


# Emotional Effects on Factors Associated with Chronic Low Back Pain

This article was published in the following Dove Press journal:  
*Journal of Pain Research*

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**Purpose:** Although chronic low back pain (CLBP) has profound effects on patients, society, and economy, its causes are difficult to identify. Psychogenic effects or social stress is known to affect CLBP; hence, investigation of its underlying causes requires a multifactorial approach. We determined the factors associated with CLBP by using an Internet-based survey. To prevent CLBP, we need to understand its cause and background.

**Patients and methods:** A total of 1000 participants either with (+) or without (–) CLBP answered the Japanese Orthopaedic Association Back Pain Evaluation Questionnaire (JOABPEQ), which assesses five domains of CLBP: low back pain, lumbar function, walking ability, social life function and mental health. We also administered a new questionnaire for participants, that comprised five different domains: Body, Lifestyle, Emotion, Diet, and Social. To evaluate psychogenic effects on CLBP, we added two original factors, namely outshout and *HIE*, which have not yet been studied. *HIE* is a traditional concept (sense) of “feeling cold” or “chilly.” All participants completed both questionnaires.

**Results:** Multivariate logistic regression analysis extracted four factors (sleep, room temperature, outshout, and *HIE*) that were associated with CLBP. The mental health domain was assessed using the JOABPEQ for each of these factors. The factors outshout and *HIE* differed between CLBP (+) and CLBP (–) patients. CLBP (–) participants also showed a difference in Sleep and *HIE* factors.

**Conclusion:** Among psychogenic effects, Emotion was common to all the four extracted factors. There was no common physical divisor. Therefore, we hypothesized that acute low back pain might develop into CLBP in the presence of psychological stress or other emotional factors such as outshout or *HIE*. Hence, we need to consider both physical and psychogenic effects in the prevention and treatment of CLBP. Furthermore, appropriate evaluation and treatment of psychological stress may be effective in reducing CLBP.

**Keywords:** Japanese Orthopaedic Association Back Pain Evaluation Questionnaire, JOABPEQ, outshout, *HIE*, nonspecific low back pain

## Plain Language Summary

Current lifestyle, improper sleeping habits, and unhealthy diet lead to psychological or social stress, which in turn is known to influence the development of chronic lower back pain (CLBP). However, the exact causes of CLBP are yet to be revealed. To shed more light on this issue, we undertook an Internet-based survey in which the participants had to answer a questionnaire related to five aspects of CLBP: low back pain, lumbar function, walking ability, social life function and mental health. In addition, we included two new variables, namely outshout (the expression of anger through outburst) and *HIE* (feeling of coldness). Based on our results, we think that psychological stress (especially emotional disturbance such as outshout or *HIE*) could promote acute low back pain to develop into CLBP. We therefore recommend that timely diagnosis and treatment of psychological stress could help to minimize the incidence of CLBP.

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## Introduction

Low back pain (LBP) that persists for more than three months is defined as chronic low back pain (CLBP). Particularly, among carers and factory workers, CLBP frequently causes work absenteeism and has profound effects on the patients themselves, society, and the economy.<sup>1</sup> In 2016, the Japanese Ministry of Health, Labour and Welfare estimated that 28 million people nationwide suffer from CLBP.<sup>2</sup> Although some local governments in the country recently started a program of domiciliary visits to treat patients with CLBP, the effectiveness of this program has not yet been assessed.

LBP is often prolonged because the identification of its cause is difficult; physical factors such as smoking or lack of exercise have been implicated as the cause of prolonged LBP.<sup>3,4</sup> However, 85% of CLBP is nonspecific, with no identified physiological, neural, or orthopedic disorders in the spine.<sup>5</sup> Most CLBP cases show substantial discrepancies between the objective observations of medical practitioners and patients' subjective complaints, thus suggesting causes other than physiological disorders. As psychogenic effects could affect CLBP, a multifaceted approach to both diagnosis and treatment is necessary.<sup>6</sup>

The Japanese Orthopaedic Association has recently developed a pain evaluation questionnaire (the Japanese Orthopaedic Association Back Pain Evaluation Questionnaire (JOABPEQ)) to assess five key domains of CLBP: low back pain, lumbar function, walking ability, social life function and mental health.<sup>7-9</sup> It was subsequently suggested that psychological effects or social stress might also affect CLBP.<sup>10</sup> To augment the JOABPEQ, we prepared a new questionnaire comprising five domains (Body, Lifestyle, Emotion, Diet, and Social) and further investigated psychogenic effects on CLBP using the original factors Outshout and *HIE*, which have not yet been identified.

