ORIGINAL ARTICLE

Catastrophic thinking and worsening subjective health of community-dwelling older adult women with chronic pain

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Abstract

Objective: Catastrophic thinking in patients with chronic pain (CP) causes inactivity and depression. In this survey, we intended to clarify the cutoff value of the subscales (rumination, magnification, and helplessness) of the Pain Catastrophizing Scale (PCS) with the PCS scores of community-dwelling older adult women with chronic pain.

Methods: The subjects were 121 women with CP among local residents who received a medical check conducted in Kaizuka City, Osaka Fu. The survey items included demographic data, pain-related surveys, physical and psychologic functions, and health-related indicators.

Results: The subjective health was found to be significantly associated with the presence of catastrophic thinking ($p < 0.05$). Additionally, rumination and magnification, the subscales of the PCS, had moderate sensitivity and specificity. Furthermore, the cutoff value was clarified to be 7.5 for the rumination score and 3.5 for the magnification score.

Conclusion: In this study, we identified individuals of the elderly with chronic pain for early care.

INTRODUCTION

In Japan, the aging population is accelerating, and the number of community-dwelling older adults who require long-term care is increasing due to the declined mental and physical functions (Inokuchi, 2007; Arai, 2015). The causes of age-related disability are complex, but chronic pain (CP) is one of the causes of physical disability in the elderly. In previous studies, the investigators reported that the elderly with CP in Japan is associated to social frailty (Hirase, 2019), exhaustion (Nakai, 2019), and a declined activity of daily living (ADL) (Sugai, 2017). Vlaeyen (2000) advocated that in fear-avoidance model as a vicious circle of pain, pain causes catastrophe, impacting negatively on thoughts, emotions, cognition, and behavior, leading to the development of CP as a result of inactivity, depression, and reduced ability and to worsening the symptoms. In previous studies, the investigators reported that patients with CP with increased pain catastrophe scores, can elevate anxiety and fear of pain, resulting in increasing fear-avoidance as well as possible inactivity and depression (Quartana, 2009; Wertli, 2014). Recently, pain catastrophe has been reported as factors to declined physical or psychosomatic function in children with CP (Miller, 2018),

and to increased chronic pelvic pain in women with CP (Marshall, 2017; Sewell, 2018).

Currently, in Japan, the importance of approaches to prevent the occurrence of diseases and disorders through health promotion has been emphasized locally (Shinkai, 2016). If such approaches are to be included in the management of CP, to know characteristics of the physical and mental function of the community-dwelling older adults but not the inpatient or outpatient with CP is necessary. In addition, Nakamura (2014), reported that 80% of community-dwelling older adults with CP have treatment history, but 50% of them stop treatment due to limited effectiveness of the treatment. On the other hand, they indicated that, even if they had CP, older adult people who do not need treatment because they have not had catastrophe, and maintain their subjective health. Subjective health is to know health condition subjectively in physical function, psychological function, income, and disaster (Steptoe, 2015).

Pain catastrophizing scale (PCS), self-reported measure comprising rumination, magnification, and helplessness. Magnification and rumination are related to primary appraisal processes in which individuals may focus on and exaggerate the threat value of

a painful stimuli. Helplessness is related to secondary appraisal processes in which individuals negatively evaluate their ability to deal effectively with painful stimuli (Sullivan, 1995). Hirase (2017) revealed that helplessness of PCS subscale is most associated to chronic musculoskeletal pain of community-dwelling with exercise habit. Previously we reported that long term CP duration can have high PCS score and high magnification of PCS subscale, and high depression score (Hida, 2020).

In particular, women are negatively affected by the catastrophic thinking associated with CP. Female patients with CP are more likely to focus on pain-related negative emotions because of high levels of catastrophic thinking (Keogh, 2002; Ramírez-Maestre, 2004). The subscales of catastrophic thinking have complex negative effects on patients with CP. But studies on the effects of the subscales of PCS are limited. Investigating the effects of PCS subscales can improve for more personalized care for patients with CP. In this study, we intended (a) to investigate the effect of CP on the physical and mental function of the elderly living in the community, and (b) to clarify the cutoff value of the PCS subscale based on the survey results.

