RESEARCH ARTICLE

Injustice Experience Questionnaire, Japanese Version: Cross-Cultural Factor-Structure Comparison and Demographics Associated with Perceived Injustice

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Abstract

Objective

The Injustice Experience Questionnaire (IEQ) assesses injury-related perceived injustice. This study aimed to (1) develop a Japanese version (IEQ-J), (2) examine its factor structure, validity, and reliability, and (3) discover which demographic variable(s) positively contributed to prediction of IEQ-J scores.

Methods

Data from 71 patients (33 male, 38 female; age = 20+) with injury pain were employed to investigate factor structure by exploratory and confirmatory factor analyses. Concurrent validity was examined by Pearson correlation coefficients among the IEQ-J, Brief Pain Inventory (BPI), and Pain Catastrophizing Scale (PCS). Internal consistency was investigated by Cronbach’s alpha, and test-retest reliability was indicated with intra-class correlations (ICCs) in 42 of 71 patients within four weeks. Relations between demographic variables and IEQ-J scores were examined by covariance analysis and linear regression models.

Results

IEQ-J factor structure differed from the original two-factor model. A three-factor model with Severity/irreparability, Blame/unfairness, and Perceived lack of empathy was extracted. The three-factor model showed goodness-of-fit with the data and sufficient reliability...
Cronbach’s alpha of 0.90 for total IEQ-J; ICCs = 0.96. Pearson correlation coefficients among IEQ-J, BPI, and PCS ranged from 0.38 to 0.73. Pain duration over a year (regression coefficient, 11.92, 95%CI; 5.95–17.89) and liability for injury on another (regression coefficient, 12.17, 95%CI; 6.38–17.96) predicted IEQ-J total scores.

Conclusions
This study evidenced the IEQ-J’s sound psychometric properties. The three-factor model was the latter distinctive in the Japanese version. Pain duration over a year and injury liability by another statistically significantly increased IEQ-J scores.

Introduction
The Injustice Experience Questionnaire (IEQ) is an assessment tool for measuring injury-related perceived injustice [1]. Relationships between perception of injustice and health-related issues have long been discussed. For example, associations between injustice and sleeping problems [2], cerebrovascular disease [3], and sick leave from work [4] have been reported. Victims injured by another’s error or negligence (e.g., whiplash injury) are likely to experience injustice that prevents them from recovering and returning to work [5]. Perceived injustice might predictively indicate prognosis and be an important therapeutic target for recovering from severe injury [5]. Thus, perception of injustice should be investigated as a negative belief among traumatized patients.

Furthermore, injured patients with chronic pain not only perceive injustice, but also catastrophize their experience of pain [1]. Total scores of the Pain Catastrophizing Scale (PCS), a measure of exaggerating pain among chronic patients, were highly correlated with total scores of the IEQ [1]. Pain catastrophizing is also an exaggerated negative belief that prevents patients from recovering and seems to be a treatment target for patients suffering chronic pain [6]. The original version of the PCS was in English, but has already been translated into many languages; for instance, Brazilian, Portuguese [7], Chinese [8], Italian [9], Korean [10], Turkish [11], and Japanese [12]. Moreover, cross-cultural assessment of the PCS has been implemented [7–12].

The IEQ’s original version was developed in a Canadian sample by Sullivan et al. in English and French [1], and the Spanish version was used in a previous study of patients with fibromyalgia, although fibromyalgia is not injury-related pain [13]. The IEQ has never been translated into Japanese. Therefore, we developed the Japanese version of the IEQ (IEQ-J) to examine perceived injustice in the Japanese clinical population.

The original IEQ version had two factors, Severity/irreparability and Blame/unfairness, in the Canadian population [1], and its factor structure has also already been confirmed in an Australian compensable population [14]. However, the IEQ’s factor structures might differ in Canadian, Australian, and Japanese populations. Thus, we re-examined its factor structure.

Furthermore, we researched the association between demographic variables regarding injury-related pain and IEQ-J scores to reinforce evidence from previous studies [1,13,15]. The following demographic variables were examined: duration of pain, cause of injury, liability for injury, employment status, compensation, and dispute. Presumably, victims injured by another’s error or negligence and the injured who are compensated are more likely to perceive injustice than persons with self-inflicted injury or without compensation. Sullivan et al. indicated that motor vehicle accidents were associated with higher IEQ scores [1]. Ferrari reported...
that whiplash victims at 6-months post-injury showed higher IEQ scores than victims at 3-months post-injury. Higher IEQ scores were also a risk factor for lack of recovery [15].

The present study’s three objectives were to develop the Japanese version of the IEQ, to examine its factor structure, validity, and reliability, and to discover which demographic variable(s) positively contributed to prediction of IEQ-J scores.

**Materials and Methods**

**Translation of the IEQ into Japanese**

Language and cultural equivalence should be adapted from an original to a translated questionnaire [16]. Therefore, the IEQ’s translation into Japanese was based on guidelines for cross-cultural adaptation of self-report measures [17]. After obtaining authorization to develop the Japanese version from the original IEQ’s author (M.S.), the original was translated into Japanese by four persons: a medical doctor (K.Y.), a physical therapist (T.N.), and a clinical psychologist (T.A.)—all native Japanese speakers—and a medical student (D.W.) who is a native English speaker also speaking Japanese. This initial translation was then reverse translated to English by another native English speaker (E.S.), who is bilingual in English and Japanese and who had no prior knowledge of the original IEQ. This back-translated version was compared with the original version and judged for translation clarity and linguistic equivalence by the four persons noted above, another medical doctor (M.S.), the corresponding author (H.I.), and the original IEQ’s author (M.S.). Consequently, minor modifications were made to the initial Japanese translation. Then, this final questionnaire was named the Japanese version of the IEQ (IEQ-J). The Japanese form of the IEQ-J was shown in Fig 1. The original author of IEQ (M.S.) was approved the use of this Japanese form for free.

