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Association of musculoskeletal pain in other body parts with new-onset shoulder pain: a longitudinal study among survivors of the Great East Japan Earthquake

Yoshihiro Hagiwara ,[1] Yutaka Yabe,[1] Takuya Sekiguchi ,[1] Yumi Sugawara ,[2] Masahiro Tsuchiya,[3] Shinichirou Yoshida,[1] Takahiro Onoki,[1] Tadahisa Takahashi,[1] Jun Iwatsu,[1] Ichiro Tsuji,[2] Eiji Itoi[1]

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For numbered affiliations see end of article.

Correspondence to
Dr Yoshihiro Hagiwara; hagi@med.tohoku.ac.jp

ABSTRACT

Objective Shoulder pain is a common health problem coexisting with other musculoskeletal pain. However, the effects of pre-existing musculoskeletal pain on the development of shoulder pain are not clear. The present study aimed to elucidate the association between coexisting musculoskeletal pain at other body sites and new-onset shoulder pain among survivors of the Great East Japan Earthquake (GEJE).

Design This is a longitudinal study.

Setting The study was conducted at the severely damaged coastal areas in Ishinomaki and Sendai cities.

Participants The survivors who did not have shoulder pain at 3 years after the GEJE were followed up 1 year later (n=2131).

Interventions Musculoskeletal pain (low back, hand and/or foot, knee, shoulder and neck pain) was assessed using self-reported questionnaires.

Main outcome measures The outcome of interest was new-onset shoulder pain, which was defined as shoulder pain absent at 3 years but present at 4 years after the disaster. The main predictive factor for new-onset shoulder pain was musculoskeletal pain in other body parts at 3 years after the GEJE; this was categorised according to the number of pain sites (0, 1, ≥2). Multiple regression analyses were conducted to calculate the odds ratio (OR) and 95% confidence interval (CI) for new-onset shoulder pain due to musculoskeletal pain in other body parts.

Results The incidence of new-onset shoulder pain was 6.7% (143/2131). Musculoskeletal pain in other body parts was significantly associated with new-onset shoulder pain. Using the survivors without other musculoskeletal pain as reference, the adjusted OR and 95% CI for new-onset shoulder pain were 1.86 (1.18 to 2.94) for those with one body part and 3.22 (2.08 to 4.98) for those with ≥2 body parts presenting with musculoskeletal pain (p<0.001).

Conclusions Pre-existing musculoskeletal pain in other body parts was significantly associated with new-onset shoulder pain among survivors; this provides useful information for clinical and public health policies.

Strengths and limitations of this study

- The strength of this study was its longitudinal design and large sample size, which allowed the performance of stratified analyses for the investigation of the research question.
- As for our study limitations, the questionnaires and informed consent forms were mailed to the participants, with a relatively low response rate for the first time period.
- The reliability and validity of the self-reported questionnaire used to assess musculoskeletal pain in our study were not evaluated.
- While this questionnaire included five pain sites without illustration, it did not include other pain sites such as the hip or elbow that are important for maintaining the kinematic chain.
- The generalisability of the results of our study, which was conducted on disaster survivors, is unclear.

BACKGROUND

Nine years have passed since the Great East Japan Earthquake (GEJE) and a devastating tsunami hit the northeastern coast of Japan hard on 11 March 2011. Approximately 18 400 individuals were confirmed dead or missing, and 3739 died from related events after the GEJE.[1] Although reconstruction has continued and the number of survivors who have had to flee from their hometowns has decreased in some areas, more than 48 000 survivors still remain far from their hometowns.[1] It is well known that natural disasters are associated with chronic and long-term health problems including psychological disorders, physical inactivity and functional disabilities due to the impact of life-threatening stress and changes in living

conditions resulting from the devastation of home environments and public health systems.[2–4]

Most pain syndromes after earthquakes or natural disasters are caused by traumatic events in the acute phase.[5] However, multiple causes have affected chronic pain among survivors in the recovery phase.[4–6] The prevalence of musculoskeletal pain has been reported to be higher in the recovery phase after the GEJE, and almost half of the survivors experienced musculoskeletal pain at multiple sites.[7] Furthermore, musculoskeletal pain is associated with new-onset poor physical function, psychological distress and continued residence in temporary prefabricated housing in the recovery phase after the GEJE.[7–10] Multiple factors influence musculoskeletal pain in GEJE survivors, and an improved understanding of these factors is important to provide better care.