We conducted a cross-sectional study on various factors using a web-based questionnaire-answering system to assess the possibility of profound psychogenic effects on CLBP, to hypothesize the development of CLBP, and to propose a new approach to CLBP, particularly nonspecific CLBP.

## Methods

### Participants

Participants were recruited from a database that is administered by a Japanese survey company (Cross Marketing Inc., Tokyo, Japan). Questionnaires were administered

using an Internet-based survey conducted by a Japanese survey company (Cross Marketing Inc., Tokyo, Japan). From a total of 300,000 people listed in a database administered by this company, a subsample of 5000 subjects was drawn using random sampling stratified by age and place of residence. This subsample was re-sampled by proportional allocation to balance the gender ratio, yielding a final sample of 1000 subjects, including 519 males and 481 females. All participants used a web-based questionnaire-answering system provided by the survey company. Before starting the investigation, we informed all subjects that the data collected would be used only for research and that they could withdraw from the study at any time. We explained that their participation would be kept confidential. Informed consent was obtained from all subjects prior to enrollment. All 1000 subjects who accessed the survey web page responded and gave us informed consent before starting the questionnaire. This study was approved by the Medical Ethics Committee of Ibaraki Prefectural University of Health Sciences (Ibaraki, Japan, e135-h291212).

### Chronic Low Back Pain

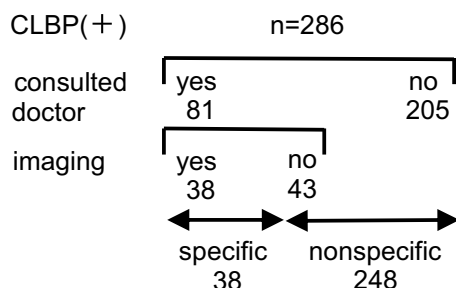
Chronic low back pain (CLBP) refers to pain, stiffness, decreased movement of the lower back, and difficulty in straightening one's lower back, experienced for more than three months. Participants were divided into two groups: CLBP (-) ( $n = 714$ , 71.4%) and CLBP (+) ( $n = 286$ , 28.6%). In addition to the new questionnaire ([Appendix](#)), clinical details such as visits to doctors or diagnostic imaging were recorded ([Figure 1](#)).

### JOABPEQ

All subjects completed the JOABPEQ, a specific instrument for LBP evaluation developed by the Japanese Orthopaedic Association in 2007 by referring to Rolland-Morris Disability Questionnaire Score or SF36 (Medical Outcomes Study, a 36-Item Short-Form Health Survey).

JOABPEQ includes 25 questions in five domains: low back pain, lumbar function, walking ability, social life function and mental health. The score of each domain was calculated according to the official guidelines and ranged from 0 to 100 points. The lower the score, the worse is the patient's condition. Participants were asked to report on various aspects of their CLBP condition during the preceding week.<sup>7-9</sup>

### Overview of CLBP(+) patients



**Figure 1** Overview of CLBP (+) patients. The total number of CLBP (+) subjects was 286. Eighty-one of them consulted doctors, while 205 of them did not. Thirty-eight of them had specific CLBP, whose cause was organic, and the rest of them (248) had nonspecific CLBP, whose cause was not organic.

## New Questionnaire (Body, Lifestyle, Emotion, Diet and Social)

The new questionnaire that we developed is presented in the [Appendix](#).

### Body [Age, Gender and Body Mass Index (BMI)]

The domain of Body has three subfactors of Age, Gender and Body Mass Index (BMI). In this study, subjects were drawn using random sampling stratified by age and gender in advance as mentioned. Subjects were asked to indicate the appropriate category for age [20–29, 30–39, 40–49, 50–59 (years)] and Gender (Male, Female).

