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Original Article

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Relationship Between Kihon Checklist Score and Anxiety Levels in Elderly Patients Undergoing Early Phase II Cardiac Rehabilitation

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Abstract

Background: The frailty state consists of not only physical but also psycho-emotional problems, such as cognitive dysfunction and depression as well as social problems. However, few reports have examined the relationship between frailty and anxiety levels in elderly patients undergoing cardiac rehabilitation (CR).

Methods: We analyzed 255 patients (mean age: 74.9 ± 5.8 years, 67% male) who participated in early phase II CR at Juntendo University Hospital. At the beginning of CR, patients carried out self-assessments based on the Kihon Checklist (KCL) and the State Trait Anxiety Inventory Form (STAI). Patients were divided into three groups: frailty group (n = 99, 39%), pre-frailty group (n = 81, 32%), and non-frailty group (n = 75, 29%) according to the KCL. We assessed results from the KCL scores and its relationship with anxiety levels.

Results: Among the three groups, there were no significant differences in age, underlying illnesses, or the prevalence of coronary risk factors. Depressive mood domains of the KCL were significantly higher in the frailty and pre-frailty groups than in the non-frailty groups (3.0 ± 1.5 vs. 1.4 ± 1.2 vs. 0.4 ± 0.6; $P < 0.01$). The state anxiety level was significantly higher in the frailty group than in the non-frailty group (41.6 ± 0.9 vs. 34.9 ± 1.0; $P < 0.01$). The trait anxiety levels were significantly higher in the frailty group and pre-frailty group than in the non-frailty group (45.5 ± 0.9 vs. 39.2 ± 1.0 vs. 35.1 ± 1.1; $P < 0.01$). State anxiety and trait anxiety also showed a significantly positive correlations with the KCL scores ($r = 0.32$ vs. 0.41, $P < 0.01$).

Conclusions: Frailty scores were positively correlated not only with physical function but also with depression mood and anxiety levels in elderly patients undergoing early phase II CR. These results suggest that assessment of depressive mood and anxiety is also important in elderly patients undergoing early phase II CR.

Keywords: Frailty; Anxiety; Elderly patients; Cardiac rehabilitation; Kihon Checklist

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Introduction

As Japan's population gradually becomes a "super-aged society", the number of elderly patients with cardiovascular disease (CVD) has continued to increase [1]. Interestingly, frailty is an important prognostic factor in patients with CVD [2, 3]. Frailty is regarded as a geriatric syndrome associated with high vulnerability to stressors toward adverse health outcomes, resulting from the decreased reserves of multiple physiological systems [4]. Frailty is clinically considered to be an early form of physical, social or psychological disability. Therefore, functions of the elderly people should be assessed across multiple domains to identify frail individuals [5]. The Kihon Checklist (KCL), a self-administered questionnaire, is considered to be a useful tool for frailty screening in older adult populations [6]. Indeed, total KCL scores have been shown to correlate signifi-

cantly with Fried's frailty phenotype values [7].

Patients with CVD have a high rate of concurrent psycho-emotional stress [8], including depression and anxiety symptoms. It is noteworthy that approximately 20% of patients with ischemic heart disease and 25% of patients with heart failure experience psycho-emotional stress [9, 10]. Moreover, psycho-emotional stress is a risk factor for CVD and is associated with recurrence of CVD, re-hospitalization due to heart failure as well as mortality [11, 12]. Despite the impact of psycho-emotional stress on CVD, few reports have examined the relationship between frailty and anxiety levels in elderly patients with CVD. In the present study, we retrospectively examined the relationship between KCL score and anxiety levels in elderly patients undergoing early phase II cardiac rehabilitation (CR) at Juntendo University Hospital.

Materials and Methods

Study population

This was a retrospective cross-sectional study. We enrolled 658 consecutive patients who participated in early phase II CR program from November 2015 to December 2016 at Juntendo University Hospital, Tokyo, Japan. In Japan, the indications for CR in CVD patients include acute myocardial infarction, angina pectoris after open heart surgery, chronic heart failure, major vessel disease, peripheral artery disease and post-transcatheter aortic valve implantation [13]. CR comprises medical evaluation of patients, exercise therapy, education for secondary prevention and support of psychosocial factors [14]. The present study enrolled elderly patients (aged $\geq$ 65 years) who participated in CR and were evaluated for clinical parameters, including risk profiles and physical function. Of the initial 658 patients we enrolled, 233 patients were excluded for being aged < 65 years and 170 patients lacked anxiety evaluation scores. This resulted in 255 patients being included in the study who met all criteria. The purpose of the study was explained in writing to the patients and consent was obtained in accordance with the Declaration of Helsinki. Although the survey items in the present study were retrospectively examined, approval was obtained for research involving patients from the Institutional Review Board of Juntendo University Hospital (approval number: 13-058).

Data collection and measurements

We assessed age, sex, underlying diseases, coronary risk factors, left ventricular ejection fraction, body composition, muscle strength and exercise tolerance at the beginning of the CR, as described previously [15, 16]. Anthropometric parameters, including percentage of body fat, lean bodyweight and muscle mass were measured by bioelectrical impedance analysis (MC-780A; TANITA, Tokyo, Japan). In addition, we measured grip strength and a 6-min walking distance in the participants. Grip strength of both hands was measured in a standing position, and the higher grip strength value of the two hands was used. The 6-min walking test protocol was performed as previously described [3]. For blood biochemistry, parameters such as hemoglobin, albumin, creatinine, estimated glomerular filtration rate (eGFR), triglyceride, high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), hemoglobin A1c (HbA1c), brain natriuretic peptide, and geriatric nutritional risk index (GNRI) were measured [17].

KCL

The KCL is a 25-item self-administrated questionnaire developed by the Japanese Ministry of Health, Labor and Welfare to identify frail older individuals who are at risk of requiring new certification for long-term care insurance [7]. The KCL comprises of seven types of questions aimed to assess the instrumental activities of daily living, physical function, nutritional status, oral function, social activities of daily living, cognitive function and depressive mood of participants. Thus, the KCL is a comprehensive evaluation method that focuses on the social and psychological aspects in addition to the physical aspects of frailty. Given its ability to assess frailty across multiple domains, the KCL is regarded as an effective screening tool [7]. The questions on the KCL require a simple "yes" or "no" answer, and are scored as 1 or 0 points, respectively. The patients were classified into three groups based on the KCL. Out of a maximum of 25 points, those with scores of $\geq$ 8 points were defined as the frailty group, those with 4 - 7 points are classified as the pre-frailty group, and those with $\leq$ 3 points as the non-frailty group [7].

Anxiety level

Anxiety levels were evaluated with a self-administered State Trait Anxiety Inventory Form (STAI) [18]. This form is an inventory consisting of 40 statements about the feelings of the participant, divided into two parts. In part I (consisting of 20 statements), patients are instructed to indicate the intensity of their feelings of anxiety at a particular moment (these indicate state anxiety), using scores ranging from 1 (absolutely not) to 4 (very much). In part II (other 20 statements), patients describe how they generally feel (these indicate trait anxiety) by reporting the frequency of their symptoms of anxiety, again using scores ranging from 1 (hardly ever) to 4 (often). The total score of each part may range between 20 and 80, with higher scores indicating higher levels of anxiety. In the present study, we used the Japanese version of the STAI [19].

Statistical analysis methods

Continuous variables are presented as mean ± standard deviation (SD). Differences among the three groups were analyzed by one-way analysis of variance (ANOVA) followed by Tukey's honest significant difference test. The χ^2 test was used to compare categorical variables. Spearman's correlation coefficient was used to calculate the correlations between the KCL