In a cross-sectional study, the three most frequent sites of chronic pain in GEJE survivors after 1.5 years were the knee and surrounding regions, low back and shoulder.[6] Subjective shoulder pain after the GEJE was significantly associated with sleep disturbances in a prospective cohort study[11] and with living status, economic hardship and sleep disturbance in a cross-sectional study.[12] Nevertheless, there have been no reports on the association between subjective pain apart from the shoulder (hereafter referred to as 'other musculoskeletal pain') and new-onset subjective shoulder pain. As musculoskeletal pain coexists at multiple sites, we speculated that the increase in musculoskeletal pain in other body parts might be associated with new-onset shoulder pain and lead to a higher prevalence of shoulder pain after natural disasters. The present longitudinal study aimed to examine the association between existing musculoskeletal pain and new-onset shoulder pain during the recovery phase after the GEJE. Clarifying this association may be helpful in preventing and treating shoulder pain after a disaster.

METHODS

Participants

A panel study was conducted on GEJE survivors residing in severely damaged coastal areas, including Ogatsu and Oshika areas in Ishinomaki City and Wakabayashi Ward in Sendai City, Miyagi Prefecture, Japan. The main purpose of this study was to better understand the physical, mental and social problems of the survivors in order to improve their social and medical support. The surveys began at 3 months after the GEJE and were administered every 6 months. The first study population included residents registered in the Residential Registry of the Ogatsu and Oshika areas and survivors living in prefabricated housing in the Wakabayashi Ward. Because the number of responders increased until 3 years after the GEJE and remained constant after that period, we adopted the data at 3 and 4 years after the GEJE. From November 2013 to February 2014, 3 years after the GEJE, residents, aged 18 years or older and who were registered in the Residential Registry of Ogatsu and Oshika areas, and survivors, who had participated in the previous survey in Wakabayashi Ward, were recruited (n=6396). Self-reported questionnaires and informed consent forms were mailed to these residents, and a 44.6% (2853/6396) response rate was obtained. Of these, participants who already had shoulder pain were excluded (n=239). The remaining participants were followed up from November 2014 to February 2015, 4 years after the GEJE, and an 81.5% (2131/2614) follow-up rate was obtained for this period. Finally, 2131 participants were included in this study (figure 1).

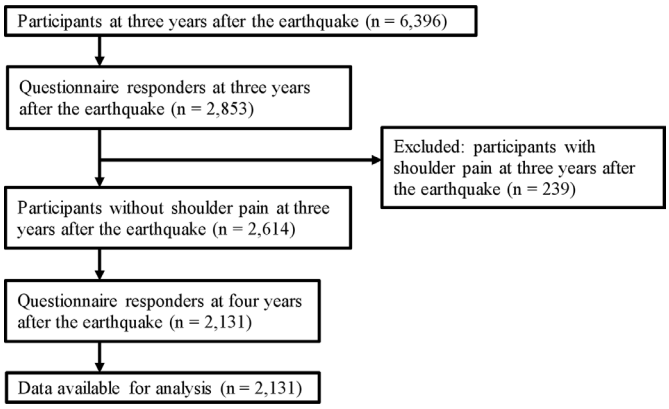

Figure 1 Flowchart of this study.

Musculoskeletal pain

Musculoskeletal pain was assessed using self-reported questionnaires based on the Comprehensive Survey of Living Conditions without illustration. The questions were as follows: 'Have you had symptoms in the last few days? If yes, please place a mark next to all your symptoms'. The examples of choices were palpitation, dizziness, diarrhoea and musculoskeletal symptoms such as low back, hand and/or foot, knee, shoulder and neck pain.[7] The outcome of interest was new-onset shoulder pain, which was defined as shoulder pain absent at 3 years (the first period) and present at 4 years after the GEJE (the second period). The main predictor was other musculoskeletal pain during the first period, which included hand and/or foot, knee, low back and neck pain. Other musculoskeletal pain was categorised into three groups according to the number of painful sites (0, 1, ≥2).

