

Chronic Anger-Related Somatic Symptom Disorder in Korea: Development and Validation of the Hwa-Byung Symptom Scale

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This study aimed to develop and validate a theory-informed, psychometrically robust measure to assess Hwa-Byung symptoms, addressing limitations of earlier tools such as the Hwa-Byung Scale (HBS). Items were developed based on prior literature and reviewed by Korean medicine neuropsychiatrists. A total of 300 Hwa-Byung patients and 93 controls completed the Hwa-Byung Symptom Scale (HBSS). Factor analysis, convergent validity testing, regression, and ROC analysis were conducted. The HBSS revealed two factors, namely, psychological and physical symptoms, with Cronbach's α values of .90 and .82, respectively. Scores were significantly correlated with the HBS, Korean Version of the Beck Depression Inventory 2nd Edition, Korean Version of the Beck Anxiety Inventory, Korean Version of the State-Trait Anger Expression Inventory, and Eogul scale. Regression analysis supported its diagnostic validity. The optimal cutoff score was 21 (sensitivity = .970, specificity = .925). The HBSS is a reliable and valid tool for assessing the core symptoms of Hwa-Byung. It may be used cautiously as a screening instrument in both clinical and community settings, pending further validation.

Keywords: Hwa-Byung, Hwa-Byung diagnostic tool, scale development, psychometric validation

Introduction

Psychosomatic disorders are characterized by the manifestation of physical symptoms arising from psychological factors such as stress, anxiety, and depression, and they have been widely documented across populations (Arnon & Levav, 1979; Vesterling et al.,

2023). These disorders are associated with significant impairments in quality of life and substantial healthcare and social burdens, positioning them as a critical concern within the field of public health (Kroenke, 2003; Moock & Kohlmann, 2008). Although psychosomatic conditions occur globally, their manifestations vary across cultural contexts. In the Korean, difficulties in emotion regulation are often expressed through distinctive somatic patterns, most notably exemplified by Hwa-Byung (Park et al., 2002; Min et al., 2009).

Hwa-Byung is a syndrome characterized by unresolved negative emotions, such as anger, manifesting as physical and psychological symptoms. Typical physical symptoms include respiratory stuffiness, epigastric mass, heat sensation, and chest pressure. Psychologically, it is characterized by prominent feelings of unfairness, anger, accompanied by a lingering sense of resentment

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known as “Han (恨)” (National Association of Korean Medicine Neurology and Psychiatry Textbook Compilation Committee, 2012). However, researchers have not reached a consensus on its definition, complicating accurate diagnosis. Some psychiatric studies have suggested Hwa-Byung as a variant of depression with somatic symptoms or has cultural characteristics (Chae, 2002; Lin et al., 1992). These conceptual discrepancies have resulted in Hwa-Byung being classified as a Concept of Cultural Distress rather than an independent diagnostic category within the DSM system. In contrast, Korean medicine neuropsychiatrists argue that Hwa-Byung has distinct characteristics, and that differentiated diagnostic tools are needed.

The differences between psychiatric and Korean medicine diagnostic frameworks are particularly evident in how Hwa-Byung is understood. DSM-based psychiatry often views Hwa-Byung as a depressive disorder accompanied by anger (De Bles et al., 2019; Busch, 2009; Simon & Lively, 2010). Prolonged emotional suppression may manifest in externalized anger, internalized depression, and somatic symptoms such as chest tightness or heat sensations (Committee for the Compilation of Neuropsychiatry Textbook, Colleges of Korean Medicine Nationwide, 2007). Hwa-Byung thus exhibits a multidimensional structure, encompassing emotional, cognitive, and somatic domains (Park et al., 2002). Previous studies have found that while Hwa-Byung shares similarities with depressive disorders, it is distinguished by unique symptoms such as unresolved resentment, intense anger, and pronounced chest tightness (Min et al., 2009). Additionally, a defining feature of Hwa-Byung is the presence of both emotional and distinct physical symptoms, such as chest tightness, sensations of heat, and a pronounced feeling of blockage or pressure in the throat or upper abdomen.

Kwon et al. (2008) developed the “Hwa-Byung Scale (HBS),” the first objective diagnostic assessment tool for Hwa-Byung, consisting of two subscales measuring symptoms and personality traits. However, this tool has several limitations. Firstly, HBS emphasized the distinction between Hwa-Byung and depression for a more accurate differential diagnosis. The items were designed to differentiate Hwa-Byung from depression, selecting items based on their ability to distinguish the two rather than comprehensively measuring Hwa-Byung symptoms. This approach may exclude essen-

tial symptoms of Hwa-Byung that overlap with depression, undermining the primary purpose of diagnosis and failing to provide valid diagnostic information for patients with both conditions.

Second, there is an unclear boundary between the subscales. Kwon et al. (2008) attempted to categorize Hwa-Byung symptoms into emotional and somatic symptoms. However, factor analysis resulted in a unidimensional structure. Previous studies indicate that individuals with Hwa-Byung consistently report experiencing both emotional and somatic symptoms, and the predominant symptoms may vary depending on individual characteristics (Min et al., 2009; Chung et al., 2013). Therefore, a detailed assessment of symptoms is essential for accurate classification, which serves as a foundation for providing effective treatment tailored to each patient.

Lastly, statistics from the Health Insurance Review & Assessment Service (2023) show an increasing prevalence of young adults in their 20s–30s seeking medical care for Hwa-Byung (National Health Insurance Service, 2023). Young Hwa-Byung patients visit the hospital when they experience acute anger and perceive it as associated with Hwa-Byung (Min, 2008). Unlike the well-known pathological mechanism of Hwa-Byung, occurring after prolonged anger suppression, young patients tend to experience immediate anger (Chung et al., 2013). This highlights the importance of considering both traditional and younger patients’ symptoms when diagnosing Hwa-Byung. However, the HBS primarily targets patients in their 50s and does not adequately capture younger patients’ symptoms (Kwon et al., 2008).

In addition to these limitations, the increasing number of younger individuals in Korea seeking clinical care for Hwa-Byung suggests that, despite its lack of recognition as an independent diagnostic category within the DSM, Hwa-Byung should not be overlooked as a clinically meaningful condition (Kwon, 2024). Although recent presentations of Hwa-Byung continue to overlap with features of general psychopathology, including depression, anxiety, and difficulties in anger regulation, treating these symptoms as comorbid manifestations of depressive or anxiety disorders may hinder the adequate identification of the distinct emotional and somatic characteristics of Hwa-Byung (Park et al., 2025). Consequently, there is a risk that the core clinical features of Hwa-Byung may be overlooked in clinical practice, highlighting the need for a diagnostic

scale that can clearly assess and differentiate Hwa-Byung.

Therefore, this study aims to address the limitations of existing diagnostic scales by developing the “Hwa-Byung Symptom Scale (HBSS)”, a comprehensive assessment tool designed to more adequately capture the clinical features of Hwa-Byung. We will integrate a literature review with interviews of Korean medicine neuropsychiatrists to create a tool capturing both shared and distinctive features of Hwa-Byung compared to other psychological disorders. The HBSS is expected to show significant positive correlations with existing Hwa-Byung and depression scales. We aim to determine the factor structure, reliability, and validity of the HBSS and establish a diagnostic cutoff point for accurate diagnosis. In this study, we refer to Kwon’s HBS as the “existing-HBS” to distinguish it from the HBSS.

Methods

Development of the Scale

The Hwa-Byung Comprehensive Test (HCT) was developed to systematically assess the unique characteristics and symptoms of Hwa-Byung (Choi & Kim, 2023). The HCT consists of three components: the HBSS, the Hwa-Byung Event Questionnaire (HBE), and the Hwa-Byung Psychological Trait Scale (HPT). Among these, the HBSS was developed and validated in this study to evaluate current physical and psychological symptoms.

Preliminary items were generated through a literature review, a Delphi study, and qualitative interviews with Hwa-Byung patients, including younger individuals in their 20s and 30s (Lee et al., 2022; Park et al., 2024). The initial 37 items (19 psychological and 18 physical) were reviewed by clinical experts and researchers. Through three rounds of expert and patient evaluation of content validity, items with low validity or redundancy were revised or removed. This process resulted in a final set of 16 preliminary items for the HBSS (Kwon et al., 2008; Kim et al., 2004; Lynn, 1986; Fehring, 1987).

Validation the Scale

Participants

In this study, two types of participant groups were recruited to examine the validity and reliability of the HBSS. Data collection was

conducted from August 1, 2022, to April 17, 2023, with approval from the Institutional Review Board (IRB No. KHNMC0H 2022-02-009-011). Sample 1 was recruited from a medical institution located in Seoul and consisted of individuals diagnosed with Hwa-Byung. This sample was used to analyze the construct validity of the HBSS. The group included patients diagnosed with Hwa-Byung using the Hwa-Byung Diagnostic Interview Schedule (HBDIS) (Kim et al., 2004). Moreover, the Structured Clinical Interview for DSM-5 (SCID-5) assessed the presence of delusions or hallucinations (First et al., 2015). Considering the variability of Hwa-Byung patterns by age, participants were recruited through stratified sampling based on age-specific prevalence rates. The sample comprised 300 Hwa-Byung patients ($M_{age} = 51.21$, $SD = 11.10$; 89% female), including 39 participants under 40 years old (13%), 78 in their 40s (26%), 115 in their 50s (38.3%), 58 in their 60s (19.3%), and 10 in their 70s or above (3.3%).

Sample 2 was a control group recruited to determine whether the HBSS could effectively predict Hwa-Byung and to establish the cutoff score. Participants were recruited through community outreach and poster advertisements, and informed consent was obtained from all participants. Individuals with no diagnoses of any mental disorders, including Hwa-Byung, were screened using the SCID-5 and HBDIS. The control group consisted of 93 participants ($M_{age} = 27.4$, $SD = 10.09$; 74% female), with 84 participants under 40 years old (90.3%), 3 in their 40s (3.2%), 5 in their 50s (5.4%), and 1 in their 70s or above (1.1%).

Measurements

HBDIS

HBDIS is an interview tool for diagnosing Hwa-Byung, consisting of seven sequentially structured items (Kim et al., 2004). It includes four items about symptoms in the diagnostic criteria for Hwa-Byung, two items on related stress and psychosocial functioning, and one item addressing exclusion criteria. Each item is evaluated using a 4-point Likert scale (1 = absence of symptoms; 2 = presence of symptoms that do not meet diagnostic criteria; 3 = presence of symptoms meeting criteria). A final Hwa-Byung diagnosis is made if all criteria are met. The Cronbach’s α for the entire scale is reported as .85.

SCID-5-CV

The SCID-5-CV is a semi-structured interview guide for making DSM-5 diagnoses (First et al., 2015). It is a tool capable of screening mood disorders, psychotic disorders, substance use disorders, anxiety disorders, somatic symptom disorders, eating disorders, and adjustment disorders. This study used only the items related to delusions and hallucinations.

HBS

The existing-HBS is a self-report measure assessing Hwa-Byung symptoms (Kwon et al., 2008). The scale consists of 31 items, including 15 for Hwa-Byung symptoms and 16 for Hwa-Byung personality traits. Respondents rate their agreement using a 5-point Likert scale (0 = Not at all true; 4 = Completely true). The cut-off score for the Hwa-Byung symptoms subscale is 30 points. In the validation process, only the symptoms scale was used, with a Cronbach's α of .91.

HBSS

The HBSS is designed to assess the severity of Hwa-Byung symptoms. The scale consists of psychological symptoms (9 items) and physical symptoms (7 items). Responses are recorded on a 5-point Likert scale (0 = Not at all; 4 = Very much), with higher total scores indicating greater severity of Hwa-Byung symptoms.

Korean Version of the Beck Depression Inventory 2nd Edition (K-BDI-II)

The K-BDI-II consists of 21 items that encompass both major and secondary symptoms of depression. Each item is rated on a 4-point Likert scale (0 = Not at all true; 3 = Very true / Extremely hard to bear), with higher total scores indicating more severe depressive symptoms (Beck et al., 1996). The Cronbach's α for the total items was .92 in this study.

K-BAI

The Beck Anxiety Inventory is a self-report questionnaire assessing the severity of anxiety symptoms (Beck et al., 1988). It consists of 21 items covering cognitive, emotional, and physical areas of anxiety. Symptoms are rated for the past week on a 4-point Likert scale (0 = Not at all; 3 = Severely/It bothered me a lot), with higher

scores indicating more severe symptoms. This study used the K-BAI and the Cronbach's α for the total items was .93.

Korean Version of the State-Trait Anger Expression Inventory (K-STAXI)

K-STAXI was developed in consideration of Korea's cultural and linguistic context (Chon et al., 1997; Chon et al., 2023). The scale consists of state anger (10 items), trait anger (10 items), and anger expression. The anger expression subscale consists of anger expression-out (8 items), anger suppression (8 items), and anger control (8 items). The state anger scale measures the intensity of angry feelings at a specific time, while the trait anger scale measures the tendency to experience anger as a personality trait. Each item was evaluated on a 4-point Likert scale (1 = Not at all true; 4 = Completely true). Higher scores indicate higher levels of anger suppression, expression, and control. The Cronbach's α for each sub-scale was significant in this study (state anger = .95, trait anger = .95, anger expression = .83).

The Eogul Scale

The Eogul Scale measures a feeling of resentment and unfairness when being scolded or punished undeservedly. The scale consists of 15 items across three factors: emotional/physical reaction, unjust beliefs, and avoidant behaviors (Jeon & Kim 2021). The emotional/physical reaction factor includes items reflecting emotional and physical responses to injustice. The unjust belief factor covers cognitive evaluations of unfair situations, and the avoidant behaviors factor includes patterns of inhibition without expressing emotions. Each item is rated on a 5-point scale (0 = Not at all; 4 = Completely true), with higher scores indicating higher levels of Eogul. The Cronbach's α for the total items was .94 in this study.

Statistical Analysis

Descriptive statistics (mean, standard deviation, skewness, kurtosis) were computed for all items. The factor structure of the HBSS was examined using principal axis factoring with oblimin rotation, with the number of factors determined by eigenvalues, scree plots, and interpretability. Internal consistency of each subfactor was evaluated using Cronbach's α . Convergent validity was assessed through Pearson correlation coefficients with the existing-

HBS, K-BDI-II, K-BAI, K-STAXI, and Eogul Scale. Predictive validity was tested using ROC curve analysis to identify the diagnostic cutoff, and logistic regression was performed to examine the distinction between the patient group and non-patient group. All analyses were conducted using SPSS 21.0, Jamovi, and R, with statistical significance set at $p < .05$.

Results

Descriptive Statistics

In this study, item means ranged from 2.47 to 3.35, with standard

deviations between .65 and 1.09 (Table 1). Skewness and kurtosis values did not exceed 3 and 7, respectively, indicating substantial normality. After the inter-item correlation analysis, one physical symptom item and two psychological symptom items were eliminated, resulting in a total of 13 items in the HBSS.

Exploratory Factor Analysis and Reliability

To verify the factorability of the 13 items, the Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity were conducted. The KMO value was .935, and Bartlett's test of sphericity produced a statistically significant result of 2,058.71 ($p < .001$), confirming that

Table 1. Item Analysis and I-CVI of the HBSS

Item	Min.	Max.	<i>M</i>	<i>SD</i>	Skew	Kurtosis	I-CVI
No. 1	0	4	2.65	.99	-.93	.54	.93
No. 2	1	4	3.13	.65	-.50	.78	.96
No. 3	0	4	2.84	.82	-.89	1.39	.87
No. 4	0	4	2.98	.75	-.75	1.04	.90
No. 5	0	4	2.92	.78	-.69	.88	.84
No. 6	0	4	2.47	.91	-.40	-.67	.84
No. 7	1	4	3.33	.74	-.96	.57	.96
No. 8	1	4	3.35	.75	-1.15	1.27	.96
No. 9	0	4	3.26	.77	-1.01	1.17	.84
No. 10	0	4	2.90	.91	-.83	.79	.87
No. 11	0	4	2.90	.81	-.72	.91	.93
No. 12	0	4	2.51	1.09	-.40	-.51	.90
No. 13	0	4	2.80	.89	-.73	.59	.81

I-CVI = Item-level Content Validity Index.

Table 2. Factor Pattern Matrix with Loadings and Communalities of Each Item and Eigenvalues

Items		Factor		Communality
		1	2	
Physical	5. I feel a sensation of full heat in my chest.	-.05	.80	.52
	3. I feel something pushing-up from the abdomen to the chest.	.03	.75	.52
	1. I feel a lump in my throat or pit of my stomach.	-.07	.67	.64
	6. My heart beats fast even at rest.	-.10	.61	.39
	2. I feel chest stuffiness.	.16	.56	.64
	4. I feel heat rising to my face.	.05	.49	.55
Psychological symptoms	9. I get annoyed and irritated easily due to piled-up anger.	.87	-.07	.58
	11. There are times when I feel like I cannot suppress my anger.	.86	-.06	.61
	13. There are times when I cannot cope with my anger.	.78	-.03	.71
	12. There are times when I feel angry enough to want to break things.	.71	.02	.66
	8. I have unresolved, piled-up anger.	.67	.09	.71
	7. I have a feeling of unfairness and resentment.	.64	.11	.60
Eigenvalues		1.16	6.644	.63

Factor1 = Physical symptoms; *Factor2* = Psychological symptoms; *Com* = communality.

the factor analysis was appropriate. Moreover, the factor analysis identified two factors from the 13 items, accounting for 52.97% of the total variance (Table 2). After the factor analysis, Cronbach's α was calculated, showing that the HBSS had a good internal consistency (Cronbach's $\alpha = .92$). Specifically, Cronbach's α was .90 for the psychological symptoms and .82 for the physical symptoms. Overall, Cronbach's α for all items was .91.

Convergent & Discriminant Validity

Significant correlations were observed between the HBSS and other Hwa-Byung-related measures, while the correlation with depressive symptoms (K-BDI-II) was moderate ($r = .42$) (Table 3). The relative strength of these associations supports the convergent and discriminant validity of the HBSS.

Logistic Regression Analysis

The HBSS and existing-HBS were each entered as independent variables in separate binary logistic regression models adjusted for age to compare their predictive utility. When the HBSS was used as a predictor, the model showed a significant improvement in fit ($\chi^2 = 138.628$, $df = 1$, $p < .001$), explaining 60.8% to 90.3% of the

Table 3. Convergent & Discriminant Validity of the HBSS

Measure		HBSS
Symptoms of existing HBS		.69**
K-BDI-II		.42**
K-BAI		.55**
STAXI	State anger	.53**
	Trait anger	.53**
	Anger expression	.36**
Eogul Scale		.61**

HBSS = Hwa-Byung Symptom Scale; K-BDI-II = Korean version of Beck Depression Inventory-II; K-BAI = Korean version of Beck Anxiety Inventory; STAXI = State-Trait Anger Expression Inventory; Eogul Scale = resentment scale.

** $p < .01$.

Table 4. Logistic Regression Analysis of the HBSS Adjusted for Age

Variables	B	SE	Wald	df	p	Exp(B)
HBSS	.225***	.032	48.761	1	< .001	1.252
AGE	.097***	.025	15.507	1	< .001	1.102
Constant	-7.827***	1.210	41.836	1	< .001	.000

B = regression coefficient; SE = Standard Error; Wald = Wald chi-square test; df = degrees of freedom; Exp(B) = odds ratio.

*** $p < .001$.

variance in Hwa-Byung diagnosis (Cox & Snell $R^2 = .608$, Nagelkerke $R^2 = .903$). The HBSS significantly predicted the likelihood of a Hwa-Byung diagnosis ($B = .225$, $SE = .032$, $Wald = 48.761$, $p < .001$), with an odds ratio of 1.252 (Table 4). The classification accuracy was 96.0%.

When the existing-HBS was used as a predictor, the model also showed a significant improvement in fit ($\chi^2 = 105.000$, $df = 1$, $p < .001$), accounting for 57.4% to 85.2% of the variance (Cox & Snell $R^2 = .574$, Nagelkerke $R^2 = .852$). The existing-HBS significantly predicted Hwa-Byung diagnosis ($B = .180$, $SE = .027$, $Wald = 45.832$, $p < .001$), with an odds ratio of 1.198 (Table 5). The classification accuracy for this model was 94.7%.

ROC Analysis

The cutoff point for the Hwa-Byung diagnosis was set at 21 points and yielded both high sensitivity and specificity, with values of .97 and .92, respectively (Figure 1). The area under the curve of the

Table 5. Logistic Regression Analysis of the Symptom Subscale of the Existing-HBS Adjusted for Age

Variables	B	SE	Wald	df	p	Exp(B)
Existing HBS	.180***	.027	45.832	1	< .001	1.198
AGE	.128***	.022	34.709	1	< .001	1.136
Constant	-8.664***	1.183	53.630	1	< .001	.000

B = regression coefficient; SE = Standard Error; Wald = Wald chi-square test; df = degrees of freedom; Exp(B) = odds ratio.

*** $p < .001$.

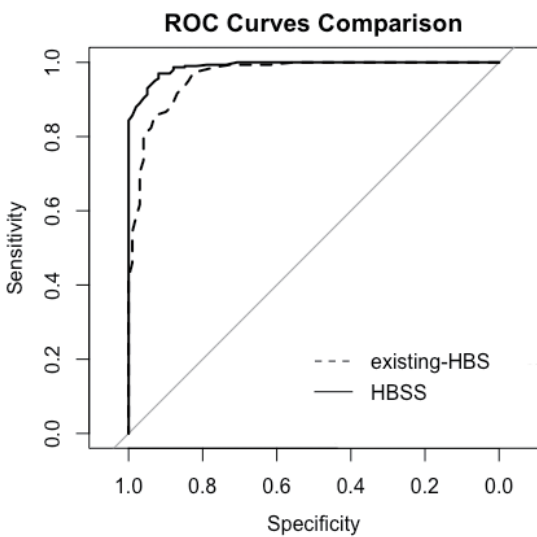


Figure 1. The ROC curve for the diagnostic cutoff point of HBSS and the existing-HBS.

HBSS was .990 at the 21-point cut-off, indicating excellent predictive accuracy. In this study, the AUC of the symptom subscale of the existing-HBS was .959. The closer the AUC value is to 1, the higher the predictive power of the model (Hajian-Tilaki, 2013). When analyzing the sensitivity and specificity of existing-HBS using the 30-point cut-off from previous studies, this study found values of .84 and .90, respectively. Thus, while existing-HBS demonstrates high predictive accuracy, HBSS exhibits superior predictive power overall, particularly with substantially higher sensitivity that increases the probability of detecting patients.

Discussion

This study aimed to develop a reliable and valid scale to assess Hwa-Byung symptoms. As part of the initial validation, an exploratory factor analysis of the HBSS was conducted, revealing two factors—psychological and physical symptoms. This finding addresses a limitation of the existing Hwa-Byung Symptom Scale, which combines emotional and somatic symptoms into a single factor.

The factor structure also aligns with clinical research findings on Hwa-Byung. In previous studies, younger Hwa-Byung patients predominantly exhibited psychological symptoms, particularly anger expression, whereas patients in their 50s and 60s tended to report both psychological and physical symptoms (Min, 2008; Park et al., 2022). These age-related differences in symptom expression highlight the clinical importance of distinguishing between psychological and physical symptom domains, as this distinction may support more targeted, age-specific interventions.

We examined both the convergent and discriminant validity of the HBSS. The HBSS showed significant positive correlations with the existing Hwa-Byung Symptom Scale (Kwon et al., 2008), anxiety symptoms (BAI), the Eogul scale, and the state and trait anger subscales of the STAXI, supporting its convergent validity with core constructs of Hwa-Byung. The correlation with depressive symptoms (K-BDI-II) was moderate ($r = .42$), which is an expected finding given the symptom overlap and high comorbidity between chronic Hwa-Byung and depression (Chung et al., 2013). In contrast, the association with anger expression was comparatively weaker ($r = .36$), suggesting that the HBSS is not readily reducible

to general depressive distress or overt anger expression, thereby supporting acceptable discriminant validity.

Finally, the regression analysis indicated that the HBSS showed comparable predictive power to the existing HBS, with slightly higher classification accuracy. The ROC analysis revealed that HBSS achieved a superior AUC of .990 compared to .959 for existing-HBS, indicating enhanced overall predictive power for Hwa-Byung detection. Additionally, HBSS demonstrated higher sensitivity and specificity at the optimal cutoff, outperforming existing-HBS. These results highlight the clinical utility of HBSS, as its superior sensitivity may support earlier recognition of potential Hwa-Byung cases in screening contexts. However, this study has several limitations. First, the Hwa-Byung and control groups differed in both sample size and age distribution (patients primarily in their 40s–50s, controls mostly in their 20s). This imbalance may have confounded ROC estimates and inflated the apparent discriminative validity of the cutoff point (Hajian-Tilaki, 2013; