Other musculoskeletal pain is associated with new-onset low back pain: A longitudinal study among survivors of the Great East Japan Earthquake

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Abstract

Background

Low back pain (LBP) is a common health problem experienced after natural disasters. LBP is often concurrent with other musculoskeletal pain; however, the effects of preexisting musculoskeletal pain on LBP are not clear. The purpose of this study was to elucidate the influence of other musculoskeletal pain on new-onset LBP among survivors of the Great East Japan Earthquake (GEJE).

Methods

A longitudinal study was conducted with survivors at three and four years after the GEJE ($n = 1,782$). Musculoskeletal pain, such as low back, hand and/or foot, knee, shoulder, and neck pain, were assessed with self-reported questionnaires. New-onset LBP was defined as LBP absent at three years but present at four years after the disaster. Musculoskeletal pain except for LBP at three years after the GEJE were categorized according to the number of pain sites (0, 1, ≥ 2). Multiple regression analyses were performed to calculate the odds ratio (OR) and 95% confidence interval (CI) for new-onset LBP due to the other musculoskeletal pain.

Results

The incidence of new-onset LBP was 14.1% (251/1,782). Other musculoskeletal pain were significantly associated with new-onset LBP. Using "0" as a reference, the adjusted OR and 95% CI for new-onset LBP were 1.69 (1.17-2.42) in "1" and 2.85 (1.86-4.36) in " ≥ 2 " musculoskeletal pain ($p < 0.001$).

Conclusions

Preexisting other musculoskeletal pain was associated with new-onset LBP among survivors in the recovery period after the GEJE. Attention should be paid to other musculoskeletal pain sites to treat and prevent LBP after natural disasters.

Background

Low back pain (LBP) is one of the most frequent health problem worldwide [1]. It leads to disability and limitation of activities in daily life [2]; therefore, gaining an understanding of the factors related to LBP is important. Risk factors of LBP include age, sex, obesity, smoking, psychological distress, and sleep disturbance [2–5]. Further, musculoskeletal pain often occurs at multiple sites, and single-site pain is considered to increase the risk for pain at other sites [6]. Indeed, some reports have found that LBP occurs concurrently with other musculoskeletal pain [7–9]. Most of these studies were cross-sectional; therefore, the influence of preexisting musculoskeletal pain on new onset of LBP is not clear.

Musculoskeletal pain, including LBP, are reported to increase after natural disasters [10]. The Great East Japan Earthquake (GEJE) accompanied by a devastating tsunami attacked the north-eastern coastal

areas of Japan in March 11, 2011 [11]. This terrible disaster resulted in serious damage to these areas, and a long period of reconstruction. High prevalence of LBP has been also reported after the GEJE [12, 13], and previous longitudinal studies have revealed associated factors, such as subjective economic hardship and sleep disturbance [5, 13]. High prevalence of other musculoskeletal pain was also seen in the recovery phase after the GEJE, and almost half of the survivors had musculoskeletal pain at multiple sites [14]. Since musculoskeletal pain co-exists at multiple sites, we speculated that increased other musculoskeletal pain could be associated with new onset of LBP and lead to high prevalence of LBP after natural disasters. The aim of this study was to examine the influence of musculoskeletal pain other than LBP on new-onset LBP in the recovery period after the GEJE longitudinally. For this purpose, we analyzed panel data of surveys conducted three and four years after the GEJE.

Materials And Methods

Participants

We hypothesized that other musculoskeletal pain could be associated with new onset of LBP after natural disasters. A panel study was therefore conducted with the GEJE survivors living in the severely damaged coastal areas, including Ogatsu and Oshika areas in Ishinomaki City, and Wakabayashi Ward in Sendai City, Miyagi prefecture, Japan. The surveys began three months after the GEJE and were administered every six 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. From November 2013 to February 2014, three years after the GEJE, the residents (aged 18 years or over) who were registered in the Residential Registry of Ogatsu and Oshika areas, and the survivors who had participated in the previous survey in Wakabayashi Ward, were recruited ($n = 6,396$). Self-reported questionnaires and informed consent forms were mailed to these residents and a 44.6% ($2,853/6,396$) response rate was obtained. Among those, the participants who already had LBP were excluded ($n = 663$). The remaining participants were followed from November 2014 to February 2015, four years after the GEJE, and an 81.4% ($1,782/2,189$) follow-up rate was obtained for this period. Finally, a total of 1,782 participants were included in this study (Fig. 1). This study was approved by the institutional review board of our university (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.