**Sample Population**

During the current study from December 2014 to May 2015, 74 patients with pain owing to injury participated. They answered three questionnaires and provided their background information. Two participants with acute pain within a month of injury and a participant who did not respond to the IEQ-J were excluded. Thus, analysis included 71 participants (33 male, 38 female), aged 20 and older, from four facilities in Japan—31 and 24 participants from two university hospitals, two participants from a prefectural hospital, and 14 participants from an orthopedic clinic. There is no single method for factor analysis of calculating a minimum sample size [18]. Many recommend a subject-to-variables ratio of 5 to 10:1, with a minimum of 50 or 100 samples [18,19]. In the current study, the subject-to-variables ratio was 5.9:1, with over 50 subjects. The sample size of the current study thus exceeded minimum requirements.

**Measures**

**Perceived Injustice.** Developed by Sullivan et al., the Injustice Experience Questionnaire (IEQ) is a 12-item, self-report scale for measuring perceived injustice associated with injury [1]. Responders rate the frequency with which they have experienced each of 12 pain-related perceptions. The IEQ uses a 5-point Likert-type scale, ranging from 0 (never) to 4 (all the time) [1]. The original IEQ’s items are as follows:

- Item 1. Most people don’t understand how severe my condition is.
- Item 2. My life will never be the same.
- Item 3. I am suffering because of someone else’s negligence.
Item 4. No one should have to live this way.

Item 5. I just want to have my life back.

Item 6. I feel that this has affected me in a permanent way.

Item 7. It all seems so unfair.

Item 8. I worry that my condition is not being taken seriously.

Item 9. Nothing will ever make up for all that I have gone through.

Item 10. I feel as if I have been robbed of something very precious.

Item 11. I am troubled by fears that I may never achieve my dreams.

Item 12. I can’t believe this has happened to me [1].
A two-factor model was proposed for the IEQ’s original version: Severity/irreparability comprised Items 1, 2, 4, 5, 6, and 8; Blame/unfairness comprised Items 3, 7, 9, 10, 11, and 12 [1]. Cronbach’s alpha for the original IEQ was 0.92.

**Pain intensity and interference.** The Brief Pain Inventory (BPI) was originally developed to assess the intensity and interference of cancer-related pain. It consists of a mannequin for describing pain sites and two aspects for evaluation: pain intensity and pain interference [20]. The Japanese version of the BPI (BPI-J) was developed by Uki et al. [21]. Cronbach’s alpha for the BPI-J’s pain intensity and pain interference scale were both 0.81 [21]. The BPI’s pain intensity scale is equal to the numerical rating scale (NRS); it is supported by the initiative on methods, measurement, and pain assessment in clinical trials (IMMPACT) [22]. The NRS assesses pain severity at its “worst,” “least,” and “average” for the last 24 hours and “now” on a 0 (= no pain) to 10 (= worst pain imaginable) scale. On the BPI’s pain interference scale, responders answer how their pain interferes with seven daily activities; general activity, mood, walking, work, relations with others, sleep, and enjoyment of life, from 0 (= does not interfere) to 10 (= interferes completely) [20,22].

The original version, the McGill Pain Questionnaire (MPQ) [23] was used to measure pain intensity, and the Pain Disability Index (PDI) [24] was used to measure pain interference. Because there was no Japanese version of the PDI, we used the BPI to assess both pain intensity and interference.

**Pain Catastrophizing.** The Pain Catastrophizing Scale (PCS) consists of 13 items that describe individuals’ specific beliefs about their pain and evaluates catastrophic thinking about pain [6]. Each item is rated on a 5-point Likert-type scale ranging from 0 (not at all) to 4 (all the time); a PCS total score is calculated by summing the 13 items from 0 to 52 points. The PCS has three subscales to assess Helplessness, Magnification, and Rumination. The Japanese PCS version, including the two subscales of Helplessness and Rumination, has been assessed for validity and reliability [12]. A previous study indicated that the PCS showed high internal consistency (Cronbach’s alpha = 0.87) and a strong correlation between the IEQ and the PCS (coefficient of correlation = 0.75, \( p < 0.01 \)) [1].

**Demographic variables.** In addition to these previous three measures, participants were asked about their backgrounds: age, sex, duration of pain, cause of injury, liability of injury, employment status, compensation, and dispute. Duration of pain was divided into six categories: under a month, from a month to under three months, from three months to under six months, from six months to under a year, from a year to under five years, and over five years. Cause of injury included four categories: traffic accidents, workers’ accidents (except traffic accidents), falls, and others. There were four choices of liability for injury: self-inflicted, another person, both, or unsure. Employment status was divided into three categories: on sick leave, working, or non-employed. Compensated and under dispute were yes-or-no questions.

**Statistical Analysis**

**Validity and Reliability.** First, the IEQ-J’s structural validity was supported by exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). EFA was performed to determine the IEQ-J’s factor structure using promax rotation and the maximum likelihood estimation method. Correlations between IEQ-J factors were also calculated. CFA was enforced to confirm the factor structure derived from EFA by accounting for variation and covariance among the 12 items and using fit indexes for three different factor structure models (Models 1–3). Model 1 had one factor; model 2 had two factors, consistent with the original IEQ version [1]; and the current study’s EFA proposed three factors. Fit indices were selected by reference to a previous paper, which reported CFAs of the IEQ and PCS [14] and Guidelines for
Determining Model Fit [25]. As absolute fit indices, the $\chi^2$, $\chi^2$/df, the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR) were used. According to values of the RMSEA, $<0.05$ suggests a good fit, from 0.08 to 0.10 indicates a moderate fit, and $>0.10$ means a poor fit [25]. Values for SRMR in the range of 0.09 or lower indicate a good fit [25]. On behalf of incremental fit indices, the comparative fit index (CFI) and the Tucker-Lewis Index (TLI) were used [25]. A cut-off close to 0.95 of the CFI and the TLI is recommended for relatively good fit, as indicated by Hu and Bentler [26].

Second, the IEQ-J’s concurrent validity was calculated by Pearson’s correlation coefficients among the BPI, the PCS, and the IEQ-J.