Covariates

The following variables were included in the analysis because they were considered as potential cofounding factors in previous reports[13–15]: sex, age, body mass index (BMI), living area, smoking habits, drinking habits, comorbid conditions (hypertension, diabetes mellitus, myocardial infarction and cerebral stroke), working status, walking time per day, living status, subjective economic conditions, psychological distress (Kessler Psychological Distress Scale),[16] sleep disturbance (Athens Insomnia Scale)[17] and social isolation (Lubben Social Network Scale).[14]

Statistical analysis

Univariate and multivariate logistic regression models were used to calculate odds ratios (ORs) and 95% confidence intervals (CIs) for new-onset shoulder pain according to the number of other musculoskeletal pain sites during the first period. Variables included in the analysis were sex (male or female), age (continuous variable), BMI (continuous variable), living area (Ogatsu, Oshika or Wakabayashi), smoking habit (nonsmoker, smoker or unknown), drinking habit (non-drinker, <45.6 g of alcohol per day, ≥45.6 g of alcohol per day or unknown), comorbid conditions (absence or presence of each comorbid condition), working status (unemployed, employed or unknown), walking time per day (<30 min, 30 min to <1 hour, ≥1 hour or unknown), living status (living in the same house as before the GEJE, prefabricated housing, new house, others or unknown), subjective economic condition (normal, a little bit hard, hard, very hard or unknown), Kessler Psychological Distress Scale (continuous variable), Athens Insomnia Scale (continuous variable) and the Lubben Social Network Scale (continuous variable). We further divided the participants into subgroups by sex (male or female), and ORs and 95% CIs for new-onset shoulder pain were calculated in the same manner. For the stratified analysis, multiplicative interaction between other musculoskeletal pain sites and sex was tested using the Wald test. Additionally, the ORs and 95% CIs for new-onset shoulder pain according to each body part with musculoskeletal pain except shoulder pain in the first period were calculated. We included the same variables (Model 1) and added each musculoskeletal pain such as hand and/or foot, knee, low back and neck pain as covariates (Model 2). All statistical analyses were performed using SPSS V.24.0. A p value of <0.05 was considered statistically significant. Furthermore, we used p<0.025 as the significance level in the subgroup analysis in order to avoid alpha error.[18]

Patient and public involvement

The patients and public were not involved in the development of the research questions, outcome measures or study design. The patients were also not involved in the recruitment and performance of the study.

RESULTS

Participants' baseline characteristics are summarised in table 1.

Among 2131 participants, 1343 (63%), 423 (19.8%) and 365 (17.1%) had no, one and two or more other musculoskeletal pain sites during the first period, respectively. Participants who reported having other musculoskeletal pain were more likely to be female; to be living in Ogatsu; and to have high BMI, comorbid conditions (eg, hypertension and cerebral stroke), short walking time, subjective economic hardship, higher Kessler Psychological Distress Scale score, higher Athens Insomnia Scale score and lower Lubben Social Network Scale score (table 1).

The rate of new-onset shoulder pain was 6.7% (143/2131). The crude and adjusted ORs and 95% CIs for new-onset shoulder pain according to the number of other musculoskeletal pain sites are presented in table 2.

Other musculoskeletal pain was significantly associated with new-onset shoulder pain in the crude and adjusted analyses. Using survivors without other musculoskeletal pain as a reference, adjusted ORs and 95% CIs for new-onset shoulder pain were 1.86 (1.18 to 2.94) for one musculoskeletal pain site and 3.22 (2.08 to 4.98) for ≥2 sites (p for trend <0.001) (table 2). The results of the stratified analysis are shown in table 3. Other musculoskeletal pain was significantly associated with new-onset shoulder pain in each group. The association was stronger in older (≥65 years) participants than in younger (<65 years) participants (p for trend: <0.001 for ≥65 years and 0.003 for <65 years); additionally, such an association was stronger in male participants than in female participants (p for trend: <0.001 for male participants and <0.011 for female participants). There was no statistically significant multiplicative interaction between musculoskeletal pain, except shoulder pain, and age or sex (table 3).