Table 1. Clinical Characteristics of the Study Participants

	Non-frailty (n = 75)	Pre-frailty (n = 81)	Frailty (n = 99)	P value
Age (years)	73.8 ± 5.7	75.0 ± 5.8	75.5 ± 5.8	0.14
Male (%)	60 (80)	48 (60)[a]	62 (62)[a]	0.01
BMI (kg/m^2)	23.5 ± 2.7	22.5 ± 3.9	21.5 ± 4.6[a]	< 0.01
Hypertension (%)	55 (73)	53 (66)	70 (70)	0.35
Dyslipidemia (%)	37 (49)	37 (46)	46 (46)	0.89
Diabetes mellitus (%)	20 (27)	24 (30)	36 (36)	0.26
Current smoker (%)	14 (19)	9 (10)	13 (13)	0.24
CVD at the beginning of CR				
Ischemic heart disease (%)	40 (53)	43 (53)	52 (52)	0.99
Open heart surgery (%)	41 (55)	49 (61)	64 (64)	0.41
Chronic heart failure (%)	13 (17)	19 (24)	24 (24)	0.51
Anthropometric parameters and physical function				
Body fat percentage (%)	22.8 ± 8.0	24.2 ± 11.2	21.7 ± 9.8	0.28
Lean body weight (kg)	47.5 ± 7.6	42.7 ± 8.6[a]	41.9 ± 9.2[a]	< 0.01
Grip strength (kg)	28.1 ± 6.8	27.1 ± 7.4	25.4 ± 7.9	0.27
6-min walking test (m)	387 ± 72	339 ± 92[a]	310 ± 95[a]	< 0.01
Laboratory data				
Hemoglobin (g/dL)	13.2 ± 1.9	12.5 ± 1.8[a]	12.2 ± 1.7[a]	< 0.01
Albumin (g/dL)	3.9 ± 0.4	3.8 ± 0.6	3.7 ± 0.5	0.08
Creatinine (mg/dL)	1.03 ± 1.13	1.19 ± 1.28	1.31 ± 1.60	0.39
eGFR (mL/min/1.73m^2)	67.0 ± 21.3	63.2 ± 26.6	57.5 ± 24.6[a]	0.03
TG (mg/dL)	112 ± 59	114 ± 96	104 ± 48	0.58
HDL-C (mg/dL)	49 ± 15	50 ± 15	49 ± 15	0.93
LDL-C (mg/dL)	101 ± 27	103 ± 30	94 ± 28	0.08
HbA1c (%)	6.0 ± 0.7	6.1 ± 0.9	6.2 ± 0.9	0.31
BNP (pg/mL)	205 ± 407	265 ± 374	303 ± 709	0.49
GNRI	102.3 ± 8.5	98.1 ± 14.3	96.0 ± 12.1[a]	< 0.01
LV ejection fraction (%)	59.7 ± 15.3	56.3 ± 14.6	57.1 ± 16.4	0.34

Data are presented as the mean value ± SD. [a]P < 0.05 vs. non-frailty by Tukey's honest significant difference test. BMI: body mass index; CVD: cardiovascular disease; CR: cardiac rehabilitation; eGFR: estimated glomerular filtration rate; TG: triglyceride; HDL-C: high-density lipoprotein cholesterol; LDL-C: low-density lipoprotein cholesterol; HbA1c: hemoglobin A1c; BNP: brain natriuretic peptide; GNRI, geriatric nutritional risk index; LV: left ventricular.

score and anxiety levels. Differences were considered significant when the P value was < 0.05. Statistical analysis was performed using the software JMP12.0 (SAS Institute Inc., Cary, NC, USA).

Results

Clinical characteristics of the patients

The clinical characteristics of the patients were presented in Table 1. Overall, the mean age of patients was 74.9 ± 5.8 years and 170 patients (67%) were males. There were 75 patients (29%) in the non-frailty group, 81 patients (32%) in the pre-frailty group, and 99 patients (39%) in the frailty group. Among the three groups, there were no significant differences in age, underlying disease or the prevalence of coronary risk factors. The frailty and pre-frailty groups consisted of a significantly lower proportion of male patients, and had lower lean body weight, 6-min walk distance and hemoglobin levels than those in the non-frailty group (P < 0.05 for all parameters). The frailty group also had significantly lower body mass index (BMI), GNRI and eGFR levels than those in the non-frailty group (P < 0.05 for all parameters).

KCL score and anxiety level

Table 2 presented a comparison between the KCL scores and

Table 2. Comparison of Kihon Checklist Score and Anxiety Levels Among Three Groups

	Non-frailty (n = 75)	Pre-frailty (n = 81)	Frailty (n = 99)	P value
Kihon Checklist				
Instrumental activities of daily living	0.2 ± 0.4	0.4 ± 0.8	1.5 ± 1.7[a, b]	< 0.01
Physical function	0.4 ± 0.7	1.3 ± 1.1[a]	2.4 ± 1.4[a, b]	< 0.01
Nutritional status	0.3 ± 0.5	0.6 ± 0.6[a]	0.8 ± 0.7[a, b]	< 0.01
Oral function	0.2 ± 0.5	1.0 ± 0.8[a]	1.5 ± 0.9[a, b]	< 0.01
Social activities	0.1 ± 0.4	0.3 ± 0.5[a]	0.8 ± 0.7[a, b]	< 0.01
Cognitive function	0.1 ± 0.3	0.5 ± 0.6[a]	0.8 ± 0.9[a, b]	< 0.01
Depressive mood	0.4 ± 0.6	1.4 ± 1.2[a]	3.0 ± 1.5[a, b]	< 0.01
STAI				
State anxiety	34.9 ± 1.0	37.7 ± 0.9	41.6 ± 0.9[a]	< 0.01
Trait anxiety	35.1 ± 1.1	39.2 ± 1.0[a]	45.5 ± 0.9[a, b]	< 0.01

Data are presented as the mean value ± SD. [a]P < 0.05 vs. non-frailty. [b]P < 0.05 vs. pre-frailty by Tukey's honest significant difference test. STAI: state-trait anxiety inventory.

anxiety levels among the three groups. The pre-frailty group had significantly higher values in all sub-items except for instrumental activities of daily living when compared to the non-frailty group (P < 0.01 for all parameters). Furthermore, the frailty group had significantly higher values in all sub-items of the KCL when compared to the pre-frailty and the non-frailty groups (P < 0.01 for all parameters).