Third, internal consistency supported by Cronbach’s alpha and test-retest reliability also demonstrated the IEQ-J’s reliability. Intra-class correlations (ICCs) were computed to evaluate test-retest reliability. The sample size for ICC analysis was determined with the following assumptions: the null hypothesis $H_0$ is that the ICC is 0.60, the alternative hypothesis $H_1$ is that the ICC is 0.80. When the power is 0.90, the minimum required size of the sample is 39. In the present study, 42 of 71 participants who had returned to the clinic within one to four weeks of first completing the IEQ-J questionnaire, completed the secondary IEQ-J questionnaire. We then performed ICC analyses for the IEQ-J’s primary and secondary total scores.

Further analyses
To discover what elements increased perceived injustice and pain catastrophizing, linear regression models were created for associations between demographic variables and the IEQ-J total score, the IEQ-J subscale scores, and the total PCS score.

The significance level of statistical hypothesis testing was set at $p = 0.05$. CFA was performed using IBM SPSS Amos ver23 (IBM Corp., New York, USA); sample size for ICCs analysis was determined by PASS software ver13 (NCSS, Utah, USA), and ICCs analysis used IBM SPSS ver21 (IBM Corp., New York, USA). Other than those listed, statistical analyses were performed using SAS version 9.4 (SAS Institute Inc., North Carolina, USA).

Ethical Provisions
All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation, and with the Helsinki Declaration of 1975, as revised in 2000 [27]. This study was approved by the Osaka University Hospital Institutional Review Boards (No. 14248) and Kobe University Graduate School of Medicine Institutional Review Boards (No. 1703). Written informed consent was obtained from all patients included in the study.

Results
Sample characteristics
Demographic valuables are shown in Table 1. The mean age of the 71 participants was 50.7 (SD 14.4). The number of males was 33 and females, 38 (46.5% and 53.5%, respectively). Ratio of participants’ duration of pain was as follows: from one month to less than three months (5.6%); from three months to less than six months (4.2%); from six months to less than a year (12.7%); from a year to less than five years (32.4%); and five years or more (45.1%). Proportions of pain sites were head, face, and mouth (16.9%); cervical region (23.9%); upper shoulder and upper limbs (63.4%); thoracic region (8.5%); abdominal region (7.0%); low back, lumbar spine, sacrum, and coccyx (35.2%); lower limbs (46.5%); pelvic region (21.1%); and anal, perineal, and genital region (0%). Widespread pain, at more than three major sites, was (35.2%).
Table 1. Sample characteristics.

|                                | Frequency (n) | %    |
|--------------------------------|---------------|------|
| Age (years)                    | 50.7±14.4     |      |
| Number of subjects             | 71            |      |
| Number of women, n (%)         | 38, 53.5      |      |
| Facility                       |               |      |
| A university hospital          | 31, 43.7      |      |
| B university hospital          | 24, 33.8      |      |
| C prefectural hospital         | 2, 2.8        |      |
| D orthopedic clinic            | 14, 19.7      |      |
| Duration of pain               |               |      |
| > 1 month, < 3 months          | 4, 5.6        |      |
| > 3 months, < 6 months         | 3, 4.2        |      |
| > 6 months, < 1 year           | 9, 12.7       |      |
| > 1 year, < 5 years            | 23, 32.4      |      |
| > 5 years                      | 32, 45.1      |      |
| Pain site                      |               |      |
| Head, face, and mouth          | 12, 16.9      |      |
| Cervical region                | 17, 23.9      |      |
| Upper shoulder and upper limbs | 45, 63.4      |      |
| Thoracic region                | 6, 8.5        |      |
| Abdominal region               | 5, 7.0        |      |
| Low back, lumbar spine, sacrum, and coccyx | 25, 35.2 | |
| Lower limbs                    | 33, 46.5      |      |
| Pelvic region                  | 15, 21.1      |      |
| Anal, perineal, and genital region | 0, 0.0     | |
| More than three major sites    | 25, 35.2      |      |
| Cause of pain                  |               |      |
| Traffic accidents              | 37, 52.1      |      |
| Workers’ accidents (except traffic accidents) | 9, 12.7 | |
| Falls                          | 12, 16.9      |      |
| Others                         | 13, 18.3      |      |
| Liability for injury           |               |      |
| Self-inflicted                 | 18, 25.4      |      |
| Another person                 | 38, 53.5      |      |
| Both                           | 11, 15.5      |      |
| Not sure                       | 4, 5.6        |      |
| Employment status              |               |      |
| On sick leave                  | 28, 39.4      |      |
| Working                        | 27, 38.0      |      |
| Non-employed                   | 16, 22.5      |      |
| Compensation                   |               |      |
| Compensated                    | 43, 61.4      |      |
| Uncompensated                  | 27, 38.6      |      |
| Non-Responder                  | 1, -          |      |
| Dispute                        |               |      |
| Under dispute                  | 15, 21.7      |      |
| Not disputed                   | 54, 78.3      |      |
| Non-Responder                  | 2, -          |      |

Note. Age: Mean ±SD

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Causes of participants’ pain included traffic accidents (52.1%), worker’s accidents (except for traffic accidents) (12.7%), falls (16.9%), and others (18.3%). Subjective judgments about liability of injury included one’s self (25.4%), another person (53.5%), both one’s self and another (15.5%), and not sure (5.6%). Participants’ employment statuses included on sick leave (39.4%), working (38.0%), and unemployed (22.5%). Among the 71 participants, 61.4% were compensated, 38.6% were uncompensated, and one participant did not respond to this question. The number of cases under dispute was 15 (21.7%), not under dispute 52 (78.3%), and the number of non-responders was two of 71 participants.

Factor structure

Exploratory factor analysis. Results of EFA for the IEQ-J are shown in Table 2, and correlations between factors are indicated in Table 3. In IEQ-J, three factors were extracted: Severity/irreparability consisted of Items 2, 5, 6, 9, 10, and 11; Blame/unfairness consisted of Items 3, 4, 7, and 12; and Perceived lack of empathy included Items 1 and 8. Correlation coefficients between IEQ-J factors ranged from 0.48 to 0.56, indicating moderate correlation.

Confirmatory factor analysis. In Fig 2, the three-factor model of the IEQ-J, derived by EFA, is shown with error terms e1–e12, and standardized parameter estimates ranging from 0.43 to 0.94.

In Table 4, a summary of goodness-of-fit indices for the three models is indicated. In model 1, although 0.085 of SRMRs (0.09 or lower) were a good fit [25], RMSEA was 0.13 (>0.10), and the CFI and TLI were under 0.95, indicating poor fit [26]. In model 2, 0.085 of SRMRs was a good fit, but RMSEA was 0.13 (>0.10), and the CFI and TLI of model 2 were 0.83 (around 0.95), indicating a poor fit [26]. RMSEA of model 3 was 0.06 (<0.10), a good fit for

Table 2. Factor loadings and internal consistency of the IEQ-J for the three factors.

| Item                                      | Severity/irreparability (α = 0.89) | Blame/unfairness (α = 0.79) | Perceived lack of empathy (α = 0.74) | Item/total correlation (r) |
|-------------------------------------------|------------------------------------|------------------------------|--------------------------------------|---------------------------|
| Item 2 My life will never be the same.    | 0.64                               | 0.02                         | 0.21                                 | 0.71                      |
| Item 5 I just want to have my life back.  | 0.42                               | 0.33                         | -0.07                                | 0.58                      |
| Item 6 I feel that this has affected me in a permanent way. | 0.63                               | 0.22                         | -0.07                                | 0.67                      |
| Item 9 Nothing will ever make up for all that I have gone through. | 0.71                               | 0.01                         | 0.18                                 | 0.75                      |
| Item 10 I feel as if I have been robbed of something very precious. | 0.99                               | -0.04                        | -0.06                                | 0.76                      |
| Item 11 I am troubled by fears that I may never achieve my dreams. | 0.82                               | -0.11                        | 0.04                                 | 0.64                      |
| Item 3 I am suffering because of someone else’s negligence. | -0.10                              | 0.81                         | 0.04                                 | 0.55                      |
| Item 4 No one should have to live this way. | 0.43                               | 0.58                         | -0.04                                | 0.79                      |
| Item 7 It all seems so unfair.            | -0.01                              | 0.79                         | 0.02                                 | 0.58                      |
| Item 12 I can’t believe this has happened to me. | 0.04                               | 0.41                         | 0.04                                 | 0.40                      |
| Item 1 Most people don’t understand how severe my condition is. | 0.15                               | 0.23                         | 0.56                                 | 0.68                      |
| Item 8 I worry that my condition is not being taken seriously. | 0.01                               | -0.03                        | 0.76                                 | 0.48                      |

Note. Factor loadings greater than 0.40 are in bold
IEQ-J; Japanese version of the Injustice Experience Questionnaire

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Whereas the three models’ SRMRs range was 0.09 or lower, indicating a good fit [26], the SRMR of model 3 (0.063), was better than that of model 1 (0.085), and of model 2 (0.084). Furthermore, the CFI (0.98) and TLI of Model 3 (0.97) were recognized as a good fit (around 0.95) [26].

Concurrent validity. Correlation coefficients of the IEQ-J total score and total/subscales scores of the BPI ranged from $r = 0.38$ to $0.68$, $p < 0.01$ (Table 5). Correlation coefficients of

| Factor 1: Severity/irreparability | Factor 2 | Factor 3 |
|----------------------------------|----------|----------|
| Factor 1: Severity/irreparability | 1.00     | 0.55     | 0.56     |
| Factor 2: Blame/unfairness       | 0.55     | 1.00     | 0.48     |
| Factor 3: Perceived lack of empathy | 0.56     | 0.48     | 1.00     |

Note. IEQ-J; Japanese version of the Injustice Experience Questionnaire
The original IEQ total score and the McGill Pain Questionnaire score were $r = 0.54$, $p < 0.01$, and the Pain Disability Index score was $r = 0.44$, $p < 0.01$ [1]. Concurrent validity of the IEQ-J was observed in this study population.

**Reliability.** Cronbach’s alpha of the IEQ-J’s total score was 0.90; of Severity/irreparability, 0.89; of Blame/unfairness, 0.79, and of Perceived lack of empathy, 0.74 (Table 2). ICCs of the IEQ-J total and subscale scores ranged from 0.93 to 0.96. Over 0.70 of ICC was assessed a reproducible result (Table 6) [28].

**Demographic variables related to injury or pain.** Associations between demographic valuables and mean value of IEQ-J total scores are indicated in Table 7. The mean value of IEQ-J total score was 24.1 (12.0 SD), and the median value was 25.0. The mean value of IEQ-J total scores in participants whose duration of pain was over a year (26.4) was higher than that in participants whose duration of pain was under a year (16.1). Participants who believed liability for injury rested with another person (27.7) also experienced pain for longer than participants who believed liability lay with themselves or with both parties, or who were not sure (20.0). According to cause of injury, employment status, compensation, and dispute, IEQ-J total scores’ mean value of participants whose conditions were considered to have increased IEQ-J scores. Scores of participants injured by traffic accidents, on sick leave, compensated, and injury under dispute were not significantly higher than that of participants with workers’ accidents, falls, or other; working or non-employed; uncompensated or non-responder; and not disputed or non-responder.

| Variable | 1 | 2 | 3 | 4 | 5 | 6 |
|----------|---|---|---|---|---|---|
| IEQ-J Total | 1 | | | | | |
| PCS Total | 0.73 (0.59–0.82)† | | | | | |
| BPI Average pain intensity | 0.55 (0.36–0.69)† | 0.53 (0.34–0.68)† | | | | |
| BPI Maximum pain | 0.46 (0.25–0.62)† | 0.43 (0.21–0.60)† | 0.81 (0.71–0.88)† | | | |
| BPI Minimum pain | 0.38 (0.16–0.56)† | 0.31 (0.08–0.51)† | 0.63 (0.46–0.75)† | 0.58 (0.40–0.71)† | | |
| BPI Now | 0.55 (0.36–0.69)† | 0.56 (0.37–0.70)† | 0.86 (0.78–0.91)† | 0.78 (0.66–0.85)† | 0.58 (0.39–0.71)† | |
| BPI Interference scale | 0.68 (0.52–0.79)† | 0.70 (0.55–0.80)† | 0.69 (0.54–0.79)† | 0.61 (0.43–0.74)† | 0.43 (0.21–0.60)† | 0.74 (0.60–0.83)† |

Note: $n = 71$;
† $p < 0.01$,
‡ $p < 0.001$

IEQ-J, Japanese version of the Injustice Experience Questionnaire; PCS, Pain Catastrophizing Scale; BPI, Brief Pain Inventory

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Table 6. Intraclass correlation coefficient of Japanese version of the Injustice Experience Questionnaire.

| Items, n = 42 | Test-retest ICC |
|---------------|----------------|
| IEQ-J Total | 0.96 (0.93–0.98) |
| IEQ-J Severity/irreparability | 0.95 (0.90–0.97) |
| IEQ-J Blame/unfairness | 0.93 (0.87–0.96) |
| IEQ-J Perceived lack of empathy | 0.96 (0.93–0.98) |

Note. ICC, intraclass correlation coefficient; IEQ-J, Japanese version of the Injustice Experience Questionnaire

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Results of multiple/simple regression analyses to examine associations between demographic variables and IEQ-J total and subscale scores and PCS total scores are shown in Table 8. Pain duration over a year contributed significant variance to higher IEQ-J total scores (regression coefficient (B) of multiple regression = 11.92, 95%CI: 5.95–17.89, B of single regression = 10.3, 95%CI: 3.75–16.69); subscales (Severity/irreparability, B of multiple regression = 7.16, 95%CI: 3.65–10.67, B of single regression = 6.59, 95%CI: 2.92–10.27; Blame/unfairness, B of multiple regression = 3.13, 95%CI: 0.85–5.43, B of single regression = 2.18, 95%CI: -0.41–4.77; Perceived lack of empathy, B of multiple regression = 1.62, 95%CI: 0.28–2.96, B of single regression = 1.50, 95%CI: 0.24–2.77). Liability for injury by another person also contributed significant variance to higher IEQ-J total scores (B of multiple regression = 12.17, 95%CI: 6.38–17.96, B of single regression = 7.69, 95%CI: 2.24–13.14) and subscales (Severity/irreparability, B of multiple regression = 5.19, 95%CI: 1.79–8.59, B of single regression = 2.69, 95%CI: -0.60–5.98; Blame/unfairness, B of multiple regression = 5.71, 95%CI: 3.49–7.93, B of single regression = 4.30, 95%CI: 2.34–6.26). Moreover, compensation contributed significant variance to higher IEQ-J total scores (B of multiple regression = 3.24, 95%CI: 0.06–6.41, B of single regression = 3.40, 95%CI: 0.08–6.73). Traffic accident injury seems to be an independent factor for decreasing IEQ-J total score on multiple regression (B = -6.27, 95%CI: -11.81–0.74); Severity/irreparability (B = -3.28, 95%CI: -6.53–-0.03); and Blame/unfairness (B = -2.32, 95%CI: -4.45–0.20). However, traffic accident injury did not significantly increase IEQ-J scores in simple regression analysis. Pain duration over a year and compensation contributed significant variance to higher PCS total scores; pain duration over a year, B of multiple regression = 10.41, 95%CI: 4.22–16.60, B of single regression = 9.40, 95%CI: 3.21–15.59; and compensated, B of multiple regression = 6.30, 95%CI:

| Variables (n = 71) | Mean (SE) |
|-------------------|-----------|
| n                 |           |
| Duration of pain  |           |
| < 1 year          | 16        | 16.1 (2.8) |
| ≥ 1 year          | 55        | 26.4 (1.5) |
| Cause of injury   |           |
| Workers' accidents, falls, or others | 34 | 24.6 (2.1) |
| Traffic accidents | 37        | 23.6 (2.0) |
| Liability for injury |               |
| Self-inflicted, both, or not sure | 33 | 20.0 (2.0) |
| Another person    | 38        | 27.7 (1.9) |
| Employment status |           |
| Working or non-employed | 43 | 22.8 (1.8) |
| On sick leave     | 28        | 26.1 (2.3) |
| Compensation      |           |
| Uncompensated or non-responder | 43 | 21.6 (2.3) |
| Compensated       | 28        | 25.7 (1.8) |
| Dispute           |           |
| Not disputed or non-responder | 56 | 23.1 (1.6) |
| Under dispute     | 15        | 27.8 (3.1) |

Note. Analysis of covariance was used to test for differences from the category of < 1 year, workers’ accidents, falls, or others; both or not sure; working or non-employed; uncompensated or non-responder; and not disputed or non-responder. SE, standard errors: *p < 0.01.

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Table 8. Multiple or simple regression analysis examining associations between sample characteristics and perceived injustice or pain catastrophizing.