For each musculoskeletal pain site, hand and/or foot pain, low back pain and neck pain were all associated with new-onset shoulder pain in Model 1, and the association was also significant for low back pain and neck pain in Model 2 (table 4).

DISCUSSION

The present study revealed that other pre-existing musculoskeletal pain was associated with new-onset shoulder pain among survivors in the recovery phase after the GEJE. Furthermore, the effect was stronger with musculoskeletal pain that occurred at multiple sites.

Previous cross-sectional studies have shown that musculoskeletal pain often occurs at multiple sites, such as the shoulder, elbow, knee and low back.[19 20] Chronic musculoskeletal pain in the Japanese general population occurs at a frequency of 15.4% and is the highest among those aged 30 to 59 years.[21] However, pain increased at a frequency of 62% with a mean Numeric Rating Scale score of 2.74 in GEJE survivors.[6] Furthermore, the prevalence of musculoskeletal pain increased in the recovery phase after the GEJE, and almost half of the survivors experienced musculoskeletal pain at multiple sites.[7] Musculoskeletal pain was associated with new-onset poor physical function, psychological distress and continued residence in temporary prefabricated housing in the recovery phase after the GEJE,[7–10] which disturbs activities of daily living. A better understanding regarding influential factors of pain among survivors is necessary to help them to return to their normal life in a manner similar to that before the GEJE.

The shoulder was the third most frequent pain site after the knee and low back among GEJE survivors[6];

Table 1 Baseline characteristics of the participants

		Number of musculoskeletal pain except shoulder pain				
		n (%)	0	1	≥2	
		2131	1343	423	365	P value
Sex	Male	985 (46.2)	678 (50.5)	170 (40.2)	137 (37.5)	
	Female	1146 (53.8)	665 (49.5)	253 (59.8)	228 (62.5)	<0.001
Age (years)	<65	1071 (50.3)	686 (51.1)	208 (49.2)	177 (48.5)	
	≥65	1060 (49.7)	657 (48.9)	215 (50.8)	188 (51.5)	0.601
BMI (kg/m^2)*	18.5 to <25	1234 (57.9)	800 (59.6)	237 (56.0)	197 (54.0)	
	<18.5	62 (2.9)	38 (2.8)	19 (4.5)	5 (1.4)	
	≥25	763 (35.8)	455 (33.9)	152 (35.9)	156 (42.7)	0.007
Living area	Ogatsu	923 (43.3)	573 (42.7)	178 (42.1)	172 (47.1)	
	Oshika	800 (37.5)	535 (39.8)	156 (36.9)	109 (29.9)	
	Wakabayashi	408 (19.1)	235 (17.5)	89 (21.0)	84 (23.0)	0.005
Smoking habit*	Non-smoker	1595 (74.8)	1011 (75.3)	304 (71.9)	280 (76.7)	
	Smoker	413 (19.4)	263 (19.6)	82 (19.4)	68 (18.6)	0.06
Drinking habits*	Non-drinker	1280 (60.1)	794 (59.1)	259 (61.2)	227 (62.2)	
	<45.6 g of alcohol/day†	418 (19.6)	273 (20.3)	76 (18.0)	69 (18.9)	
	≥45.6 g of alcohol/day†	225 (10.6)	148 (11.0)	40 (9.5)	37 (10.1)	0.684
Comorbid conditions	Hypertension	808 (37.9)	477 (35.5)	158 (37.4)	173 (47.4)	<0.001
	Diabetes mellitus	210 (9.9)	125 (9.3)	40 (9.5)	45 (12.3)	0.218
	Myocardial infarction	129 (6.1)	75 (5.6)	25 (5.9)	29 (7.9)	0.243
	Cerebral stroke	27 (1.3)	12 (0.9)	11 (2.6)	4 (1.1)	0.022
Working status*	Unemployed	1109 (52.0)	696 (51.8)	232 (54.8)	181 (49.6)	
	Employed	976 (45.8)	619 (46.1)	179 (42.3)	178 (48.8)	0.366
Walking time/day*	≥1 hour	616 (28.9)	423 (31.5)	108 (25.5)	85 (23.3)	
	30 min to <1 hour	772 (36.2)	503 (37.5)	135 (31.9)	134 (36.7)	
	<30 m	707 (33.2)	394 (29.3)	173 (40.9)	140 (38.4)	<0.001
Living status*	Same house as before the GEJE	530 (29.7)	393 (29.3)	134 (31.7)	90 (24.7)	
	Prefabricated house	685 (38.4)	530 (39.5)	171 (40.4)	168 (46.0)	
	New house	224 (12.6)	163 (12.1)	45 (10.6)	40 (11.0)	
	Others	331 (18.6)	246 (18.3)	71 (16.8)	66 (18.1)	0.318
Economic condition*	Normal	940 (44.1)	653 (48.6)	153 (36.2)	134 (36.7)	
	A little hard	553 (26.0)	347 (25.8)	107 (25.3)	99 (27.1)	
	Hard	416 (19.5)	207 (15.4)	120 (28.4)	89 (24.4)	
	Very hard	183 (8.6)	98 (7.3)	42 (9.9)	43 (11.8)	<0.001
Psychological distress*	Absence	1786 (83.8)	1183 (88.1)	326 (77.1)	277 (75.9)	
	Presence	265 (12.4)	110 (8.2)	80 (18.9)	75 (20.5)	<0.001
Sleep disturbance*	Absence	1496 (70.2)	1060 (78.9)	253 (59.8)	183 (50.1)	
	Presence	622 (29.2)	273 (20.3)	168 (39.7)	181 (49.6)	<0.001
Social isolation*	Absence	1521 (71.4)	984 (73.3)	289 (68.3)	248 (67.9)	
	Presence	605 (28.4)	354 (26.4)	134 (31.7)	117 (32.1)	0.04