Similar to previous studies, we also calculated BMI<sup>4,11,12</sup> by asking their height (cm) and weight (kg), and then applied the following formula:  $BMI = \text{weight (kg)} \div \text{height (m)}^2$ . We then categorized the subjects into three groups based on their BMI (<18.5, 18.5–24.9, ≥25.0)

### Lifestyle [(Exercise, Bathing, Cigarette, Sleep and Room Temperature (RT))]

Lifestyle [Exercise,<sup>13</sup> Bathing,<sup>14–16</sup> Cigarette,<sup>4,17</sup> Sleep<sup>18–20</sup> and Room Temperature (RT)]<sup>21–23</sup> affects CLBP. We asked subjects to select the frequency of their exercise (Hardly, Frequently, N/A), the style of their personal washing [Shower only, Bath (<10 min), Bath (≥10 min)], and the number of cigarettes smoked per day (0, 1–20, ≥20). We also asked them the duration of sleep (<6, 6–7, 7–8, ≥8 hrs per night) and the RT (<18 or ≥18 °C) of the location from where they were answering our questionnaire.

### Emotion (Happiness, Anger, Outshout and HIE)

Researchers have reported that emotion can affect CLBP, therefore, we asked the subjects to select the frequency of their emotions of happiness and anger from never,

sometimes, or frequently.<sup>24</sup> We also asked participants to indicate frequency of outshout (the expression of anger through outburst) (Never, Sometimes, Frequently).

*HIE*, a well-known concept within traditional Chinese medicine (TCM), is a subjective sense of “feeling cold” or “chilly”. “Mild” *HIE* is a simple sense of being chilly, whereas “severe” indicates feelings of discomfort.<sup>25–28</sup> Therefore, first we asked participants about the presence or absence of *HIE*, and if present, its severity (Never, Mild, Severe).

### Diet (Red Meat, White Meat and Cold Food)

In accordance with previous studies, we asked the subjects to rate the frequency of intake of red meat, white meat, and cold food (Hardly, Frequently, N/A).<sup>28,29</sup>

### Social (Occupation and Residence)

One’s social situation may influence CLBP; therefore, we asked subjects to provide information about their occupation (Manager, Full-time, Part-time/no job)<sup>30,31</sup> and residence (North area, East, area, West area, South area of Japan).<sup>32</sup>

## Outshout and HIE–Original Factors

Although the causes of CLBP are difficult to identify, researchers have reported the possibility of emotional influence on CLBP.<sup>10,24</sup> We constructed an original factor, Outshout, in the emotional domain because emotion may affect our behavior and health through the hypothalamic-pituitary-adrenal system.<sup>33,34</sup> For example, laughter, an expression of the emotion happiness, has a positive physiological effect.<sup>35,36</sup> Conversely, it is known that anger may exacerbate LBP.<sup>37–40</sup> In order to compare the effect of emotions on LBP, an objective indicator of emotional status is required; that is why we devised the outcome measure that we named “outshout.” The action of shouting out loud is considered as an expression of anger and/or frustration. We analyzed the frequency of outshout, with the reasoning that we could infer a higher degree of emotional turmoil from an increased frequency of outshout.

The second original factor that we incorporated into our new questionnaire was *HIE* in the emotion domain. This is a subjective sense of “feeling cold” or “chilly.” In traditional Chinese medicine (TCM), *HIE* is called *Xuhan*, and it is known to induce pain including CLBP.<sup>41</sup> Local/small studies<sup>25–28</sup> cannot be a good evidence. We quantified *HIE* (a traditional concept) by measuring body temperature (a modern concept) because according to a recent

study, *HIE* may be modified by multiple factors including emotion.<sup>42</sup> Other information that might affect both body temperature and *HIE* was obtained through the questionnaire, such as the RT while answering the questionnaire and the current diet followed.

## Statistical Analysis

All statistical analyses were performed using IBM SPSS Statistics software for Windows version 25.0 (IBM Corp., Armonk, NY, USA). Means ( $\pm$  standard deviations) were used to characterize the distributions of continuous variables.

First, Pearson's chi-squared test was conducted to study the two groups [CLBP (+) or CLBP (-)] and determine candidate factors of the multivariate analysis.