| Dependent = IEQ-J Total | Multiple regression analysis | Simple regression analysis |
|-------------------------|-----------------------------|---------------------------|
|                         | R² = 0.29                   |                           |
| Age                     | 0.11 (-0.09–0.31)           | -0.05 (-0.25–0.15)        |
| Sex: women              | 0.71 (-4.55–5.96)           | 0.16 (-5.60–5.91)         |
| Duration: ≥ 1 year      | 11.92 (5.95–17.89)          | 10.3 (3.75–16.69)         |
| Cause of injury: traffic accident | -6.27 (-11.81–0.74)       | -0.97 (-6.71–4.77)        |
| Liability for injury: another person | 12.17 (6.38–17.96)       | 7.69 (2.24–13.14)         |
| Employment status: on sick leave | 2.79 (-2.29–7.88)        | 3.34 (-2.48–9.16)         |
| Compensated             | 4.76 (-0.66–10.17)         | 4.15 (1.64–9.94)          |
| Under dispute           | 1.56 (-5.18–8.30)          | 4.71 (-2.23–11.65)        |

| Dependent = IEQ-J Severity/irreparability | Multiple regression analysis | Simple regression analysis |
|-------------------------------------------|-----------------------------|---------------------------|
| R² = 0.28                                 |                             |                           |
| Age                                       | 0.09 (-0.03–0.21)           | -0.02 (-0.14–0.10)        |
| Sex: women                                | -0.76 (-3.85–2.32)         | -1.38 (-4.72–1.95)        |
| Duration: ≥ 1 year                        | 7.16 (3.65–10.67)          | 6.59 (2.92–10.27)         |
| Cause of injury: traffic accident         | -3.28 (-6.53–0.03)         | -0.09 (-4.53–2.14)        |
| Liability for injury: another person      | 5.19 (1.79–8.59)           | 2.69 (-0.60–5.98)         |
| Employment status: on sick leave          | 1.73 (-1.25–4.72)          | 2.08 (-1.31–5.46)         |
| Compensated                               | 3.24 (0.06–6.41)           | 3.40 (0.08–6.73)          |
| Under dispute                             | 2.59 (-1.37–6.54)          | 3.50 (-0.50–7.51)         |

| Dependent = IEQ-J Blame/unfairness        | Multiple regression analysis | Simple regression analysis |
| R² = 0.30                                 |                             |                           |
| Age                                       | 0.02 (-0.05–0.09)           | -0.02 (-0.10–0.06)        |
| Sex: women                                | 1.50 (0.51–3.52)           | 1.64 (0.54–3.82)          |
| Duration: ≥ 1 year                        | 3.13 (0.85–5.43)           | 2.18 (0.41–4.77)          |
| Cause of injury: traffic accident         | -2.32 (-4.45–0.20)         | 0.34 (-1.87–2.55)         |
| Liability for injury: another person      | 5.71 (3.49–7.93)           | 4.30 (2.34–6.26)          |
| Employment status: on sick leave          | 1.20 (-0.75–3.16)          | 1.42 (-0.82–3.65)         |
| Compensated                               | 1.09 (-0.99–3.16)          | 0.29 (-1.97–2.56)         |
| Under dispute                             | -0.76 (-3.35–1.82)         | 1.01 (-1.68–3.71)         |

| Dependent = IEQ-J Perceived lack of empathy | Multiple regression analysis | Simple regression analysis |
| R² = 0.02                                 |                             |                           |
| Age                                       | 0.01 (-0.04–0.05)           | -0.01 (-0.05–0.03)        |
| Sex: women                                | -0.03 (-0.22–1.15)         | -0.10 (-1.20–1.00)        |
| Duration: ≥ 1 year                        | 1.62 (0.28–2.96)           | 1.50 (0.24–2.77)          |
| Cause of injury: traffic accident         | -0.67 (-1.91–0.58)         | -0.11 (-1.21–1.00)        |
| Liability for injury: another person      | 1.27 (-0.03–2.57)          | 0.69 (-0.40–1.78)         |
| Employment status: on sick leave          | -0.15 (-1.29–1.00)         | -0.16 (-1.28–0.97)        |
| Compensated                               | 0.43 (-0.79–1.65)          | 0.45 (-0.67–1.57)         |
| Under dispute                             | -0.26 (-1.78–1.26)         | 0.19 (-1.15–1.54)         |

| Dependent = PCS Total                     | Multiple regression analysis | Simple regression analysis |
| R² = 0.18                                 |                             |                           |
| Age                                       | 0.03 (-0.17–0.25)           | -0.06 (-0.25–0.14)        |
| Sex: women                                | -0.60 (-6.05–4.84)         | -2.25 (-7.78–3.29)        |
| Duration: ≥ 1 year                        | 10.41 (4.22–16.60)         | 9.40 (3.21–15.59)         |
| Cause of injury: traffic accident         | -0.98 (-6.70–4.74)         | 0.97 (-4.57–6.52)         |
| Liability for injury: another person      | 5.19 (0.79–11.18)          | 2.71 (-2.81–8.23)         |
| Employment status: on sick leave          | 4.39 (0.93–9.72)           | 4.04 (-1.57–9.64)         |
| Compensated                               | 6.30 (0.71–11.89)          | 7.20 (1.82–12.58)         |
| Under dispute                             | -3.62 (-10.58–3.35)        | -59 (-7.34–6.15)          |

Note: n = 71; IEQ-J, Japanese version of Injustice Experience Questionnaire; PCS, Pain Catastrophizing Score

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Discussion

The current study confirmed the validity and reliability of the IEQ-J. This study partially referred to consensus-based standards for the selection of health measurement instruments (COSMIN) checklist [29]. The COSMIN checklist indicates seven general requirements for evaluating methodological quality of studies on health-related patient-reported outcomes: internal consistency, reliability, measurement error, content validity, construct validity (subdivided into structural validity, hypotheses testing, and cross-cultural validity), criterion validity, and responsiveness [29]. The current study was highly qualified according to these requirements.

The factor structure derived from the current study differed from that of the original IEQ version. Three factors, Severity/irreparability (Items 2, 5, 6, 9, 10, and 11), Blame/unfairness (Items 3, 4, 7, and 12), and Perceived lack of empathy (Items 1 and 8), were proposed by EFA in the current study. This three-factor model indicated good fit to the data. However, Perceived lack of empathy is a distinctive factor of the IEQ-J. Thus, Item 4, “No one should have to live this way” belonged under Severity/irreparability in the previous study, but under Blame/unfairness in the current study. By contrast, Item 9, “Nothing will ever make up for all that I have gone through,” Item 10, “I feel as if I have been robbed of something very precious,” and Item 11, “I am troubled by fears that I may never achieve my dreams” belonged to Perceived lack of empathy in the previous study, but to Severity/irreparability in the current study. This result might be due to cross-cultural differences in meanings or interpretations when people encounter similar emotional situations. For example, Boiger et al. indicated that anger is condoned in the United States, but condemned in Japan; conversely, shame is condoned in Japan, but condemned in the United States [30]. The Japanese generally consider perceived lack of empathy as perceived injustice and indifference. They respect showing empathy to others without verbal communication, in order to harmonize social relationships. Furthermore, the Japanese are accustomed to perceiving empathy from others, and thus, once they perceive lack of empathy, it is interpreted as injustice and indifference.

