

The relationship between the construct of alexithymia and the steps of emotion expression

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Abstract

Background: Alexithymia is a central concept in psychosomatic disorders, but its treatment has not been established. Therefore, in order to clarify the details of the pathogenesis of alexithymia for further treatment, the present study aimed to evaluate the association between alexithymia pathophysiology, classified by the presence or absence of alexithymia as assessed by the 20-item version of The Toronto Alexithymia Scale (TAS-20), and emotional expressive process functioning as assessed by Japanese version of the Difficulties in Emotion Regulation Scale (J-DERS).

Methods: From February 2018 to June 2019, first-time patients aged 16 years or older referred to our department were eligible for inclusion, and patients with mental illness, patients who declined to provide information, and those who consented but failed to complete the form were excluded. The comparison between the median J-DERS total and subscale scores of the TAS-20 high-scoring group (defined as ≥ 52 points) and the TAS-20 low-scoring group (defined as ≤ 51 points) was set as the primary outcome. J-DERS total score and subscales were used as dependent variables, and multiple linear regression analysis was

used to analyze the association with the subscales of the TAS-20.

Results: Of the 188 total subjects, 106 (56%) were included in the analysis. On the median total J-DERS score, the TAS-20 high scoring group was significantly higher than the low scoring group. Similarly, a significant difference was seen with each J-DERS subscale. Of the three TAS-20 subscales, only difficulty in identifying feelings correlated with the J-DERS total score and subscales.

Conclusions: Although alexithymia has been considered to be a disruption in one of steps of the emotional expression process, the results of our study revealed that alexithymia affects the several emotional expression process. Future research may help treat alexithymia by providing psychotherapy that is commensurate with each step of the emotional expression process.

Key words: alexithymia, psychosomatic disorder, emotions

Background

Alexithymia consists of the clinically observed features of 1) difficulty in identifying and describing feelings; 2) difficulty in distinguishing between feelings and the bodily sensations of emotional arousal; 3) constricted imaginative processes; and 4)

an externally oriented cognitive style in which attention is directed toward external facts connected to stimuli rather than one's internal self ¹.

Sifneos et al. coined the term "alexithymia" as a central concept to describe such a psychosomatic disorder, which was present in patients with physical disease, developed and progressed in close correlation

with psychosocial factors, and exhibited organic or functional disturbances^{2,3}. Alexithymia has been reported to correlate not only with psychosomatic disease but also with physical diseases such as diabetes mellitus and chronic pain^{4,5}. Furthermore, psychotherapies, such as cognitive-behavioral therapy or supportive psychotherapy, are administered based on the premise that the subjects are aware of their emotions or stress, it is difficult to apply these therapies to an appreciable effect with alexithymic patients⁶. Therefore, it is important to clarify the pathogenesis of alexithymia.

Kennedy–Moore and Watson described the process of emotional expression in which emotional experiences brought about by emotion-eliciting stimuli are expressed, comprising the following five steps (Figure. 1).

- STEP 1 [Initial prereflective reaction]
- STEP 2 [Conscious perception of response]
- STEP 3 [Labeling & interpretation of response]
- STEP 4 [Evaluation of response as acceptable]
- STEP 5 [Perceived context for expression]

Among these, a disruption in STEP 1 is not clinically problematic because the patient does not have any emotions as the expression of emotions by emotion-eliciting stimuli is limited to a prereflex response. A disruption in STEP 2 is the inability to recognize emotions even when they are aroused by emotion-eliciting stimuli. Alexithymia reflects dysfunctional skills in STEP 3 (identifying, labeling and understanding emotions) (Figure. 1)⁷.

Two traditional methods have been used to elucidate the mechanism underlying this emotional process: first is Swart et al.’s study, which employed Gross & John’s Emotion Regulation Questionnaire (ERQ)⁸ to assess the difficulty of emotion regulation and second is Gratz & Roemer’s The Difficulties in Emotion Regulation Scale (DERS) (Table 1-a)⁹. This questionnaire is based on Gratz & Roemer’s (a) “awareness and understanding of emotions,” (b) “acceptance of emotions,” (c) “ability to control impulsive behaviors and behave in accordance with desired goals when experiencing negative emotions,” and (d) “ability to use situationally appropriate emotion regulation strategies flexibly to modulate emotional

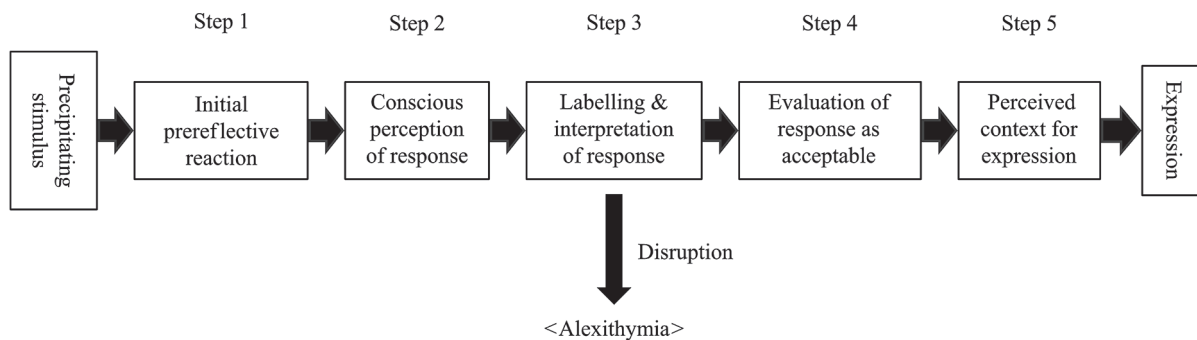


Diagram based on concepts outlined by Kennedy-Moore and Watson in *expressing emotion* (1999)

Figure 1. The process of emotional expression

Five steps exist between affective arousal and emotional expression.

STEP 1: Initial prereflective reaction: emotional arousal

When the emotion-eliciting stimulus is received, a reaction happens in which the stimulus is perceived, preconscious cognitive and emotional processing takes place, and emotional arousal occurs. This arousal is a bodily signal.

STEP 2: Conscious perception of the response: recognition of emotional states

The individual observes the affective reaction caused by the bodily signal, and consciously recognizes this experience. Specific bodily signs such as a racing heart or shaking hands may be noticed. Includes repressor, which is a lack of awareness of negative emotional states.

STEP 3: Labeling and interpreting the response: identification, labeling, and understanding of emotions

If the affective response can be consciously perceived, then the experience undergoes cognitive processing and is labeled as an emotional experience, and an attempt is made to label and interpret it. Alexithymia is a disruption of this step.

STEP 4: Evaluation of the response as acceptable: assessment for emotional acceptance

If the affective response can be labeled and interpreted, then it is compared with the individual’s beliefs and goals, and the individual decides whether to accept the feeling.

STEP 5: Perceived context for expression: determining the expression of emotions

If the individual perceives that revealing their feelings is possible or desirable in their interpersonal environment, they then ultimately express these feelings.

responses as desired in order to meet individual goals and situational demands,” which are reflected in the four domains of emotion regulation ability⁹. Of these, (a) “awareness and understanding of emotions” is not included in Gross’ model of emotion regulation¹⁰.

There are emotional response processes and systems that are interrelated with neurophysiological processes, motor or behavioral expressive processes, and a cognitive-experiential system in emotional response in humans¹¹. Alexithymia reflects deficits in a cognitive-experiential system (subjective awareness and verbal reporting of feeling states), according to Taylor and colleagues¹². Moreover, according to Greenberg, emotion processing includes being aware of emotions, labeling emotional responses, regulating emotions, and accepting them¹³. Therefore, to clarify the relationship between the construct of alexithymia and the steps of emotional expression, it is necessary to use the DERS (Table 1-a)⁹, which includes (a) “awareness and understanding of emotions.”

In the Japanese version of DERS (J-DERS) (Table 1-b)¹⁴, GOALS and IMPULS as well as AWARENESS and CLARITY, which are similar to each other among

the six DERS subscales created by Gratz & Roemer, are combined into the same factor, which is called the four-factor solution. This is because this four-factor solution reflects the four domains—(a) to (d)—that are important for emotion, as proposed by Gratz & Roemer, better than the six-factor solution.

The relationship among the Kennedy–Moore & Watson model, the J-DERS concept, and Gratz & Roemer’s explanation is shown in Figure 2.

By comparing the above-mentioned Kennedy–Moore & Watson’s emotion expression process with Gratz & Roemer’s four emotion regulation abilities and J-DERS, it can be concluded that STEPs 1–3 (arousing, recognizing, and identifying and labeling emotions) of Kennedy–Moore & Watson’s emotional expression process correspond to (a) “awareness and understanding of emotions” (emotional arousal, recognition, and understanding) of Gratz & Roemer’s emotion regulation abilities, and its disruption is considered to correspond to ① “lack of emotional awareness” in J-DERS. Similarly, STEP 4 (deciding whether to accept emotions considering personal beliefs and goals) corresponds to (b) “acceptance of

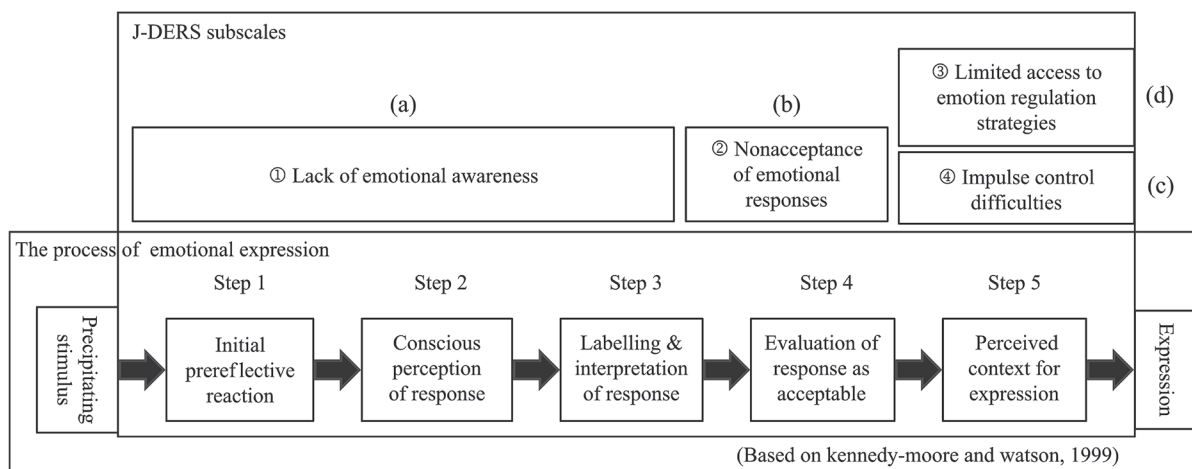


Figure 2. J-DERS and its relation to the process of emotional expression (Kennedy–Moore & Watson model and Gratz & Roemer model)

By comparing the above-mentioned Kennedy–Moore & Watson process of emotional expression with Gratz & Roemer’s four emotion regulation abilities and J-DERS, it can be concluded that STEPs 1–3 (arousing, recognizing, and identifying and labeling emotions) of Kennedy–Moore & Watson’s emotion expression process correspond to (a) “awareness and understanding of emotions” (emotional arousal, recognition, and understanding) of Gratz & Roemer’s emotion regulation abilities, and its disruption is considered to correspond to ① lack of emotional awareness in J-DERS. Similarly, STEP 4 (deciding whether to accept emotions considering personal beliefs and goals) corresponds to (b) “acceptance of emotions” (accepting and evaluating emotional responses) and its disruption corresponds to ② nonacceptance of emotional responses. In addition, STEP 5 (considering whether emotions can be expressed but are expressed depending on the environment of the situation) corresponds to (c) “ability to control impulsive behaviors and behave in accordance with desired goals when experiencing negative emotions” and (d) “ability to use situationally appropriate emotion regulation strategies flexibly to modulate emotional responses as desired in order to meet individual goals and situational demands” (“ability to control undesirable behaviors and behave in accordance with desired goals when experiencing negative emotions”), and its disruption is considered to correspond to ④ impulse control difficulties and ③ limited access to emotion regulation strategies.

Table 1-a The Difficulties in Emotion Regulation Scale (DERS)

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- The DERS contains six subscales:
- ① Nonacceptance of Emotional Response (NONACCEPTANCE)
 - ② Difficulties in Engaging in Goal-Directed Behavior (GOALS)
 - ③ Impulse Control Difficulties (IMPULSE)
 - ④ Lack of Emotional Awareness (AWARENESS)
 - ⑤ Limited Access to Emotion Regulation Strategies (STRATEGIES)
 - ⑥ Lack of Emotional Clarity (CLARITY)
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Gratz & Roemer. *J Psychopathol Behav Assess.* 2004

Table 1-b Japanese version of the Difficulties in Emotion Regulation Scale (J-DERS)

The J-DERS is a Japanese scale for evaluating potentially clinically problematic disruption in four abilities. Described by Gratz and Roemer, the scale reflects the process of emotional regulation from emotional arousal to emotional expression, using the following subscales:

- ① Lack of Emotional Awareness
- ② Nonacceptance of Emotional Responses
- ③ Limited Access to Emotion Regulation Strategies
- ④ Impulse Control Difficulties

Questions to be included in each subscale:

- ① Lack of Emotional Awareness
 - 1) I am clear about my feelings. (r)
 - 2) I have difficulty making sense of my feelings.
 - 3) I know exactly how I am feeling. (r)
 - 4) I am confused about how I feel.
- ② Nonacceptance of Emotional Responses
 - 1) When I'm upset, I become angry with myself for feeling that way.
 - 2) When I'm upset, I become embarrassed for feeling that way.
 - 3) When I'm upset, I become irritated with myself for feeling that way.
 - 4) When I'm upset, I start to feel very bad about myself.
- ③ Limited Access to Emotion Regulation Strategies
 - 1) When I'm upset, I believe that I will remain that way for a long time.
 - 2) When I'm upset, I believe that I'll end up feeling very depressed.
 - 3) When I'm upset, I believe that there is nothing I can do to make myself feel better.
 - 4) When I'm upset, it takes me a long time to feel better.
- ④ Impulse Control Difficulties
 - 1) When I'm upset, I have difficulty getting work done.
 - 2) When I'm upset, I get out of control.
 - 3) When I'm upset, I lose control over my behaviors.
 - 4) When I'm upset, I have difficulty thinking about anything else.

Answers are given on a 5-point Likert scale ranging from 1 (almost never) to 5 (always)

Higher scores indicate greater difficulty regulating emotions

(r) Indicates a reverse-score item.

J-DERS was used with its creators' permission.