*Because each item has a limited number of respondents, the actual number is not necessarily in accordance with the total.
†22.8 g of alcohol amounts to one go or traditional unit of sake (180 mL), which also approximates to two glasses of wine (200 mL), or beer (500 mL) in terms of alcohol content. Categorical values are presented as numbers and percentage (%).
BMI, body mass index; GEJE, Great East Japan Earthquake.

Table 2 Influence of musculoskeletal pain except shoulder pain on new-onset shoulder pain

	Number of musculoskeletal pain except shoulder pain				
	Total	0	1	≥2	P for trend
Participants	2131	1343	423	365	
New-onset shoulder pain, n (%)	143 (6.7)	56 (4.2)	37 (8.7)	50 (13.7)	
Crude OR (95% CI)		1	2.20 (1.43 to 3.39)	3.65 (2.44 to 5.45)	<0.001
Adjusted OR (95% CI)		1	1.86 (1.18 to 2.94)	3.22 (2.08 to 4.98)	<0.001

Values are adjusted for sex, age, body mass index, living area, smoking habits, drinking habits, complications, working status, walking time, living status, subjective economic condition, psychological distress, sleep disturbance and social isolation.
CI, confidence interval; OR, odds ratio.

each of these is a common site of pain and disability in the general population.[22] Shoulder pain is considered to have multifactorial causes and often presents with other pain symptoms.[23 24] Furthermore, shoulder pain of long duration, at high intensity and with a high level of disability predicts persistent complaints.[25 26] There has been speculation in the literature concerning the association between concurrent pains at different sites. Pain at one site can negatively affect motion or posture and places additional burden on the other parts of the body.[27] Factors associated with pain at one site can also be related to pain at another site.[28] In addition, pain at one site can cause central sensitisation, which can result in the development of pain at other sites.[29] These conditions may explain the association between pre-existing musculoskeletal pain and new-onset shoulder pain among GEJE survivors. To our knowledge, this is the first study to report that the effect of other musculoskeletal pain on new-onset shoulder pain becomes stronger with multisite musculoskeletal pain, which is a so-called dose–response relationship. Most studies on musculoskeletal pain have focused on pain at a single site or on regional distribution; however, it is quite important to pay attention to the other pain sites when following survivors.