Musculoskeletal pain

Musculoskeletal pain was assessed using self-reported questionnaires based on Comprehensive Survey of Living Conditions. The questions were: "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, diarrhea, and musculoskeletal symptoms such as low back, hand and/or foot, knee, shoulder, and neck pain [14]. The outcome of interest was new-onset LBP, which was defined as LBP absent at three years (first

period), and present at four years after the GEJE (second period). The main predictor was musculoskeletal pain except for LBP at the first period which included hand and/or foot, knee, shoulder, and neck pain. Musculoskeletal pain except for LBP was categorized 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 potential confounding 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 ($\geq 10/24$ on the Kessler Psychological Distress Scale) [16], sleep disturbance ($\geq 6/24$ on the Athens Insomnia Scale) [17], and social isolation ($< 12/30$ on the Lubben Social Network Scale) [15].

Statistical analysis

Univariate and multivariate logistic regression models were used to calculate odds ratios (OR) and 95% confidence intervals (95% CI) for new-onset LBP according to the number of musculoskeletal pain sites except for LBP in the first period. Variables included in the analysis were sex, age (< 65 or ≥ 65 , years), BMI (< 18.5 , 18.5 to < 25 , ≥ 25 , or unknown), living area (Ogatsu, Oshika, or Wakabayashi), smoking habits (nonsmoker, smoker, or unknown), drinking habits (non-drinker, < 45.6 grams of alcohol per day, ≥ 45.6 grams of alcohol per day, or unknown), comorbid conditions (absence or presence of each comorbid conditions), working status (unemployed, employed, or unknown), walking time per day (< 30 min, 30 min to < 1 h, ≥ 1 h, or unknown), living status (living in the same house as before the GEJE, prefabricated housing, new house, others, or unknown), subjective economic conditions (normal, a little bit hard, hard, very hard, or unknown), psychological distress (absence, presence or unknown), sleep disturbance (absence, presence, or unknown), and social isolation (absence, presence, or unknown). We further divided the participants into subgroups by age (< 65 or ≥ 65 years) or sex (male or female). ORs and 95% CIs for new-onset LBP were calculated in the same manner. For the stratified analysis, multiplicative interaction between musculoskeletal pain except LBP and age or sex were tested using the Wald test. In addition, the ORs and 95% CIs for new-onset LBP according to each musculoskeletal pain except LBP in the first period were evaluated. We included the same variables (Model 1) and added each musculoskeletal pain such as hand and/or foot, knee, shoulder, and neck pain as covariates (Model 2). All statistical analyses were performed using SPSS 24.0 (SPSS Japan Inc, Tokyo, Japan). A p value of < 0.05 was accepted as statistically significant.

Results

Baseline characteristics of the participants are presented in Table 1. Among the 1,782 participants, 1,343 (75.4%) had 0, 283 (15.9%) had one, 156 (8.8%) had two or more musculoskeletal pain regions except for

LBP in the first period, respectively. The participants who reported having musculoskeletal pain except for LBP were more likely to be female and older. They were also more likely to have high BMI, comorbid conditions such as hypertension and myocardial infarction, short walking time, subjective economic hardship, psychological distress, sleep disturbance, and social isolation (Table 1). The rate of new-onset LBP was 14.1% (251/1,782). The crude and adjusted ORs and 95% CIs for new-onset LBP according to the number of musculoskeletal pain regions except for LBP are shown in Table 2. Musculoskeletal pain except for LBP was significantly associated with new-onset LBP in the crude and adjusted analyses. Using “0” as a reference, adjusted ORs and 95% CIs for new-onset LBP were 1.69 (1.17–2.42) in “1” and 2.85 (1.86–4.36) in “ ≥ 2 ” musculoskeletal pain regions except LBP (p for trend < 0.001) (Table 2). The results of stratified analysis are shown in Table 3. Musculoskeletal pain except for LBP was significantly associated with new-onset LBP in each group. The association was stronger in older (≥ 65 years) compared with younger (< 65 years) participants (p for trend: < 0.001 in “ ≥ 65 years” and 0.026 in “ < 65 years”), and in male compared with female (p for trend: < 0.001 in male and 0.011 in female). There was no statistically significant multiplicative interaction between musculoskeletal pain regions except for LBP and age or sex (Table 3). For each musculoskeletal pain site, hand and/or foot, knee, shoulder, and neck pain were all associated with new-onset LBP in Model 1, and the association was also significant for knee and neck pain in Model 2. The adjusted ORs and 95% CIs (p value) for new-onset LBP were 2.22 (1.33–3.07, 0.001) for Model 1 and 1.38 (0.87–2.18, 0.175) for Model 2 in hand and/or foot, 2.27 (1.53–3.37, < 0.001) for Model 1 and 1.69 (1.09–2.62, 0.019) for Model 2 in knee, 2.29 (1.32–3.95, 0.003) for Model 1 and 1.51 (0.85–2.70, 0.165) for Model 2 in shoulder, and 2.35 (1.65–3.36, < 0.001) for Model 1 and 1.94 (1.33–2.83, 0.001) for Model 2 in neck pain, respectively (Table 4).

Table 1. Baseline characteristics of the participants.						
		Number of musculoskeletal pain except low back pain				
		n (%)	0	1	≥ 2	P value
		1,782	1,343	283	156	
Sex	Male	826 (46.4)	678 (50.5)	97 (34.3)	51 (32.7)	< 0.001
	Female	956 (53.6)	665 (49.5)	186 (65.7)	105 (67.3)	
Age	< 65	877 (49.2)	686 (51.1)	134 (47.3)	57 (36.5)	0.002
	≥ 65	905 (50.8)	657 (48.9)	149 (52.7)	99 (63.5)	
BMI*	18.5 to < 25	1,031 (57.9)	800 (59.6)	159 (56.2)	72 (46.2)	0.001
	< 18.5	50 (2.8)	38 (2.8)	12 (4.2)	0 (0.0)	
	≥ 25	635 (35.6)	455 (33.9)	101 (35.7)	79 (50.6)	
Living area	Ogatsu	770 (43.2)	573 (42.7)	117 (41.3)	80 (51.3)	n.s.
	Oshika	692 (38.8)	535 (39.8)	112 (39.6)	45 (28.8)	
	Wakabayashi	320 (18.0)	235 (17.5)	54 (19.1)	31 (19.9)	
Smoking habits*	Non-smoker	1,336 (75.0)	1,011 (75.3)	204 (72.1)	121 (77.6)	n.s.
	Smoker	342 (19.2)	263 (19.6)	55 (19.4)	24 (15.4)	
Drinking habits*	Non-drinker	1,073 (60.2)	794 (59.1)	178 (62.9)	101 (64.7)	n.s.
	< 45.6 g of alcohol/day**	351 (19.7)	273 (20.3)	54 (19.1)	24 (15.4)	
	≥ 45.6 g of alcohol/day**	179 (10.0)	148 (11.0)	20 (7.1)	11 (7.1)	