METHODS
Study subjects

Study subjects included community-dwelling older adult women who received a medical check-up in Kaizuka City in Osaka. The subjects completed a self-reported questionnaire, and were asked the presence or absence of CP with the answer of "yes" or "no." The subjects who answered "yes" (n = 121 with mean age 72.4 ± 8.1 years) were included in the study. CP was defined as "persistent pain and rekindled pain for > three months, or pain that persisted for >one month after recovery from acute tissue injury, or pain associated with a non-healing lesion" (Bonica, 1990). This cross-sectional study was approved by the Osaka Kawasaki Rehabilitation University Research Ethics Review Board (protocol number = OKRU-A016 and date of approval = 06.01, 2022), requiring to obtain a signed written informed consent from each subject.

Data collection and procedures

The investigation team consisted of doctor, nurses, physical therapists, occupational therapists, and volunteers who did health checks at a public facility in Kaizuka City. Physical, psychological, and cogni-

tive functions were measured. Study items included pain-related examination, physical function, psychological function, and health-related criteria. Data of age and the number of medications were collected as demographic information.

Pain related examinations

Pain was assessed using the PCS, which is a 13-terms self-report measure of pain-related catastrophizing factors comprising rumination, magnification, and helplessness (Sullivan, 1995). Rumination is evaluated using five questions, and the maximum score is 20 points. Magnification is evaluated using three questions, and the maximum score is 12 points. Helplessness is assessed using five questions with a maximum score of 20 (Bonica, 1990). PCS was calculated as total score, and based on a previous study, the subjects were categorized into the pain catastrophic group with ≧30, and the no pain catastrophic groups. CP duration was examined and categorized as ≧1 year and < 1 year. The subjects were asked to name the location of the painful body part and then were categorized as those with one or multiple sites of pain. A previous study of 92- to 93-year-old subjects showed that multiple sites of pain are related to high percentage of severe disability (Mänty, 2014).

Physical function

Physical function was measured using grip strength, walking speed, and limb skeletal muscle mass. Walking speed was recorded as the average value measured five times. A comfortable walking speed (m/s) was calculated measuring the required time to walk, using a stopwatch, on a walkway with a 2 m backup path in front and behind, and a measurement distance of 2.4 m. Grip strength was measured once with maximum effort of with the dominant hand using a grip force meter (Takei Scientific Instruments Co. Ltd, TKK5401). Body composition was measured using the body composition meter (InBody, InBody-270) through the bioimpedance method, and the skeletal muscle index (Skeletal Muscle Mass Index, SMI) was measured.

Psychologic function

Regarding psychological function, a questionnaire was used to investigate the Geriatric Depression Scale 15 (GDS-15) (Burke, 1991), which is a test that consisting of 15 items with "yes" or "no" answers. Each item was scored with 15 points in total, and the higher the score, the greater the degree of depression. Severe depressive was considered ≧5 points

and no depression < 5 points, and the subjects were classified into two groups (Almeida, 1999).

Health-related indicators

As for subjective health, the subjects were asked to the question "Do you think you are currently healthy?" The answers to the questions consist of 4-point scale. Kaplan (1983) reported that people with higher subjective health have a longer life expectancy regardless of illness, and that he can use this factor to predict mortality risk. To investigate fear of falling, the subject was asked to answer the question, "How scary are you currently about falls?" The answers to the question consist of a four-point scale ("not scared at all," "not scared," "somewhat scared," and "very scared.)" Those who answered "not scared at all/not scared" were categorized into the "no fall fear group" and those who answered "somewhat scared/very scared" were classified into the "fall fear group." Fear of falling has been reported to be associated with decreased ADL and activity (Tinetti, 1993).

Statistical analysis

We used the Shapiro-Wilk test to confirm the normality of the distribution of each endpoint. The endpoints of the catastrophic and non-catastrophic groups were compared by the using χ^2 test, the Mann-Whitney U test, and the unpaired *t*-test. In ad-

dition, we did logistic regression analysis with presence or absence of PCS as the dependent variable, and as the independent variable with items for which a significant difference was found from the results of the univariate analysis. Checks for collinearity were done assessing variance inflation factors for independent variables. Multicollinearity was investigated using Spearman's correlation coefficient to determine the correlation between independent variables that were significantly different in univariate analysis. In addition, a receiver operating characteristic (ROC) analysis was done to clarify the cutoff value of the PCS subscale. The objective variable of ROC analysis was the item related to PCS revealed by logistic regression analysis. PCS subscale was input to test variables, and drawn to calculate the area under the curve (AUC).