The stratified analysis according to age and sex categories showed that the association of other musculoskeletal pain with new-onset shoulder pain was also significant among categories in each group, showing the robustness of the association in this study. The rate of musculoskeletal pain was higher in participants aged <65 years than in those aged ≥65 years; however, the association between the other musculoskeletal pain and new-onset shoulder pain was stronger in those aged ≥65 years. Generally, musculoskeletal pain, especially multisite pain, has been reported to be more common among older aged people,[20] and they are considered more vulnerable to such pain.

Table 3 Stratified analysis for each age and sex group

	Number of musculoskeletal pain except shoulder pain					
	Total	0	1	≥2	P for trend	P interaction
	2131	1343	423	365		
Age (years)						
<65 (n=1071)						
No. of events/subjects	78/1071 (7.3%)	36/686 (5.2%)	18/208 (8.7%)	24/177 (13.6%)		
Adjusted OR (95% CI)		1	1.47 (0.78 to 2.80)	2.64 (1.44 to 4.85)	0.007	
≥65 (n=1060)						0.13
No. of events/subjects	65/1,060 (6.1%)	20/657 (3.0%)	19/215 (8.8%)	26/188 (13.8%)		
Adjusted OR (95% CI)		1	2.76 (1.36 to 5.61)	4.24 (2.14 to 8.40)	<0.001	
Sex						
Male (n=985)						
No. of events/subjects	54/985 (5.5%)	23/678 (3.4%)	11/170 (6.5%)	20/137 (14.6%)		
Adjusted OR (95% CI)		1	2.06 (0.93 to 4.58)	5.33 (2.60 to 10.92)	<0.001	
Female (n=1146)						0.29
No. of events/subjects	89/1146 (7.8%)	33/665 (5.0%)	26/253 (10.3%)	30/228 (13.2%)		
Adjusted OR (95% CI)		1	1.98 (1.12 to 3.51)	2.66 (1.50 to 4.72)	0.003	

Values are adjusted for sex, age, body mass index, living area, smoking habits, drinking habits, complications, working status, walking time, living status, subjective economic condition, psychological distress, sleep disturbance and social isolation.
CI, confidence interval; OR, odds ratio.

Table 4 Influence of each musculoskeletal pain on new-onset shoulder pain

		Absence	Presence	P value
Hand or foot pain	Participants	1886	245	
	New-onset shoulder pain, n (%)	113 (6.0)	30 (12.2)	
	Model 1 OR (95% CI)	1	1.99 (1.26 to 3.14)	0.003
	Model 2 OR (95% CI)	1	1.56 (0.96 to 2.54)	0.075
Knee pain	Participants	1853	278	
	New-onset shoulder pain, n (%)	115 (6.2)	28 (10.1)	
	Model 1 OR (95% CI)	1	1.55 (0.98 to 2.47)	0.062
	Model 2 OR (95% CI)	1	1.07 (0.65 to 1.75)	0.799
Low back pain	Participants	1708	423	
	New-onset shoulder pain, n (%)	89 (5.2)	54 (12.8)	
	Model 1 OR (95% CI)	1	2.28 (1.56 to 3.33)	<0.001
	Model 2 OR (95% CI)	1	1.91 (1.28 to 2.85)	0.002
Neck pain	Participants	1783	348	
	New-onset shoulder pain, n (%)	98 (5.5)	45 (12.9)	
	Model 1 OR (95% CI)	1	2.06 (1.38 to 3.09)	<0.001
	Model 2 OR (95% CI)	1	1.64 (1.07 to 2.50)	0.022

Values are adjusted for sex, age, body mass index, living area, smoking habits, drinking habits, complications, working status, walking time, living status, subjective economic condition, psychological distress, sleep disturbance, and social isolation (Model 1). Additionally, adjusted for hand or foot pain, knee pain, low back pain and neck pain (Model 2).
CI, confidence interval; OR, odds ratio.

However, the rate of musculoskeletal pain was higher in female participants than in male participants; however, the association of musculoskeletal pain with new-onset shoulder pain was stronger in male participants. Musculoskeletal pain, especially at multiple pain sites, was more common among female participants,[19 20] and various factors, such as menopause and loss of oestrogen, may affect such pain.[30] Careful attention is required for survivors with multiple pain sites.