Table 1. Baseline characteristics of the participants.						
Comorbid conditions	Hypertension	708 (39.7)	499 (37.2)	123 (43.5)	86 (55.1)	< 0.001
	Diabetes mellitus	169 (9.5)	122 (9.1)	28 (9.9)	19 (12.2)	n.s.
	Myocardial infarction	108 (6.1)	70 (5.2)	18 (6.4)	20 (12.8)	0.001
	Cerebral stroke	33 (1.9)	21 (1.6)	8 (2.8)	4 (2.6)	n.s.
Working status*	Unemployed	951 (53.4)	696 (51.8)	160 (56.5)	95 (60.9)	n.s.
	Employed	793 (44.5)	619 (46.1)	115 (40.6)	59 (37.8)	
Walking time/day*	≥ 1 h	519 (29.1)	423 (31.5)	69 (24.4)	27 (17.3)	< 0.001
	30 min to < 1 h	659 (37.0)	503 (37.5)	92 (32.5)	64 (41.0)	
	< 30 min	573 (32.2)	394 (29.3)	117 (41.3)	62 (39.7)	
Living status*	Same house as before the GEJE	530 (29.7)	393 (29.3)	90 (31.8)	47 (30.1)	n.s.
	Prefabricated house	685 (38.4)	530 (39.5)	103 (36.4)	52 (33.3)	
	New house	224 (12.6)	163 (12.1)	34 (12.0)	27 (17.3)	
	Others	331 (18.6)	246 (18.3)	55 (19.4)	30 (19.2)	
Economic condition*	Normal	827 (46.4)	653 (48.6)	114 (40.3)	60 (38.5)	< 0.001
	A little hard	455 (25.5)	347 (25.8)	65 (23.0)	43 (27.6)	
	Hard	325 (18.2)	207 (15.4)	77 (27.2)	41 (26.3)	
	Very hard	135 (7.6)	98 (7.3)	26 (9.2)	11 (7.1)	
Psychological distress*	Absence	1,516 (85.1)	1,183 (88.1)	217 (76.7)	116 (74.4)	< 0.001

Table 1. Baseline characteristics of the participants.						
	Presence	197 (11.1)	110 (8.2)	54 (19.1)	33 (21.2)	
Sleep disturbance*	Absence	1,305 (73.2)	1,060 (78.9)	171 (60.4)	74 (47.4)	< 0.001
	Presence	465 (26.1)	273 (20.3)	110 (38.9)	82 (52.6)	
Social isolation*	Absence	1,278 (71.7)	984 (73.3)	195 (68.9)	99 (63.5)	0.037
	Presence	499 (28.0)	354 (26.4)	88 (31.1)	57 (36.5)	
*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 amount to 1 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 (%). GEJE: Great East Japan Earthquake						

Table 2. Influence of musculoskeletal pain except LBP on new-onset LBP.					
	Number of musculoskeletal pain except LBP				
	total	0	1	≥ 2	P for trend
Participants	1,782	1,343	283	156	
New-onset LBP, n (%)	251 (14.1)	155 (11.5)	53 (18.7)	43 (27.6)	
Crude OR (95%CI)		1	1.77 (1.25–2.49)	2.92 (1.98–4.30)	< 0.001
Adjusted OR (95%CI)		1	1.69 (1.17–2.42)	2.85 (1.86–4.36)	< 0.001
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. LBP: low back pain, OR: Odds ratio, CI: Confidence interval					

Table 3. Stratified analysis for each age and sex group.						
Number of musculoskeletal pain except LBP						
	total	0	1	≥ 2	P for trend	P-interaction
	1,782	1,343	283	156		
Age						
< 65 years old (n = 877)						
Number of events/subjects	140/877 (16.0%)	93/686 (13.6%)	30/134 (22.4%)	17/57 (29.8%)		
Adjusted OR (95%CI)		1	1.58 (0.96–2.61)	2.28 (1.15–4.50)	0.026	
≥ 65 years old (n = 905)						0.39
Number of events/subjects	111/905 (12.3%)	62/657 (9.4%)	23/149 (15.4%)	26/99 (26.3%)		
Adjusted OR (95%CI)		1	1.78 (1.02–3.10)	3.11 (1.76–5.51)	< 0.001	
Sex						
Male (n = 826)						
Number of events/subjects	117/826 (14.2%)	75/678 (11.1%)	26/97 (26.8%)	16/51 (31.4%)		
Adjusted OR (95%CI)		1	3.39 (1.91–6.01)	3.92 (1.88–8.17)	< 0.001	
Female (n = 956)						0.09
Number of events/subjects	134/956 (14.0%)	80/665 (12.0%)	27/186 (14.5%)	27/105 (25.7%)		
Adjusted OR (95%CI)		1	1.14 (0.69–1.87)	2.31 (1.33–4.00)	0.011	
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. LBP: low back pain, OR: Odds ratio, CI: Confidence interval						