Next, multiple logistic regression analysis with forward stepwise model selection was performed to determine the factors significantly associated with CLBP. Candidate factors of the multivariate analysis are shown in Tables 1 and 2. The values are expressed as 95% confidence interval and adjusted odds ratio (OR). The dependent variable in the multiple logistic regression models was binary: CLBP (-) and CLBP (+), and the null hypothesis was that the probability of observing a regression coefficient of 0 or 1 is influenced solely by chance rather than by any of the independent variables.

Axillary temperatures of the two groups were compared using Student's *t*-test to study the possibility that low temperature affects CLBP. The relationship between CLBP and *HIE* was assessed using Spearman's rank correlation coefficient. Each domain of the JOABPEQ (rank scale) was evaluated independently.

Finally, to study the psychological effects on CLBP, a Mann-Whitney *U*-test was conducted to compare the medians of each factor among the CLBP (+) patients. The association between the domain of mental health disorders (JOABPEQ) and the significant factors identified by multiple logistic regression analysis was assessed by differences in these medians.

All statistical tests were two-tailed, and a statistical significance was set at  $P < 0.05$ .

## Results

### Nine Factors Significantly Associated with CLBP

The basic characteristics of the participants included this study is shown in the table. Of our 1000 participants

(average age  $\pm$  SD;  $40.5 \pm 10.8$  years), 286 (28.6%) were grouped as CLBP (+) patients, including 153 males and 133 females (Table 1). We conducted Pearson's chi-squared test to compare the two groups [CLBP (+) or CLBP (-)] and determine candidate factors of the multivariate analysis. Our result identified 9 factors [(1) – (9)] in 3 domains (Body, Lifestyle and Emotion) that were significantly associated with CLBP: in the Body domain, 1) Age ( $P = 0.031$ ), 2) BMI ( $P = 0.008$ ); in the Lifestyle domain, 3) Cigarettes/day ( $P = 0.001$ ), 4) Sleep (h) ( $P = 0.007$ ), 5) RT ( $P < 0.001$ ); and in the Emotion domain, 6) Happiness, 7) Anger, 8) Outshout, and 9) *HIE* ( $P < 0.001$  for factors 6–9). It is noteworthy that all factors in the Emotion domain showed highly significant association with CLBP.

### Four Factors Significantly Associated with CLBP

Four independent variables that showed interactions or multicollinearity among each other were excluded from the multivariate logistic regression analysis: 1) BMI (with Age), 2) Cigarettes/day (with Age and Outshout), 3) Happiness (with Sleep), and 4) Anger (with Outshout). Multivariate logistic regression analysis was conducted, thus identifying further four factors that were associated with CLBP (Table 2).

For Sleep, the OR for the “<6” category was significantly higher than that for “6 to 7,” which was the average sleeping duration of Japanese people in 2016 (1.000 and 1.402, respectively).<sup>43</sup> For RT ( $^{\circ}\text{C}$ ), the OR for the  $\geq 18$   $^{\circ}\text{C}$  group was higher than that for the  $< 18$   $^{\circ}\text{C}$  group (1.000 vs 1.708). For Outshout, OR increased with an increase in the frequency: ORs for “sometimes” and “frequently” were higher than that for “never” (1.000, 1.445, and 2.250, respectively); *HIE* showed a similar tendency, with ORs for “mild” and “severe” higher than that for “never” (1.000, 1.813, and 2.214, respectively).

### Possibility of the Effect of Low Body Temperature (BT) on CLBP

There was no significant difference in body temperature observed between the two groups ( $36.18 \pm 0.36$  and  $36.16 \pm 0.37$   $^{\circ}\text{C}$  for CLBP (-) and (+), respectively,  $P = 0.525$ , Student's *t*-test). The same was true for subgroups of CLBP (-) and (+) according to age or gender (Table 3).