State anxiety was significantly higher in the frailty groups when compared to the non-frailty group (41.6 ± 0.9 vs. 34.9 ± 1.0; P < 0.01). Trait anxiety increased in a stepwise manner across the three groups, and was significantly higher in the frailty and pre-frailty groups when compared to the non-frailty group (35.1 ± 1.1 vs. 39.2 ± 1.0 vs. 45.5 ± 0.9; P < 0.01).

The correlation between frailty scores and anxiety levels was presented in Figure 1. A significantly positive correlation was observed between the KCL score and state anxiety score (r = 0.32, P < 0.05; Fig. 1a) as well as between KCL score and trait anxiety score (r = 0.41, P < 0.05; Fig. 1b). A significantly positive correlation was also observed between the scores of items 1 to 20 of the KCL (excluding the depression items) and the state anxiety scores and trait anxiety scores (r = 0.23 vs. 0.33, P < 0.05; Fig. 1c, d).

Discussion

In the present study, we demonstrated that the anxiety scores were significantly higher in the frailty and pre-frailty patients when compared to the non-frailty patients. We also demonstrated the relationship between the frailty score and anxiety levels in elderly patients undergoing early phase II CR. To the best of our knowledge, this is the first study demonstrating the relationship between frailty score and anxiety levels in elderly patients undergoing early phase II CR.

In Japan, the estimated rates of community-dwelling elderly individuals with frailty and pre-frailty are 6.9% and 49.6%, respectively [20]. Despite a high prevalence of pre-frailty in individuals with chronic disease and CVD, the rate of frailty in patients with CVD is estimated to be 25-50% [4, 21]. Indeed, the prevalence of frailty and pre-frailty were reported 39% and 32% in this study.

Frailty was related to the risk of mental health deterioration in community dwelling elderly individuals [22]. Pre-frailty was also found to be associated with emotional distress, including depression and anxiety [22]. Recent studies have also reported that anxiety and depression are predictors of pre-frailty to frailty progression [23, 24]. In addition, anxiety is an independent risk factor for exacerbation of disability in elderly individuals [25]. Moreover, elderly individuals who report depressive symptoms are at high risk of subsequent physical decline [26]. There is mutual risk relationship between physical frailty and psycho-emotional frailty such as cognitive dysfunction, dementia and depression [27, 28]. In the present study, KCL scores (excluding those from depression and mood; items 21 to 25) positively correlated with anxiety levels (Fig. 1c, d). These results support findings from previous reports [24].

Anxiety and depression co-exist at a high rate in patients with heart failure [10]. Additionally, the presence of anxiety also promotes depression [29]. Furthermore, Andreescu et al have demonstrated that a decline in cognitive function also correlates with anxiety in elderly patients [30]. Anxiety, depression, and cognitive function are all multi-dimensional entities, interacting in complex ways within the neural mechanisms [30]. Another previous report has proposed that apathy and anxiety should be considered in clinical practice as psychological symptoms observed in frailty elderly individuals, in addition to depression and dementia [31]. Therefore, we believe that it is important to perform complex evaluations integrating psycho-emotional and cognitive function, particularly in elderly individuals.

The mechanism by which anxiety can be a risk factor for CVD is controversial. Depression and anxiety have increased physiological impairments, such as dysfunction of the autonomic nervous system and platelet activation disorders of the hypothalamic-pituitary-adrenal axis [32]. Furthermore, higher