We computed all study variables with International Business Machine Statistical Package for Social Science software version 26.0 for Windows (IBM SPSS, Inc, Armonk, New York, USA). The differences between groups were considered significant if *p*-values were smaller than 0.05.

RESULTS

The basic information on the subjects is shown in Table 1. Table 2 shows results of univariate analy-

Table 1. Demographic data in the study

Variable	M ± SD
Age, years	72.4 ± 8.1
Medication number	3.0 ± 2.8
PCP	
Helplessness	5.5 ± 4.6
Magnification	3.9 ± 3.3
Rumination	10.6 ± 5.2
Total	20.0 ± 11.5
Number of PCS, ≥ 30, n (%)	26 (21.5)
CP duration, ≥ 1 year, n (%)	74 (61.2)
Multisite pain, ≥ 2 sites, n (%)	56 (46.3)
Grip power, kg	21.4 ± 4.2
Gait speed, m/s	1.27 ± 0.2
SMI, kg/m^2	5.7 ± 0.7
GDS-15, points	4.1 ± 3.0
Low subjective health, n (%)	24 (19.8)
High fear of fall, n (%)	85 (61.2)

M ± SD, mean ± standard deviation ; CP, chronic pain, PCS, pain catastrophizing scale, SMI, skeletal muscle mass index, GDS, geriatric depression scale

Table 2. Comparison between groups based on Pain Catastrophizing Scale

	PCS (< 30) (M ± SD)	PCS (≥ 30) (M ± SD)
Age (years)	71.7 ± 8.4	75.0 ± 6.5*
Number of medication	2.7 ± 2.7	3.8 ± 2.8
CP Duration, ≥ 1 year, n (%)	54 (56.8)	20 (76.9)
Multisite pain, ≥ 2 sites, n (%)	39 (41.1)	17 (65.4)*
Grip power (kg)	21.7 ± 4.5	20.6 ± 2.9
Gait speed (m/s)	1.28 ± 0.2	1.19 ± 0.2*
SMI (kg/m^2)	5.8 ± 0.7	5.7 ± 0.6
GDS-15 (points)	3.9 ± 2.9	5.0 ± 3.0
Low subjective health, n (%)	14 (14.7)	10 (38.5)*
High fear of fall, n (%)	67 (73.6)	18 (75.0)

*$p < 0.05$
M ± SD, mean ± standard deviation; CP, chronic pain, SMI, Skeletal Muscle Mass Index; GDS, Geriatric Depression Scale

Table 3. Odds ratio of subjective health by multiple logistic regression analysis for the subjects without catastrophic thinking compared with catastrophic thinking

	Odds ratio	95% confidence interval
Subjective health	3.62	(1.37 - 9.56)**

*$p < 0.05$; **$p < 0.01$
Data were adjusted by chronic pain duration

sis for the high PCS group (PCS ≥ 30) and low PCS group (PCS < 30).

In the comparison between the high PCS group and the low PCS group, significant differences were found in the variables of age, multisite pain, gait speed, and subjective health (Table 3). As a result of univariate analysis, the multicollinearity between the variables with significant differences was judged to be non-multicollinearity because there were no variables with high correlation.

Table 3 shows the results of stepwise logistic regression analysis adjusted for duration of CP, with the presence or absence of catastrophic thinking as the independent variable, and the age, medication use, multisite pain, gait speed, and subjective health with significant differences as a result of univariate analysis as the dependent variables. As a result of logistic analysis, we found that subjective health was significantly related to the presence of catastrophic thinking ($p < 0.01$).

As shown in Figure 1, the ROC analysis was done with the objective variable set to subjective health and the test variables set to the PCS subscale. The AUC of the ROC curve was rumination 0.72, magnification 0.72, and helplessness 0.67. The cutoff value of the PCS subscale was 7.5 (sensitivity 95.8%, specificity 35.1%) for the rumination score, 3.5 (sensitivity 75.0%, specificity 60.0%) for the magnification score, and 3.5 (sen-

sitivity 83.3%, specificity 46.4%) for helplessness score (Figure. 1).

DISCUSSION

In this study, we analyzed the factors that influence catastrophic thinking, which are known to negatively affect the psychosomatic function of people with CP. Our study results (Table 2) showed that a strong significant negative association existed between high pain catastrophe and low subjective health (38.5% vs. 14,7%, $p < 0.05$). This finding agrees with that of a previous study investigating the association between CP and subjective health (Mantyselka, 2003).