**Table 1** Characteristics of the CLBP (+) and CLBP (–) Groups

Characteristic	CLBP				P Value
	(-)		(+) )		
	n	%	n	%	
Total (N = 1000)	714	71.4	286	28.6	
Body					
Age (years)					0.031*
20–29	168	74.7	57	25.3	
30–39	199	76.0	63	24.0	
40–49	174	70.2	74	29.8	
50–59	173	65.3	92	34.7	
Gender					0.522
Male	366	70.5	153	29.5	
Female	348	72.3	133	27.7	
BMI					0.008**
<18.5	109	77.3	32	22.7	
18.5–24.9	489	72.6	185	27.4	
≥25.0	116	57.1	69	42.9	
Lifestyle					
Exercise					0.155
Hardly	391	72.4	149	27.6	
Frequently	179	67.0	88	33.0	
N/A	144	74.6	49	25.4	
Bathing					0.181
Shower only	265	74.6	90	25.4	
Bath (<10 min)	240	68.4	111	31.6	
Bath (≥10 min)	209	71.1	85	28.9	
Cigarette (/day)					0.001**
0	562	74.3	194	25.7	
1–20	104	61.5	65	38.5	
≥20	48	64.0	27	36.0	
Sleep (h)					0.007**
<6	217	66.2	111	33.8	
6–7	315	74.5	108	25.5	
7–8	118	68.5	54	31.4	
≥8	64	83.1	13	16.9	
RT (°C)					<0.001**
<18	321	78.5	88	21.5	
≥18	393	66.5	198	33.5	
Emotion					
Happiness					<0.001**
Never	132	58.7	93	41.3	
Sometimes	377	72.8	141	27.2	
Frequently	205	79.8	52	20.2	
Anger					<0.001**
Never	311	78.5	85	21.5	

(Continued)

**Table 1** (Continued).

Characteristic	CLBP				P Value
	(-)		(+)		
	n	%	n	%	
Sometimes	308	70.3	130	29.7	
Frequently	95	57.2	71	42.8	
<b>Outshout</b>					<0.001**
Never	490	74.9	164	25.1	
Sometimes	176	67.4	85	32.6	
Frequently	48	56.5	37	43.5	
<b>HIE</b>					<0.001**
Never	324	78.3	90	21.7	
Mild	226	67.9	107	32.1	
Severe	164	64.8	89	35.2	
<b>Diet</b>					0.099
<b>Red meat</b>					
Hardly	93	75.0	31	25.0	
Frequently	435	69.0	195	31.0	
N/A	186	75.6	60	24.4	
<b>White meat</b>					0.126
Hardly	66	67.3	32	32.7	
Frequently	475	70.3	201	29.7	
N/A	173	76.5	53	23.5	
<b>Cold food</b>					0.107
Hardly	161	73.9	57	26.1	
Frequently	342	68.4	158	31.6	
N/A	211	74.8	71	25.2	
<b>Social</b>					0.259
<b>Occupation</b>					
Manager	94	72.3	36	27.7	
Full time	312	68.9	141	31.1	
Part-time/no job	308	73.9	109	26.1	
<b>Residence</b>					0.221
North area	65	64.4	36	35.6	
East area	327	74.1	114	25.9	
West area	205	70.0	88	30.0	
South area	117	70.9	48	29.1	

**Notes:** \*P<0.05; \*\*P<0.01.**Abbreviations:** CLBP, chronic low back pain; RT, room temperature.

## Relationship Between HIE and CLBP

Spearman's rank correlation coefficients assessing the relationship between *HIE* and each of the five domains of the JOABPEQ identified the possible effects of *HIE* on CLBP (Table 4). *HIE* was negatively related to all five domains, with mental health disorders showing the strongest correlation ( $r_s = -0.232$ ,  $P < 0.001$ , Table 4).



**Table 2** Results of Multivariate Logistic Regression Analysis

Variable	Coef	SE	P Value	OR	95% CI	
					Lower	Upper
<b>Sleep (h)</b>						
6–7	–	–	–	1.000		
<6	0.338	0.168	0.044*	1.402	1.009	1.947
7–8	0.379	0.206	0.067	1.460	0.974	2.188
≥8	–0.488	0.333	0.142	0.614	0.320	1.178
<b>RT (°C)</b>						
<18	–	–	–	1.000		
≥18	0.536	0.155	0.001**	1.708	1.260	2.316
<b>Outshout</b>						
Never	–	–	–	1.000		
Sometimes	0.368	0.166	0.026*	1.445	1.044	2.000
Frequently	0.811	0.252	0.001**	2.250	1.373	3.688
<b>HIE</b>						
Never	–	–	–	1.000		
Mild	0.595	0.183	0.001**	1.813	1.267	2.593
Severe	0.795	0.196	<0.001**	2.214	1.508	3.252
<b>Constant</b>	–1.855	0.252	<0.001**	0.156		

**Notes:** Factors significantly associated with CLBP were selected by a forward stepwise regression method. \* $P < 0.05$ ; \*\* $P < 0.01$ .

**Abbreviations:** RT, room temperature; Coef, coefficients; OR, odds ratio; CI, confidence interval.

**Table 3** Possibility of the Effect of Low Temperature on CLBP (Student's *t*-Test)

Characteristic	CLBP		P value
	(–)	(+)	
<b>BT (°C)</b>	36.18±0.36	36.16±0.37	0.525
<b>Age (years)</b>			
20–29	36.21 ± 0.39	36.22 ± 0.40	0.871
30–39	36.19 ± 0.37	36.27 ± 0.34	0.120
40–49	36.16 ± 0.36	36.09 ± 0.38	0.179
50–59	36.16 ± 0.32	36.12 ± 0.36	0.269
<b>Gender</b>			
Male	36.20 ± 0.36	36.19 ± 0.37	0.708
Female	36.16 ± 0.36	36.14 ± 0.38	0.562

**Abbreviations:** CLBP, chronic low back pain; RT, room temperature; BT, body temperature.

## Association of Mental Health Domain (JOABPEQ) with Sleep, RT, Outshout, and HIE

The scores of mental health (JOABPEQ) domain on four factors (Sleep, RT, Outshout, and HIE) indicated significant associations between CLBP and these factors (Table 2). We compared the score of OR = 1.000 (□) and that of OR > 1.000

**Table 4** Effect of HIE on CLBP

JOABPEQ	rs	P
Low back pain	–0.157	<0.001**
Lumbar function	–0.146	<0.001**
Walking ability	–0.163	<0.001**
Social life function	–0.195	<0.001**
Mental health	–0.232	<0.001**

**Note:** \*\* $P < 0.01$ .

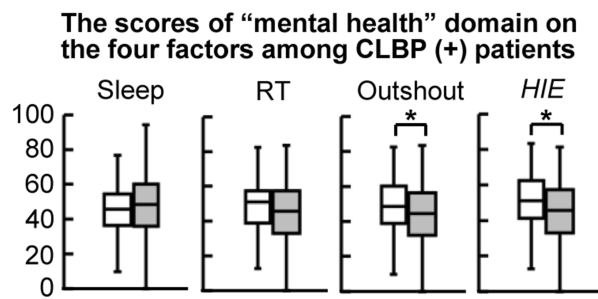
**Abbreviations:** CLBP, chronic lower back pain; JOABPEQ, Japanese Orthopaedic Association Back Pain Evaluation Questionnaire; rs, Spearman's rank correlation coefficient.

(■) for each factor among CLBP (+) patients. In this study, CLBP (+) patients had a significant difference in the factors of Outshout and HIE ( $P < 0.05$ , Figure 2).

## Discussion

### Four Factors (Sleep, RT, Outshout, and HIE) Associated with CLBP

We analyzed the results of the questionnaire consisting of 18 factors that belong to five domains. Of the 18 factors, four were identified to have significant association with CLBP: 1) Sleep (h), 2) RT (°C), 3) Outshout, and 4) HIE, which are described below (Tables 1 and 2).



**Figure 2** The scores of “mental health” on the four factors among CLBP (+) patients. We compared the score of OR = 1.000 (□) and that of OR > 1.000 (■) for each factor among CLBP (+) patients. —, median; \*P < 0.05.

**Abbreviations:** CLBP, chronic low back pain; RT, room temperature.

## Sleep

First, our result showed that OR of the <6 h group, less than the Japanese average sleeping hours, was significantly higher than that of the 6–7 h group, the Japanese average sleeping hours. As sleeping duration is related to time spent lying down, individuals with longer habitual sleep periods may experience decreased physical stress that leads to lumbar spine dysfunction. Many studies suggest that inappropriate sleeping duration worsens CLBP.<sup>44–47</sup>

Moreover, the autonomic nervous system (ANS) that controls our whole body shifts from sympathetic nerve dominance during waking to parasympathetic nerve dominance during sleep.<sup>48</sup> An inappropriate sleep affects the function of ANS and circulation.<sup>44–47</sup> In the long term, inappropriate sleep periods may induce the onset of depression as psychogenic stress.