In the J-DERS, among the six subscales of the original version of the DERS (Table 1-a), goals and impulses and awareness and clarity are treated as single factors, generating a subscale comprising four factors. Yamada & Sugie. *Japn J Res Emot* 2013

emotions” (accepting and evaluating emotional responses) and its disruption corresponds to ② “nonacceptance of emotional responses.” In addition, STEP 5 (considering whether emotions can be expressed but are expressed depending on the environment of the situation) corresponds to (c) “ability to control impulsive behaviors and behave in accordance with desired goals when experiencing negative emotions” and (d) “ability to use situationally appropriate emotion regulation strategies flexibly to modulate emotional responses as desired in order to meet individual goals and situational demands” (“ability to control undesirable behaviors and behave in accordance with desired goals when experiencing negative emotions”), and its disruption is considered to correspond to ④ “impulse control difficulties” and ③ “limited access to emotion regulation strategies.” If the four emotion regulation abilities proposed by Gratz & Roemer correspond to each of the STEPs in Kennedy–Moore & Watson’s emotional expression process, as described above, emotional processing would be on a continuum. Therefore, we used the J-DERS (Table 1-b)¹⁴ (Figure. 2), which is thought to reflect the emotion expression process, to evaluate each step of the emotion expression process in the presence and absence of alexithymia.

The 20-item version of the Toronto Alexithymia Scale (TAS-20) is a self-administered scale developed by Bagby et al¹⁵⁻¹⁸. The TAS-20 is based on three factors: Difficulty Identifying Feelings (DIF), Difficulty Describing Feelings (DDF), and Externally Oriented Thinking (EOT)^{18,19}, and it uses the total scores to assess alexithymia.

As far as we know, there have been no studies comparing the presence or absence of alexithymia with the overall emotion expression process and the function of each STEP. Therefore, this study aimed to evaluate the relationship between alexithymia pathophysiology classified with or without alexithymia as assessed by the TAS-20 and emotion expression process function using the J-DERS.

Methods

Subjects

From February 2018 to June 2019, among 188 first-time patients aged 16 years or older referred to the outpatient clinic of the Department of Psychosomatic Medicine at Kindai University Hospital, ① Neurocognitive Disorders, ② Depressive Disorders, ③ Obsessive-Compulsive and Related Disorders, ④ Neurodevelopmental Disorders, ⑤ Feeding and Eating Disorders, ⑥ Personality

Disorders, and ⑦ Anxiety Disorders (including patients diagnosed as comorbidities) were excluded. Of the remaining 152 patients, 106 were eligible for inclusion after excluding patients who declined to provide information and those who consented but failed to complete the form. In all cases, the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) was used for diagnosis.

Psychological parameters

20-item version of The Toronto Alexithymia Scale, TAS-20

To assess alexithymia in this study, we used the TAS-20, which is a self-administered scale developed by Bagby et al¹⁵⁻¹⁸. The TAS-20 is based on three factors, namely, DIF, DDF, and EOT^{18,19}.

- F1: DIF: Difficulty in identifying and in distinguishing between feelings and the bodily sensations of emotional arousal.
- F2: DDF: Difficulty in describing feelings.
- F3: EOT: An externally oriented cognitive style.

The TAS-20’s reliability and validity have been previously verified internationally^{18,20}. The test comprises 20 statements that are graded from one (strongly disagree) to five (strongly agree). The total scores are used to assess alexithymia, and a sum of ≥ 61 points indicates alexithymia, 52–60 indicates an intermediate zone, while ≤ 51 indicates non-alexithymia¹⁵⁻¹⁷.

In this study, patients with a TAS-20 score of ≥ 52 points (which covers both the alexithymia and an intermediate zone) and ≤ 51 were grouped in the TAS-20 high- and low-scoring groups, respectively. To assess alexithymia, the Japanese version of the TAS-20 was used¹⁹.

The Difficulties in Emotion Regulation Scale of Japanese version, J-DERS (Table 1-b).

As shown in Table 1-b, to assess difficulties in emotion regulation in this study, the J-DERS, which is a Japanese version of the DERS, was used¹³. The J-DERS comprises four subscales (awareness, clarity, goals, and impulse) corresponding to the same subscales in the six-scale DERS (Table1-a)⁹. The subscales measure a patient’s ability to regulate emotion in four areas, comprehensively covering the process of emotion regulation from arousal to expression¹⁴.

The manner in which the J-DERS subscales for ① lack of emotional awareness, ② nonacceptance of emotional responses, ③ limited access to emotion regulation strategies, and ④ impulse control difficulties

are thought to correspond to the process of emotional expression outlined by Kennedy–Moore & Watson is shown in Figure 2. Participants were asked to indicate on a five-point Likert-type scale depending on how the items applied to them, with 1 = almost never, 2 = sometimes, 3 = about half the time, 4 = most of the time, and 5 = almost always. Higher scores indicate greater difficulties in emotion regulation. The reliability and validity of this psychological test have been well validated internationally¹⁴.