In previous literature, forgiveness interventions, anger management interventions, and/or mindfulness meditation were considered useful for accident victims who perceived severe injustice [5]. The new factor, Perceived lack of empathy found in the current study might be a new target for treatment among Japanese patients who perceive severe injustice.

The correlation coefficient of IEQ-J and PCS total scores (r = 0.73, 95%CI: 0.59–0.82) was similar to that of IEQ and PCS total scores (r = 0.75 and p < 0.01) in Canadian patients with musculoskeletal conditions [1], and (r = 0.65, p < 0.001) in Spanish patients with fibromyalgia [13]; these showed high correlations.

We also investigated the association between demographic variables related to injury or pain and IEQ-J and PCS scores. Our study results followed past descriptions that victims whose injury occurred from another’s error or negligence are likely to perceive injustice [1,5]. We hypothesized that injury related to another’s error or negligence was associated with a higher IEQ-J score for Blame/unfairness; present findings support our hypothesis. Furthermore, the IEQ-J subscale scores for Severity/irreparability and Perceived lack of empathy increased when injury resulted from another’s error or negligence. A previous study reported that IEQ scores of subjects injured by motor vehicle accidents were significantly higher than those of subjects injured by work accidents [1]. In the current study, however, motor vehicle accident was not a dependent factor increasing IEQ-J scores. Liability for motor vehicle
accidents was not described in the previous study, but many motor vehicle accidents might be caused by another’s error or negligence: This might be why IEQ-J scores of participants injured by motor vehicle accidents were increasing.

Although compensation and dispute are hypothesized as important factors for increasing IEQ-J scores, they did not contribute thusly in the current study. However, compensation significantly increased the IEQ-J subscale Severity/irreparability and PCS total scores. This result added new evidence to the academic field of perceived injustice.

In the current study, mean values of IEQ-J total scores 24.1 (SD 12.0, n = 71) tended to be lower than mean values among an Australian sample, 27.9 (SD 17.4, n = 163), as reported by Kennedy et al. [14]. They tended to be higher than those among a Canadian sample, 17.3 (SD 12.2, n = 150), as reported by Sullivan et al. [1]. The Australian sample was compensated, with an average disability duration of over four years, so these characteristics should increase IEQ total scores [14]. Although Sullivan et al. did not report duration of injury among the Canadian population, differences in each society’s compensation system might cause this discrepancy among Japanese, Australian, and Canadian populations [1,14]. According to factor structure, previous studies among Canadian [1], Spanish [13], and Australian [14] populations did not indicate cross-cultural differences, except for factor structure and error variances of Items 2 and 5 or Items 4 and 11 among the Australian population.

This study has some limitations. First, the sample is not necessarily representative of the Japanese population, even though the sample size is sufficient to confirm the validity and reliability of the IEQ-J. Second, we did not investigate socio-economic factors other than compensation (e.g., educational level, family structure, living area, and income) in the current study. Socioeconomic disparities may influence perceived injustice as well as common psychosocial factors [31].

Conclusions

The current study provides evidence for the sound psychometric properties of the IEQ-J. Its three-factor model showed good fit to the data, even though its factor-structure differed from the original IEQ’s two-factor model. Pain duration of over a year and liability for injury by another statistically significantly increased IEQ-J total score.

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Author Contributions

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Formal analysis: KY TA KH HI.

Investigation: KY.

Methodology: KY TA HI.
Injustice Experience Questionnaire, Japanese Version: Cross-Cultural Validation

References

1. Sullivan MJL, Adams H, Horan S, Maher D, Boland D, Gross R. The role of perceived injustice in the experience of chronic pain and disability: Scale development and validation. J Occup Rehabil. 2008; 18 (3):249–61. doi: 10.1007/s10926-008-9140-5 PMID: 18536983

2. Elovainio M, Ferrie JE, Gimeno D, De Vogli R, Shipley M, Brunner EJ, et al. Organizational justice and sleeping problems: The Whitehall II study. Psychosom Med. 2009; 71(28):334–40.

3. Elovainio M, Leino-Arjas P, Vahtera J, Kivimäki M. Justice at work and cardiovascular mortality: a prospective cohort study. J Psychosom Res. 2006; 61(2):271–4. Available: http://www.ncbi.nlm.nih.gov/pubmed/16880031 PMID: 16880031

4. Kivimäki M, Elovainio M, Vahtera J, Ferrie JE. Organisational justice and health of employees: prospective cohort study. Occup Environ Med. 2003; 60:27–33; discussion 33–4. PMID: 12499453

5. Sullivan MJL, Scott W, Trost Z. Perceived injustice: a risk factor for problematic pain outcomes. Clin J Pain. 2012; 28(6):484–8. Available: http://www.ncbi.nlm.nih.gov/pubmed/22673480 doi: 10.1097/AJP.0b013e3182527d13 PMID: 22673480

6. Sullivan MJL; Bishiari SR; Pivik J. The Pain Catastrophizing Scale: Development and validation. Psychol Assess. 1995; 7(4):524–32.