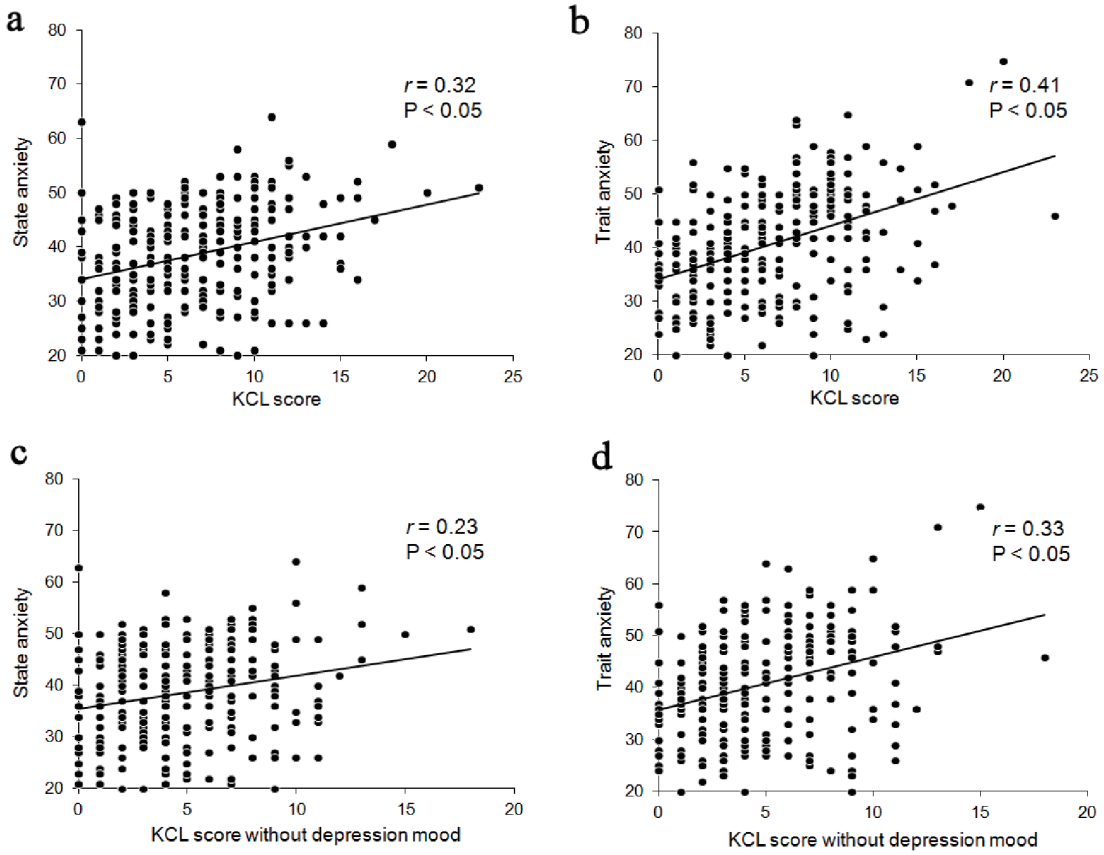

Figure 1. Correlation between KCL scores and anxiety levels. KCL score correlated with state anxiety (r = 0.32, P < 0.05) (a) and trait anxiety (r = 0.41, P < 0.05) (b) in elderly patients undergoing early phase II CR (n = 255). KCL score, excluding depression mood, correlated with state anxiety (r = 0.23, P < 0.05) (c) and trait anxiety (r = 0.33, P < 0.05) (d) in elderly patients undergoing early phase II CR (n = 255). KCL: Kihon Checklist.

anxiety is associated with behavioral issues such as inactivity, reduced ability for selfcare, smoking and poor adherence to CR [32, 33]. We believe that evaluating the levels of anxiety is also important in order to understand the behavior of elderly patients who are undergoing CR and to determine ways to help them cope with the condition.

The present study had several limitations. First, this was a single-center study with a small sample size, which limits the possibility of generalizing the results. Second, psycho-emotional states, including anxiety and depression, might be difficult to completely distinguish because they were associated with cognitive function and are also interrelated. Third, this study was a cross-sectional design. Therefore, we were unable to prove any causal relationships between frailty score and anxiety level. Thus, these findings require further examination, possibly involving several screening tools.

Conclusions

Frailty was positively correlated with depression and anxiety levels in elderly patients undergoing early phase II CR. The assessment of depressive mood and anxiety was also recognized to be important in elderly patients undergoing early phase II CR.

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Conflict of Interest

The authors do not have any conflict of interest to declare con-

cerning the present article.

Informed Consent

All patients provided written informed consent.

Author Contributions

AH has designed and performed the study. AH, MN-Y, and KS have drafted the manuscript and did critical editing. AH, MN-Y, MK, MY, TM, RM, AA, TA, SO, MS, YS, KF, AS, TY, AA, TA, MS, TM, TT, TF, HD, and TM have assisted and supported in sample collection. MN-Y and KS have carefully supervised this manuscript preparation and writing.

Data Availability

The data sets will not be publicly available because patient consent in our institute does not allow for such publication. The corresponding author will respond to inquiries on data analyses.

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