Procedures and statistics

Psychological assessments using TAS-20 and J-DERS were administered with the medical questionnaire that patients filled in before being examined at their initial visit to our hospital. We then retrospectively investigated this data based on our medical records for patients who met the eligibility criteria.

In the present study, TAS-20 scores of ≥ 52 , including alexithymia and an intermediate zone of alexithymia, were defined as the TAS-20 high-scoring group and scores of ≤ 51 were defined as the TAS-20 low-scoring group.

To evaluate how the presence of alexithymia affected each step of the process of emotional expression, the comparison between the median J-DERS total and subscale scores of the TAS-20 high-scoring group (defined as ≥ 52 points) and the TAS-20 low-scoring group (defined as ≤ 51 points) was set as the primary outcome.

The Mann–Whitney U test was used, and the significance level was set at 0.05. When corrected using the Bonferroni method, there were five primary outcomes (J-DERS total score and four subscales), and the significance level of the test was $0.05 \times 1/5 = 0.01$.

The secondary outcome examined factors related to the J-DERS total score and J-DERS subscales. The J-DERS total score and subscales were analyzed with multiple linear regression analysis using the forced imputation method, considering the J-DERS total score and subscales as dependent variables and age, sex, years of education, and the three TAS-20 subscales as independent variables. Here there were six independent variables, and the significance level was set at $0.05 \times 1/6 = 0.00833$.

SPSS V.25 (SPSS, Inc., Chicago, IL, USA) was used to statistically analyze all data.

This study was conducted in accordance with the principles of the Declaration of Helsinki and Japan's ethical guidelines for clinical research and approved by the Clinical Research Preliminary Review Board of the Kindai University Ethics Committee (Approval No.

R2-073).

Results

Figure 3 shows how the subjects were selected. Out of 188 initial candidates, 152 met the eligibility criteria. Out of these, 46 met the exclusion criteria; thus, only 106 cases (56%) were finally included in the analysis. The patient backgrounds are shown in Table 2. Patient ages ranged from 16 to 88 years with a mean age of 50.5. The most common main complaint was pain, which was reported by 40 patients (38%), followed by digestive symptoms (diarrhea, abdominal pain, or heartburn accompanying enterokinesis) in 19 patients (18%), dizziness in 13 (12%), and numbness in 13 (12%). All patients underwent a psychosomatic general consultation with a psychosomatic physician.

The mean TAS-20 and J-DERS total and subscale scores and their standard deviations (SD) are shown in Table 3. TAS-20 total score was 53.3 ± 9.8 (mean \pm SD), DIF 17.3 ± 6.2 , DDF 14.3 ± 3.6 , and EOT 21.7 ± 3.3 . J-DERS total score was 37.9 ± 13.3 , Lack of Emotional Awareness 9.3 ± 3.3 , Nonacceptance of Emotional Responses 9.6 ± 4.2 , Limited Access to Emotion Regulation Strategies 9.7 ± 4.0 , and Impulse Control Difficulties 9.6 ± 4.0 .

J-DERS scores in the TAS-20 high- and low-scoring groups are shown in Table 4. There were 60 subjects (57%) in the group that scored a total of ≥ 52 on the TAS-20 (assigned as the TAS-20 high-scoring group), and 46 subjects (43%) in the group that scored a total of ≤ 51 (assigned as the TAS-20 low-scoring group). A significant difference ($p < 0.01$) was found in the median total J-DERS scores between the TAS-20 high- and low-scoring groups, which was 42.0 (IQR 31.0–52.8) and 29.5 (23.0–37.3), respectively. For the TAS-20 high- and low-scoring groups, the median subscale score for lack of emotional awareness, nonacceptance of emotional responses, limited access to emotion regulation strategies, and impulse control difficulties was 11.0 (8.3–13.0) and 7.0 (6.0–9.0), 11.0 (8.0–15.0) and 7.0 (4.0–10.0), 10.0 (8.0–14.0) and 8.0 (6.0–10.0), and 11.0 (8.0–13.0) and 7.0 (5.0–10.0), respectively. A significant difference was observed between the two groups for each of the subscales ($p < 0.01$).

The factors related to J-DERS total and subscale scores and the results of a multivariate analysis applied to the covariates age, sex, years of education, and TAS-20 subscales are shown in additional file 1. None of the variance inflation factors exceeded 10, and multicollinearity did not exist; all the Durbin-Watson ratios were close to 2, and there were no outliers in