Table 4. Influence of each musculoskeletal pain on new-onset LBP.				
		Absence	Presence	P value
Hand and/or foot pain	Participants	1,616	166	
	New-onset LBP, n (%)	212 (13.1)	39 (23.5)	
	Model 1 OR (95%CI)	1	2.02 (1.33–3.07)	0.001
	Model 2 OR (95%CI)	1	1.38 (0.87–2.18)	0.175
Knee pain	Participants	1,595	187	
	New-onset LBP	206 (12.9)	45 (24.1)	
	Model 1 OR (95%CI)	1	2.27 (1.53–3.37)	< 0.001
	Model 2 OR (95%CI)	1	1.69 (1.09–2.62)	0.019
Shoulder pain	Participants	1,708	74	
	New-onset LBP	229 (13.4)	22 (29.7)	
	Model 1 OR (95%CI)	1	2.29 (1.32–3.95)	0.003
	Model 2 OR (95%CI)	1	1.51 (0.85–2.70)	0.165
Neck pain	Participants	1,558	224	
	New-onset LBP	190 (12.2)	61 (27.2)	
	Model 1 OR (95%CI)	1	2.35 (1.65–3.36)	< 0.001
	Model 2 OR (95%CI)	1	1.94 (1.33–2.83)	0.001
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, shoulder pain, and neck pain (Model 2). LBP: low back pain, OR: Odds Ratio, CI: Confidence interval.				

Discussion

The present study revealed that preexisting other musculoskeletal pain was associated with new-onset LBP among the survivors in the recovery period after the GEJE. Further, the effect was stronger with musculoskeletal pain that occurred at multiple sites.

Some cross-sectional studies have shown that musculoskeletal pain often occurs at multiple sites, such as shoulder, elbow, knee, and low back [18, 19]. Further, other authors reported a significant association between LBP and neck or knee pain [7–9]. A small number of longitudinal studies have investigated the effect of musculoskeletal symptoms on LBP onset. Smith et al. reported that preexisting pain resulting

from arthritis or injury was associated with new onset of LBP [20]. Papageorgiou et al. showed that musculoskeletal pain history was a predictor of subsequent LBP [21]. The results of the present study reveal that the existence of musculoskeletal pain is associated with subsequent onset of LBP, which corresponds with these reports. There has been speculation in the literature about the association between concurrent pain at different sites. Pain at one site can negatively affect motion or posture and place additional burden on the other parts of the body [22]. The factors associated with one pain can also be related to the other pain [23]. In addition, one pain causes central sensitization which can result in the development of pain at other sites [8]. These conditions can explain the association between preexisting musculoskeletal pain and new-onset LBP. Further, to our knowledge, this is the first study to report that the effect of musculoskeletal pain on onset of LBP becomes stronger with multisite musculoskeletal pain. Nordstoga et al. reported that LBP with an increasing number of musculoskeletal pain sites tends to have a worse recovery rate, which also supports our results [24]. The association of musculoskeletal pain with LBP is considered to be stronger due to increased pain sites. High prevalence of musculoskeletal pain was reported after the GEJE and many survivors had pain at multiple sites [14]. This is presumed to be one explanation for increased LBP after the GEJE. Attention should be paid to other musculoskeletal pain sites to treat and prevent LBP after natural disasters.