## RT

For the RT factor, the OR for the “≥18 °C” group was prominently higher than that of the “<18 °C” group in association with CLBP. It is known that the incidence of CLBP increases in cold seasons.<sup>49</sup> It is considered that cold stimulation may affect and induce vasoconstriction, circulation insufficiency, or hypothermia.<sup>50</sup> On the other hand, it is known that immersion in warm baths may ameliorate mild LBP because it elevates body temperature and improves circulation.<sup>14–16</sup>

In our study, most CLBP (+) subjects had mild LBP; therefore, they might prefer warmer RT to reduce their LBP by elevating their body temperature or by the improvement of circulation. In our 286 CLBP (+) subjects, only 38 had undergone imaging tests and received a clinical diagnosis of an organic cause (Figure 1). The remaining 248 subjects might be considered to have non-specific LBP. Moreover, 205 CLBP subjects reported that

their CLBP was not severe enough to warrant regular visits to doctors. A further study is needed to determine the association between severe CLBP and RT.

## Outshout

The OR increased with an increase in the frequency of this new factor (Table 2). As mentioned earlier in the Methods section, Outshout, a psychological factor, affects CLBP. Both the expression of anger and attempts to inhibit this emotion are harmful to our health and are associated with coronary diseases.<sup>51</sup> Rather than having the expected cathartic effect, the expression of anger is accompanied by elevated psychological stress and aggression.<sup>52,53</sup> Thus, the stress underlying Outshout might increase for anger, possibly causing circulatory insufficiency and CLBP because of increase in the secretion of stress hormones such as adrenaline or cortisol.<sup>54,55</sup> Moreover, patients reporting frequent Outshout may be more affected by psychological stress than those reporting its occasional occurrence. This may explain why OR for patients in the former category was higher than that for those in the latter category. In this study, the presence of alexithymia in study subjects, which is a marked dysfunction in emotional awareness, was not confirmed. Although it is a rare case, further research on this topic is warranted.

## HIE

HIE is a well-known concept within TCM and has both physical and psychological stress components.<sup>56,57</sup> Table 2 shows a positive association between HIE and CLBP. As long as HIE remains within the level of “mild,” psychological stress is hardly detectable, but once HIE progresses from “mild” to “severe,” reflecting increased psychological stress, it causes pain in the lower back, neck, shoulder, eyes, and other parts of the body. “Mild” HIE is a simple sense of being chilly, whereas “severe” indicates feelings of discomfort. Our results showed that the OR for patients reporting “severe” HIE was higher than that for reporting “mild,” probably reflecting increased psychological stress in the former group (Table 2).

## The Possibility of Physical Effects Common to Four Factors

To discover a cause or exacerbating factor of CLBP, we considered which physical effect might be common to the four factors of Sleep, RT, Outshout, and HIE. Circulatory insufficiency or hypothermia were considered as possibilities.

Therefore, the CLBP (–) and CLBP (+) groups were compared to analyze the possibility of the association between decreased body temperature (axilla) and CLBP. However, no significant difference was observed between the two groups. The same result was obtained when these two groups were divided into subgroups according to their age or gender (Table 3). This may be attributed to the wide physical variation among our subjects, who included both males and females aged from 20 to 59 years.

### The Possibility of Psychogenic Effects Common to Four Factors and Their Association with CLBP

To determine the possibility of psychogenic effects on CLBP, the Spearman's rank correlation coefficient test was conducted with *HIE* and JOABPEQ data. The mental health domain showed the highest correlation among the five domains ( $r_s = -0.232$ ,  $P < 0.001$ , Table 4).

Moreover, CLBP (+) patients showed significant difference in the score of “mental health” only in Outshout and *HIE*. They indicated difference neither Sleep nor RT ( $P < 0.05$ , Figure 2). The former factors belong to Emotion while the latter ones belong to Lifestyle.

Therefore, those significant differences support the possibility that emotional stress may be more severe than physical one. In short, Lifestyle might induce acute LBP, however, it could decrease by the improvement of Sleep or RT, for example. However, at this time point, data for acute LBP are inefficient, therefore, further investigation is needed.