Pereira (2014) reported that the relationship between CP and subjective health in community-dwelling older adults is mediated by female gender. The World Health Organization defines health as "Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity." CP is obviously one of the causes of poor health. On the other hand, we suggest that the presence of many low-score PCS subjects is considered healthy.

ROC analysis in a previous study revealed that the subscales of the PCS, rumination and magnification, have moderate predictive abilities of subjective health (Swets, 1988). Magnification overestimates the intensity of the pain itself and the problems it
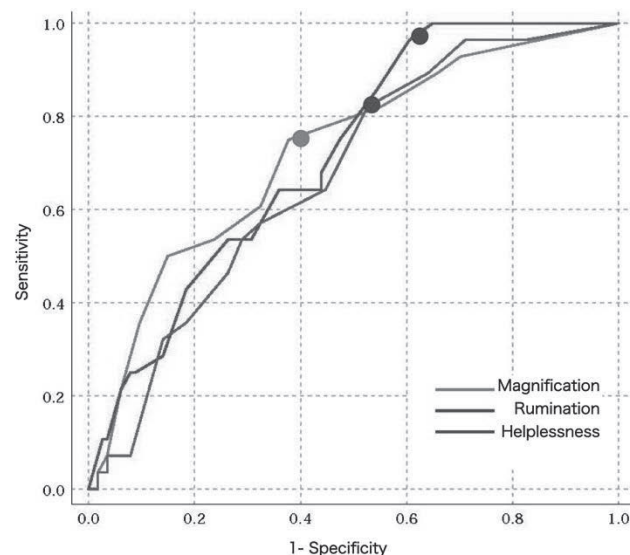

Figure1. Receiver operating characteristic curve of Pain Catastrophizing Scale subscale for estimating subjective health. The area under the curve value is 0.72 ($p<0.001$, 95% confidence interval = 0.62–0.82) in rumination, 0.74 ($p < 0.001$, 95% confidence interval = 0.63–0.85) in magnification, 0.67 ($p<0.001$, 95% confidence interval = 0.56–0.78) in helplessness (In the Results, "The AUC of the ROC curve was rumination 0.72, magnification 0.72, and helplessness 0.67." Please clarify the data).

may cause. Rumination is the excessive attention to pain-related thoughts (Sulivan, 2009). Studies on the effects of rumination and magnification on the elderly are extremely limited. La Touche (2019) reported that among the people with chronic low back pain, those with low self-efficacy have a negative association between magnifying vision and low back range of motion. Ogunlana (2015) also acknowledged that magnification and rumination are useful to predict disability in patients with nonspecific low back pain. The results of our subjects (Figure 1) showed that rumination ($p < 0.001$), magnification ($p < 0.001$) and helplessness ($p < 0.001$) had significant predictive values. Those findings in our study differ from those in the previous study. We suggest that poor subjective health is reached as a result of excessive awareness of CP and increased anxiety about the future. We also suggest that community health workers must thoroughly investigate the subject's complaints of pain which should be managed and appropriately. For proper management, finding the target of management among patients with CP is necessary.

As shown in Figure 1, the cutoff value of the PCS subscale was 7.5 (sensitivity 95.8%, specificity 35.1%) for the rumination score, 3.5 (sensitivity 75.0%, specificity 60.0%), for the magnification score and helplessness score 3.5 (sensitivity 83.3%, specificity 46.4%). Those cutoff values make the work of community health workers more efficient.

Study limitations

The readers are warned against not to over-interpret our study findings because our study have four limitations:

- In this study, we assessed CP based on screening tools rather than on full diagnostic procedures. This clinical diagnosis of CP may not be valid.
- Our study is a cross-sectional study design. Therefore, we cannot confirm the causal relationship between PCS and subjective health.
- In this study, the study data were obtained from a single city, Kaizuka City.
  The generalization of data to other cities is limited because the PCS score in daily life may be affected by geographic characteristics.
- The number of 121 older adults (consisting of about 0.5% of older adult people in the city) who have high interest in health topics were enrolled. The study subjects were not selected randomly. Therefore, the representation of samples in this study is doubtful.

Summary

We demonstrated that older adult subjects with CP through a high PCS score in community-dwelling showed low subjective health, and the subjective health were related to the PCS rumination and magnification subscale. We suggest that community-dwelling older adults with CP must take the appropriate approach, but that those with a high rumination and magnification score require earlier care.

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