The stratified analysis according to age and sex categories revealed that the association of other musculoskeletal pain with new-onset LBP was also significant among categories in each group, which showed the robustness of the association in this study. The rate of musculoskeletal pain was higher in participants aged ≥ 65 years compared with those aged < 65 years and the association between the other musculoskeletal pain and LBP was stronger in those aged ≥ 65 years. Generally, musculoskeletal pain, especially multisite pain, is more common among older adults [6, 19], and they are considered to be more vulnerable to such pain. Conversely, the rate of musculoskeletal pain was higher in females as compared with males; however, the association of musculoskeletal pain with LBP was stronger in males. Musculoskeletal pain, especially multisite pain, is more common among females [18, 19], and various factors may affect such pain, which is assumed to lower the association of musculoskeletal pain with LBP in females. Further, in each musculoskeletal pain site, musculoskeletal pain such as hand and/or foot, knee, shoulder, and neck pain were all associated with new onset of LBP in Model 1. Some authors reported the association between LBP and hand or foot [25], knee [9, 23], shoulder [25], and neck pain [8] in cross-sectional studies. There have also a small number of longitudinal studies regarding the association between LBP and each musculoskeletal pain, and preexisting LBP was reported to be associated with onset of knee [22] and neck pain [7]. To our knowledge, the present study was the first to report that preexisting hand and/or foot, knee, shoulder, and neck pain were individually associated with onset of LBP, except for the effect of other musculoskeletal pain. Further, even if the effect was considered, knee and neck pain were also associated with new-onset LBP. There is a closed kinetic relationship between the knee and lower back [9], and dysfunction of the knee joint due to pain can easily result in compensation and pain in the lower back. The spine undergoes a similar ageing process, including genetic influences and risk factors to pain in the neck and lower back [7], which can cause LBP following neck pain. The association of knee or neck pain with LBP was considered stronger compared to

other pain such as hand, foot, and shoulder pain. On the other hand, the association of hand and/or foot, and shoulder pain with LBP was not significant when considering the effect of the other musculoskeletal pain. Musculoskeletal pain except for LBP may be also associated with other pain, and that association may affect the results. Further, survivors who had LBP in the first period were excluded from this study because the purpose of this study was to assess the effects on LBP onset of musculoskeletal pain except LBP. The survivors who already had both LBP and other musculoskeletal pain were excluded, which could reduce the association.

This study had several limitations. First, the questionnaires and informed consent forms were mailed to the participants and the response rate for the first period was not high. Responders might be healthier than non-responders, which could reduce the rate of musculoskeletal pain. Second, musculoskeletal pain was assessed using a self-report questionnaire, which included five pain sites but did not include other pain sites such as hip or elbow. Pain at these sites could also affect the onset of LBP and were not assessed in this study. Finally, this study did not have a control group because the GEJE destroyed vast areas. It was difficult to assess the difference between disaster-stricken and unaffected areas.

In conclusion, preexisting musculoskeletal pain at other sites was associated with new-onset LBP among survivors in the recovery period after the GEJE.

Abbreviations

GEJE: Great East Japan Earthquake, LBP: Low back pain, OR: Odds ratio, 95%CI: 95% Confidence interval

Declarations

Ethics approval and consent to participate:

The study protocol was reviewed and approved by the Ethics Committee of Tohoku University Graduate school of Medicine (approval number: 201192). Written informed consent was obtained from all the participants.

Consent to publish

Not applicable

Availability of data and materials

All relevant data are contained in this article.

Competing interests

The authors declare no conflict of interest.

Funding:

Not applicable

Authors' contributions

YY, YH, and IT contributed to the design of the study. YS, MT, SY, YS, TY, TT and TO were responsible for data collection and supervised the study. TS and YY performed statistical analysis. YY, YH, and EI wrote the manuscript. YS, MT, IT, and JI helped to analyze the data and draft the manuscript.

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Figures

Figure 1

Flowchart of this study