7. Sehn F, Chachamovich E, Vidor LP, Dall-Agnol L, de Souza ICC, Torres ILS, et al. Cross-cultural adaptation and validation of the Brazilian Portuguese version of the pain catastrophizing scale. Pain Med [Internet]. 2012 Nov; 13(11):1425–35. Available from: http://www.ncbi.nlm.nih.gov/pubmed/23036076

8. Xu X, Wei X, Wang F, Liu J, Chen H, Xiong Y, et al. Validation of a Simplified Chinese Version of the Pain Catastrophizing Scale and an Exploration of the Factors Predicting Catastrophizing in Pain Clinic Patients. Pain Physician. 2015; Nov/Dec; 1059–72. Available: www.painphysicianjournal.com

9. Monticone M, Baiardi P, Ferrari S, Focia C, Mugnai R, Piastrini P, et al. Development of the Italian version of the Pain Catastrophising Scale (PCS-I): Cross-cultural adaptation, factor analysis, reliability, validity and sensitivity to change. Qual Life Res. 2012; 21(6):1045–50. doi: 10.1007/s11136-011-0007-4 PMID: 21912846

10. Cho S, Kim H-Y, Lee J-H. Validation of the Korean version of the Pain Catastrophizing Scale in patients with chronic non-cancer pain. Qual Life Res. 2013; 22(7):1767–72. Available: http://www.ncbi.nlm.nih.gov/pubmed/23180163 doi: 10.1007/s11136-012-0308-2 PMID: 23168163

11. Süren M, Ookay I, Gökbakan AM, Kaya Z, Erkorkmaz U, Arici S, et al. Factors associated with the pain catastrophizing scale and validation in a sample of the Turkish population. Turkish J Med Sci. 2014; 44 (1):104–8.

12. Iwaki R, Arimura T, Jensen MP, Nakamura T, Yamashiro K, Makino S, et al. Global Catastrophizing vs Catastrophizing Subdomains: Assessment and Associations with Patient Functioning. Pain Med (United States). 2012; 13(5):677–87.

13. Rodero B, Luciano J V, Montero-Marin J, Casanueva B, Palacin JC, Gili M, et al. Perceived injustice in fibromyalgia: psychometric characteristics of the Injustice Experience Questionnaire and relationship with pain catastrophising and pain acceptance. J Psychosom Res. Elsevier Inc.; 2012; 73(2):86–91. Available: http://www.ncbi.nlm.nih.gov/pubmed/22789409

14. Kennedy L, Dunstan D a. Confirmatory factor analysis of the injustice experience questionnaire in an Australian compensable population. J Occup Rehabil. 2014; 24:385–92. doi: 10.1007/s10926-013-9462-9 PMID: 23979003
15. Ferrari R. A prospective study of perceived injustice in whiplash victims and its relationship to recovery. Clin Rheumatol. 2014; 34(5):975–9. Available: http://link.springer.com/10.1007/s10067-014-2693-0 doi: 10.1007/s10067-014-2693-0 PMID: 24889404

16. Scientific Advisory Committee of the Medical Outcome Trust. Assessing health status and quality of life instruments: attributes and review criteria. Qual life Res Life Res. 2002; 11:193–205.

17. Beaton DE, Bombardier C, Guillemin F, Ferraz MB. Guidelines for the process of cross-cultural adaptation of self-report measures. Spine (Phila Pa 1976). 2000; 25(24):3186–91.

18. Maccallum RC, Widaman KF. Sample Size in Factor Analysis: The Role of Model Error. 2001; 36(4):611–37.

19. Arrindell WA, van der Ende J. An empirical test of the utility of the observer-to-variables ratio in factor and components analysis. Appl Psychol Meas. 1985; 9:165–78.

20. Cleeland C, Ryan K. Pain assessment: global use of the Brief Pain Inventory. Ann Acad Med. 1992; 23(2):129–38.

21. Uki J, Mendoza T, Cleeland CS, Nakamura Y, Takeda F. A Brief Cancer Pain Assessment Tool in Japanese. J Pain Symptom Manage. 1998; 16(6):364–73. PMID: 9879161

22. Dworkin RH, Turk DC, Farrar JT, Haythornthwaite JA, Jensen MP, Katz NP, et al. Core outcome measures for chronic pain clinical trials: IMMPACT recommendations. Pain. 2005; 113(1–2):9–19. Available: http://www.ncbi.nlm.nih.gov/pubmed/15621359 PMID: 15621359

23. Melzack R. The McGill pain questionnaire: major properties and scoring methods. Pain. 1975; 1(3):277–99. PMID: 1235885

24. Pollard C. Preliminary validity study of the pain disability index. Percept Mot Ski. 1984; 59(3):974. Available: http://www.ncbi.nlm.nih.gov/pubmed/6240632

25. Structural Equation Modelling: Guidelines for Determining Model Fit. Available: http://arrow.dit.ie/cgi/viewcontent.cgi?article=1001&context=buschmanart

26. Hu L, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. Struct Equ Model A Multidiscip J. 1999 Jan; 6(1):1–55. Available: http://www.tandfonline.com/doi/abs/10.1080/10705519909540118

27. Ethical Principles for Medical Research Involving Human Subjects. World Medical Association. 2008. Available: http://osp.od.nih.gov/sites/default/files/resources/17c.pdf

28. Donner A, Eliasziw M. Sample size requirements for reliability studies. Stat Med. 1987 Jun; 6(4):441–8. Available: http://doi.wiley.com/10.1002/sim.4780060404 PMID: 3629046

29. Mokkink LB, Terwee CB, Patrick DL, Alonso J, Stratford PW, Knol DL, et al. The COSMIN checklist for assessing the methodological quality of studies on measurement properties of health status measurement instruments: an international Delphi study. Qual Life Res. 2010; 19(4):539–49. Available from: http://link.springer.com/10.1007/s11136-010-9606-8 doi: 10.1007/s11136-010-9606-8 PMID: 20169472

30. Boiger M, Mesquita B, Uchida Y, Feldman Barrett L. Condoned or condemned: the situational affordance of anger and shame in the United States and Japan. Pers Soc Psychol Bull. 2013; 39(4):540–53. Available from: http://www.ncbi.nlm.nih.gov/pubmed/23471319 doi: 10.1177/0146167213478201 PMID: 23471319

31. Kondo N. Socioeconomic disparities and health: impacts and pathways. J Epidemiol. 2012; 22(1):2–6. Available from: http://www.ncbi.nlm.nih.gov/pubmed/22156290 PMID: 22156290