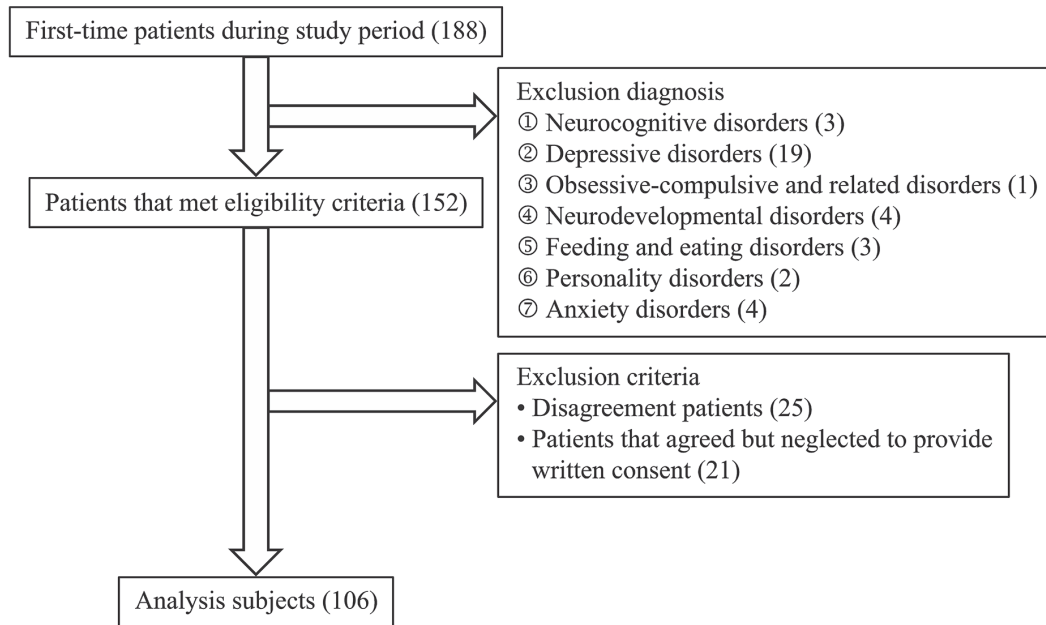


Figure 3. Flowchart of the study

The subjects of the study were first-time patients referred to the Kindai University Hospital Department of Psychosomatic Medicine Outpatient Clinic in the period from February 2018 to June 2019 that did not have dementia or mental illness and that met the criteria below:

Eligibility criteria: ① 16 years and over ② No refusal to provide information

Exclusion diagnosis: ① Neurocognitive Disorders ② Depressive Disorders ③ Obsessive-Compulsive and Related Disorders ④ Neurodevelopmental Disorders ⑤ Feeding and Eating Disorders ⑥ Personality Disorders ⑦ Anxiety Disorders (DSM-5)

Exclusion criteria: Disagreement patients, Patients who agreed but neglected to provide written consent.

Table 2. Clinical characteristics of the participants

	Number of participants (n = 106)
Age (years)	
Mean (range)	50.5 (16–88)
Education (years)	
Mean (range)	13.0 (9–16)
Sex, n (%)	
Men	35 (33)
Women	71 (67)
Symptoms, n (%)	
Pain	40 (38)
Digestive symptoms (diarrhea, abdominal pain, or heartburn accompanying enterokinesis)	19 (18)
Dizziness	13 (12)
Numbness	13 (12)
Palpitations	11 (10)
Others	10 (9)

which the predicted values exceeded ± 3 SD of the measured values. As summarized in additional file 1, out of the three TAS-20 subscales (DIF, EOT, and DDF), only DIF was correlated with the J-DERS total score, and each of the J-DERS subscales (lack of

emotional awareness, nonacceptance of emotional responses, limited access to emotion regulation strategies, and impulse control difficulties) ($p < 0.01$). Conversely, EOT and DDF had no correlation with any of the J-DERS subscales.

Table 3. TAS-20 and J-DERS total scores and subscales of the participants (n = 106)

	Mean	Standard Deviation
TAS-20		
TAS-20 Total	53.3	9.8
Difficulty Identifying Feeling	17.3	6.2
Difficulty Describing Feeling	14.3	3.6
Externally Oriented Thinking	21.7	3.3
J-DERS		
J-DERS Total	37.9	13.3
Lack of Emotional Awareness	9.3	3.3
Nonacceptance of Emotional Responses	9.6	4.2
Limited Access to Emotion Regulation Strategies	9.7	4.0
Impulse Control Difficulties	9.6	4.0

TAS-20: 20-item version of The Toronto Alexithymia Scale

J-DERS: Japanese version of the Difficulties in Emotion Regulation Scale

Table 4 J-DERS total and subscale scores in the TAS-20 high/low groups (Mann–Whitney U test)

	TAS-20 High-scoring Group (n = 60)	TAS-20 Low-scoring Group (n = 46)	
Age, mean ± SD	49 ± 24.7	52 ± 19.8	
Sex, n (%)			
Men	19(32)	16(35)	
Women	41 (68)	30 (65)	
J-DERS Total (IQR)	42.0 (31.0–52.8)	29.5 (23.0–37.3)	<i>p</i> < 0.01
Lack of Emotional Awareness (IQR)	11.0 (8.3–13.0)	7.0 (6.0–9.0)	<i>p</i> < 0.01
Nonacceptance of Emotional Responses (IQR)	11.0 (8.0–15.0)	7.0 (4.0–10.0)	<i>p</i> < 0.01
Limited Access to Emotion Regulation Strategies (IQR)	10.0 (8.0–14.0)	8.0 (6.0–10.0)	<i>p</i> < 0.01
Impulse Control Difficulties (IQR)	11.0 (8.0–13.0)	7.0 (5.0–10.0)	<i>p</i> < 0.01

SD: standard deviation, IQR: interquartile range

TAS-20: 20-item version of The Toronto Alexithymia Scale

J-DERS: Japanese version of the Difficulties in Emotion Regulation Scale

Discussion

To our knowledge, this study is the first to have used J-DERS to evaluate the patient's function at each step of the process of emotional expression that is also affected by the presence or absence of alexithymia as assessed by TAS-20.