Some authors have reported an association between shoulder and low back pain in cross-sectional studies.[31] Shoulder pain is more commonly clustered with neck pain and most frequently co-occurs with neck pain.[32] Non-neutral arm postures and continuously active neck–shoulder muscles may be key physical factors associated with pain in the neck and shoulder region.[33] The trapezius muscle in the upper back and neck region controls various movements of the neck and shoulder and has been implicated as an important muscle in the affected region in individuals with neck and shoulder pain.[25] To our knowledge, the present study is the first to report that pre-existing low back and neck pain were individually associated with new-onset shoulder pain, even if the effects of the other musculoskeletal pain were considered. Conversely, the association of hand or foot pain and knee pain with new-onset shoulder pain was not significant. Musculoskeletal pain except for shoulder pain may be also associated with the other pain, and the association can affect the results. Furthermore, survivors who had shoulder pain in the first period were excluded from this study since the purpose of this study was to assess the effect of musculoskeletal pain except shoulder pain on new-onset shoulder pain. The survivors who already had both shoulder pain and the other musculoskeletal pain were excluded, which could lower the association.

The strength of this study was its longitudinal design and large sample size, which allowed the performance of stratified analyses for the investigation of the research question. Conversely, this study had several limitations. First, the questionnaires and informed consent forms were mailed to the participants, and the response rate for the first time period was not high. Although there is no information regarding non-responders, it might be possible that responders are healthier than non-responders or that more severely affected persons may pay more attention to their situation. These could have affected the reported rate of musculoskeletal pain and strengthened or weakened the association between other musculoskeletal pain sites and new-onset shoulder pain. Additionally, this study used data that were collected at 3 and 4 years after the GEJE. Other periods may present different response rates, which could also affect the results. Second, musculoskeletal pain was assessed using a self-reported questionnaire based on the Comprehensive Survey of Living Conditions. Although this survey is widely accepted in Japan to assess several symptoms in participants, the reliability and validity of this method were not evaluated in this study. Furthermore, while this questionnaire included five pain sites, it did not include other pain sites such as the hip or elbow that are important for maintaining the kinematic

chain. Pain at these sites could also affect the onset of shoulder pain and were not assessed in this study. In addition, pain severity and frequency were not assessed, and a pain site illustration was not adopted. Differences in severity and frequency of shoulder pain might depend on a number of other musculoskeletal pain sites, which could not be assessed. Finally, this study was conducted on disaster survivors, and the generalisability of the results is unclear. The findings of this study may be extrapolated to the general population; however, this should be ascertained in future studies.

CONCLUSIONS

Pre-existing musculoskeletal pain at other sites (especially the low back and neck) was associated with new-onset shoulder pain among survivors in the recovery phase after the GEJE. Further research is needed to clarify whether this association is truly causal and examine mechanisms that could explain why people with musculoskeletal pain at other body sites are at a higher risk of developing shoulder pain, which will provide useful information to clinical and public health policies for the management of shoulder pain.

Author affiliations
[1]Department of Orthopaedic Surgery, Tohoku University School of Medicine, Sendai, Japan
[2]Division of of Epidemiology, Department of Health Informatics and Public Health, Tohoku University Graduate School of Public Health, Sendai, Japan
[3]Department of Nursing, Faculty of Health Science, Tohoku Fukushi University, Sendai, Japan

Contributors YH, YY and IT contributed to study design. YS, MT, TS, SY, YS and TO were responsible for the data collection and supervised the study. TS and YY performed statistical analysis. YH, YY and EI wrote the manuscript. YS, MT, TT, JI and IT aided in analysing the data and drafting the manuscript. All authors have read and approved the manuscript.

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Competing interests None declared.

Patient consent for publication Not required.

Ethics approval The study protocol was reviewed and approved by the Ethics Committee of Tohoku University Graduate School of Medicine (approval number: 201192) and was performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. Written informed consent was obtained from all participants.

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Data availability statement Data are available upon reasonable request. All data generated or analysed during this study are included in this published article.

ORCID iDs
Yoshihiro Hagiwara http://orcid.org/0000-0002-2992-2178
Takuya Sekiguchi http://orcid.org/0000-0003-4642-854X
Yumi Sugawara http://orcid.org/0000-0002-0197-6772

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