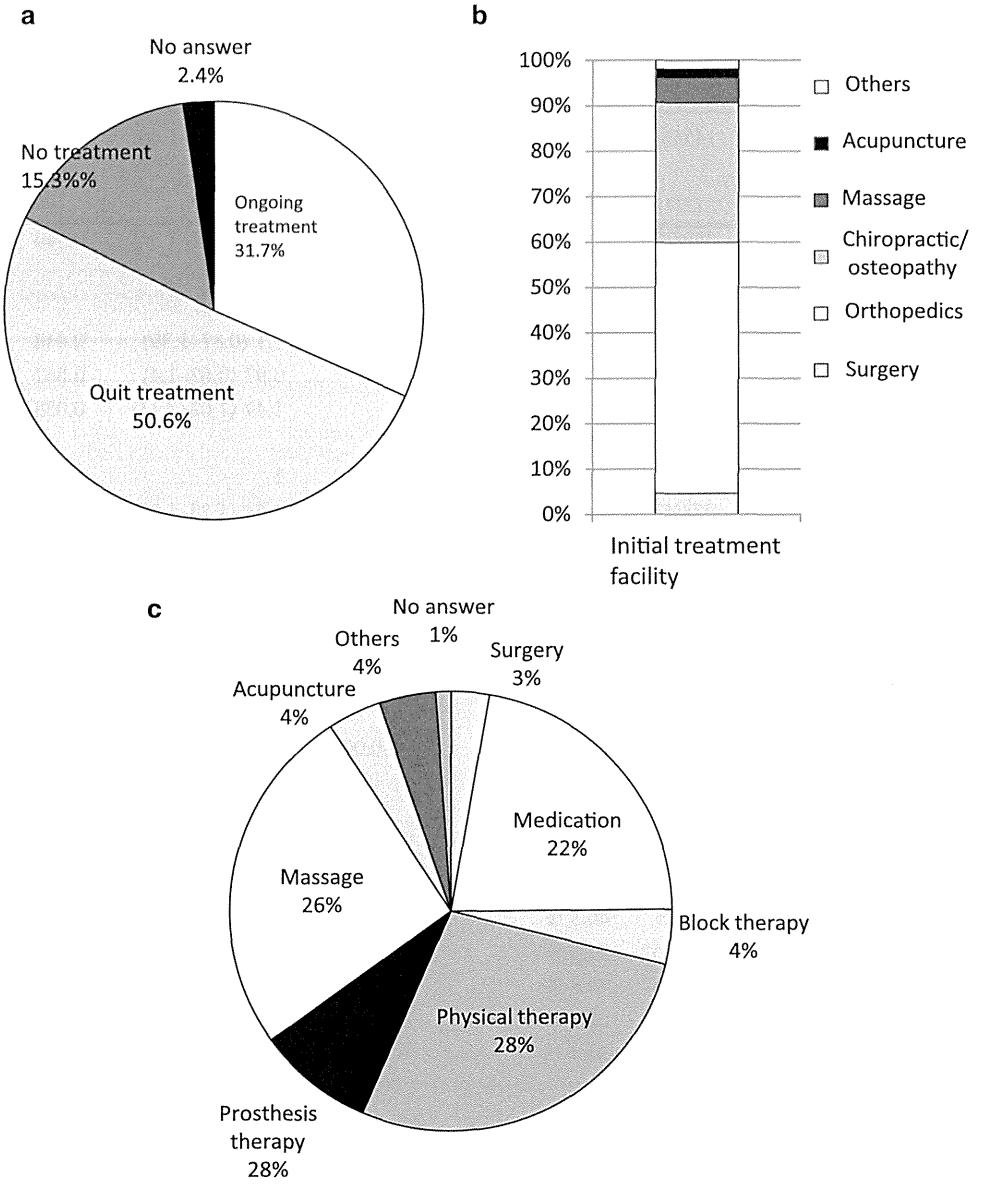

Fig. 2 Treatments received for persistent, chronic pain: **a** treatment circumstances, **b** initial treatment facility, and **c** nature of the initial treatment

Circumstances regarding changes in treatment facility

Approximately 60 % of the persons who had been treated for pain had changed treatment facilities. Of these, 31 % had changed once, 28 % had changed twice, 22 % had changed 3 times, and, of particular note, a high proportion, 15 %, had changed 5 or more times. The most common reason for changing, given by 40 %, was dissatisfaction with the previous treatment, which is consistent with the low degree of satisfaction reported (Fig. 6).

A review of the data of the initial and most-recent treatment facilities showed that the use of conventional medical facilities decreased to less than half of the initial frequency, whereas hardly any decrease in folk medicine treatment was observed (Fig. 7a). Reflecting these results, the most common most-recent treatments reported were massage for 34 %, physical therapy for 21 %, and acupuncture/moxibustion for 8 %, thereby accounting for about 60 % of the patients who received treatment. Medication was the most recent treatment for 18 %, nerve block therapy for 4 %, and orthotic treatment for 6 % (Fig. 7b). The most common reason given for discontinuing treatment was, "because it wasn't effective" (30 %), followed by, "I didn't have the time," "I couldn't afford it," and, "I thought I could take care of it myself" (Fig. 7c).

Actual status of persons with persistent, untreated chronic pain

Approximately 15 % of the respondents reporting persistent chronic pain had never received treatment (Fig. 2a). The most common reasons given for not seeking treatment