There was a significant difference in the J-DERS total score and all subscale scores between the TAS-20 high- and low-scoring groups. This indicates that alexithymia has been considered to be a disruption of STEP 3 of the emotional expression process proposed by Kennedy–Moore & Watson⁶, but since emotional processing is considered to be on a continuum, as shown in Figure 2, disruptions in STEP 3 of the emotional process affects the subsequent STEPs 4 and 5, suggesting that they do not function well and have

been disrupted too. Therefore, alexithymia affects the entire emotional expression process.

On the other hand, a comparison of the TAS-20 and J-DERS subscales showed that although DIF was correlated with all of the J-DERS total and subscale scores, DDF and EOT were not. This suggests that DIF is related to difficulty in emotion regulation ability, and DIF plays an important role in emotion regulation. In addition, J-DERS may not have correlated with DDF, which is related to the expression of emotions, or EOT²¹, which is related to mechanical thinking (*pensée opératoire*), because J-DERS focuses on internal emotional processing until the expression of emotions.

The present study had the following three limitations:

First, this study assessed alexithymia using self-administered tests. The self-report measure (TAS-20) used to evaluate alexithymia is prone to two types of

errors: false positives and false negatives. In the future, the use of two separate alexithymia measures should be considered.

Next, the presence of alexithymia was defined as a TAS-20 score of ≥ 52 , which meant that an intermediate zone was also included in the TAS-20 high-scoring group.

Third, in the present study, the cut-off values for TAS-20 were not derived from a Japanese sample.

As this study revealed, patients with alexithymia had deficits not only in STEP 3, but also in STEPs 4 and 5 of the emotional expression process. Psychotherapies that affect the entire emotional expression process, such as supportive psychotherapy and cognitive-behavioral therapy, are unlikely to work well with alexithymia patients. Future research may help treat alexithymia if psychotherapy appropriate to each step of the emotional expression process improves the functioning of each step.

Conclusions

We used J-DERS to investigate whether disruptions existed in various steps of the process of emotional expression in alexithymia, which is closely connected with psychosomatic disorders and physical disease. The results of our study revealed that disruption occurs, not only in STEP 3, which is essentially what defines alexithymia, but also in STEPs 4 and 5.

Future research may help treat alexithymia by providing psychotherapy that is commensurate with each STEP of the emotional expression process.

List of abbreviations

TAS-20: 20-item version of The Toronto Alexithymia Scale
 DIF: Difficulty Identifying Feelings
 DDF: Difficulty Describing Feelings
 EOT: Externally Oriented Thinking
 J-DERS: The Difficulties in Emotion Regulation Scale of Japanese version
 DSM-5: Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition

Declarations

Ethics approval and consent to participate

This study received the approval of the Clinical Research Preliminary Review Board of the Kindai University Ethics Committee (Approval No. R2-073). Although there were no opportunities to inform the research subjects that did not visit Kindai University Hospital during the period in which the study was conducted, we did inform and obtain the verbal consent of each research subject that visited during the study period when such an opportunity arose. All study procedures were carried out in accordance with the principles in the Declaration of Helsinki and its later amendments.

Consent for publication

Not applicable.

Availability of data and materials

Data sharing not applicable to this article as no datasets were generated or analyzed during the current study.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

TY and AK conceived the study and participated in its design. TY performed the statistical analysis. AK, HM, and RS analyzed the data and helped draft the manuscript. All authors read and approved the final manuscript.

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No conflicts of interest to disclose.

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Additional file

Name of the file: Additional file 1

File format: .xlsx

Title of data: Linear regression analysis using age, sex, years of education, and TAS-20 subscale scores.

Description of data: β : standardized partial regression coefficient

R^2 : coefficient of determination

CI: confidence interval

$p < 0.00833$ was statistically significant using Bonferroni correction for multiple tests

Additional file 1. Linear regression analysis using age, sex, years of education, and TAS-20 subscale scores.