### Hypothesized Development from Acute to Nonspecific LBP and the Possibility of a New Approach to CLBP

In our consideration of the association between mental health (a domain of JOABPEQ) and the four factors significantly associated with CLBP (Sleep, RT, Outshout, and *HIE*), two important results were found. First, multivariate logistic regression analysis highlighted only two domains (Lifestyle and Emotion) out of five that were related to CLBP. Second, interestingly it was shown that all factors within the Emotion domain differed significantly between participants with and without CLBP. These findings led us to propose a hypothesis about the onset of nonspecific LBP without organic causes (Figure 3).

In some patients, LPB may be caused by only physical factors; these patients can often recover within three months. However, when emotional factors also contribute

### A hypothesis on the development into nonspecific low back pain

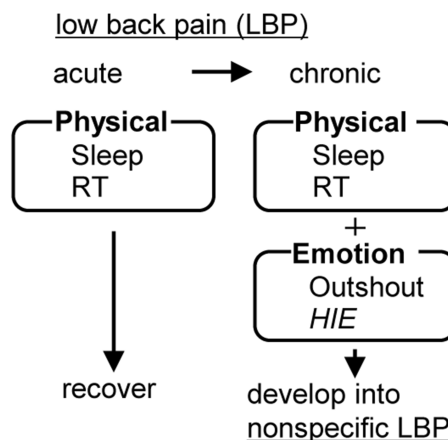


Figure 3 A hypothesis for the development of nonspecific low back pain.

to their LBP, patients may suffer for over three months. We hypothesize that psychological factors may lead from acute LBP to CLBP, thus explaining why 85% of CLBP is nonspecific; emotional factors are undetectable by conventional medical checks, such as various imaging techniques.

Even if physical stress from poor Lifestyle induced acute LBP, this could be ameliorated with adequate sleeping time or improvement of circulation. However, when psychological stress exists, which may potentially induce Outshout or *HIE*, this might prolong acute LBP and lead to nonspecific LBP, even if the organic cause itself could be managed.

It is, therefore, possible that psychological stress, such as Outshout or *HIE*, might underlie CLBP. Hence, consideration of both physical and psychogenic effects is of key importance for the prevention of CLBP. The development of therapies for CLBP should include appropriate evaluation and treatment of psychogenic effects, particularly those related to emotion.

CLBP patients might benefit from psychosocial treatment. Recent RCT studies of cognitive behavioral therapy,<sup>58</sup> the addition of therapeutic alliance,<sup>59</sup> and mindfulness<sup>60</sup> revealed the effectiveness of psychosocial treatment on CLBP, for example. Thus, the psychological factors are important to take into account when examining and treating these patients.

### Limitations

The first limitation of this study is the limited sample size; thus, further research on a larger scale is required to assess our findings. Second, because the invitation for participation in the survey was sent over the Internet, only those



participants who frequently use the Internet might have participated, and hence, the sample size was small. Therefore, this study sample may not be a representative of the wider population. These would be valuable factors to assess in any future study, and some of the conclusions drawn here will lead to further debate.

## Conclusion

We identified that our factors (Sleep, RT, Outshout, and HIE) are significantly associated with an increase in ORs for CLBP. This suggests that appropriate understanding, evaluation of, and approach to psychogenic effects, especially those of emotion, are important for multifaceted treatment of CLBP.

## Acknowledgments

The authors thank all volunteers who participated in this study. We would also like to thank Editage for assistance in English language editing. This study was supported by The Uchida Energy Science Promotion Foundation (Grant no. 1-1-59) and the Japan Society for the Promotion of Science's Grants-in-Aid for Scientific Research (Kakenhi Grant No. 19K10727).

## Author Contributions

KO, MW and CT contributed to conception and design, analysis, drafting and critical revision of the manuscript. TN and ZO contributed to conception, interpretation, drafting and critical revision of the manuscript. TH and KA contributed to conception and design, interpretation, drafting and critical revision of the manuscript. NM contributed to conception, data analysis, drafting and critical revision of the manuscript. All authors gave final approval of the version to be published and agreed to be accountable for all aspects of the work, ensuring integrity and accuracy.

## Disclosure

The authors report no conflicts of interest in this work.

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