Coefficients	Covariates	Simple Regression Model				Multiple Regression Model					
		β	t	Partial Regression Coefficient (95% CI)	p	β	t	Partial Regression Coefficient (95% CI)	p	R^2	Durbin-Watson Ratio
DERS Total Score	Age	-0.182	-1.884	-0.122 (-0.251 to 0.006)	0.062	-0.068	-0.736	-0.046 (-0.169 to 0.077)	0.463	0.287	1.871
	Sex	0.01	0.103	0.283 (-5.174 to 5.741)	0.918	-0.001	-0.008	-0.020 (-4.935 to 4.894)	0.993		
	Years of education	0.089	0.909	0.479 (-0.566 to 1.523)	0.366	0.023	0.274	0.125 (-0.781 to 1.031)	0.785		
	DIF	0.558	6.853	1.184 (0.841 to 1.527)	0.000	0.511	4.846	1.080 (0.638 to 1.522)	0.000		
	DDF	0.38	4.194	1.408 (0.742 to 2.074)	0.000	0.063	0.583	0.231 (-0.557 to 1.020)	0.561		
	EOT	0.016	0.163	-0.064 (-0.718 to 0.847)	0.871	-0.021	-0.244	-0.082 (-0.751 to 0.586)	0.807		
Lack of Emotional Awareness	Age	-0.248	-2.607	-0.040 (-0.070 to -0.009)	0.010	-0.141	-1.571	-0.023 (-0.051 to 0.006)	0.119	0.326	1.823
	Sex	0.06	0.615	0.402 (-0.896 to 1.700)	0.54	0.028	0.33	0.189 (-0.948 to 1.326)	0.742		
	Years of education	0.052	0.533	0.067 (-0.182 to 0.316)	0.595	-0.016	-0.189	-0.020 (-0.230 to 0.190)	0.85		
	DIF	0.566	6.997	0.286 (0.205 to 0.367)	0.000	0.506	4.929	0.254 (0.152 to 0.357)	0.000		
	DDF	0.399	4.432	0.351 (0.194 to 0.509)	0.000	0.055	0.528	0.049 (-0.134 to 0.231)	0.599		
	EOT	0.135	1.393	0.130 (-0.055 to 0.314)	0.167	0.099	1.211	0.094 (-0.060 to 0.249)	0.299		
Nonacceptance of Emotional Responses	Age	-0.108	-1.105	-0.023 (-0.064 to 0.018)	0.272	0.009	0.09	0.002 (-0.041 to 0.044)	0.929	0.166	1.865
	Sex	0.038	0.385	0.336 (-1.394 to 2.066)	0.701	0.039	0.407	0.348 (-1.348 to 2.043)	0.685		
	Years of education	0.087	0.885	0.149 (-0.185 to 0.482)	0.378	0.04	0.44	0.069 (-0.243 to 0.382)	0.661		
	DIF	0.459	5.262	0.309 (0.192 to 0.425)	0.000	0.451	3.952	0.304 (0.151 to 0.456)	0.000		
	DDF	0.278	2.951	0.326 (0.107 to 0.546)	0.004	0.011	0.092	0.013 (-0.259 to 0.285)	0.927		
	EOT	0.016	0.16	0.020 (-0.228 to 0.268)	0.873	-0.01	-0.113	-0.013 (-0.244 to 0.217)	0.91		
Limited access to Emotion Regulation Strategies	Age	-0.103	-1.054	-0.021 (-0.060 to 0.018)	0.294	-0.038	-0.384	-0.008 (-0.048 to 0.033)	0.702	0.16	1.808
	Sex	-0.049	-0.5	-0.416 (-2.067 to 1.235)	0.618	-0.043	-0.451	-0.366 (-1.976 to 1.245)	0.653		
	Years of education	-0.008	-0.085	-0.014 (-0.330 to 0.303)	0.932	-0.06	-0.645	-0.097 (-0.393 to 0.200)	0.52		
	DIF	0.432	4.889	0.278 (0.165 to 0.391)	0.000	0.391	3.413	0.249 (0.104 to 0.394)	0.001		
	DDF	0.319	3.432	0.358 (0.151 to 0.564)	0.001	0.086	0.732	0.095 (-0.163 to 0.354)	0.466		
	EOT	-0.024	-0.247	-0.030 (-0.266 to 0.270)	0.805	-0.066	-0.72	-0.079 (-0.299 to 0.140)	0.473		
Impulse control difficulties	Age	-0.172	-1.778	-0.034 (-0.072 to 0.004)	0.078	-0.092	-0.989	-0.018 (-0.054 to 0.018)	0.325	0.28	2.157
	Sex	-0.059	-0.606	-0.489 (-2.092 to 1.113)	0.546	-0.074	-0.829	-0.602 (-2.043 to 0.839)	0.409		
	Years of education	0.088	0.893	0.137 (-0.168 to 0.442)	0.374	0.014	0.167	0.022 (-0.243 to 0.288)	0.868		
	DIF	0.532	6.405	0.332 (0.229 to 0.435)	0.000	0.495	4.666	0.305 (0.175 to 0.435)	0.000		
	DDF	0.363	3.968	0.395 (0.197 to 0.592)	0.000	0.06	0.552	0.064 (-0.167 to 0.295)	0.582		
	EOT	-0.068	-0.694	-0.080 (-0.310 to 0.149)	0.489	-0.104	-1.233	-0.122 (-0.318 to 0.074)	0.22		

ANOVA $p < 0.05$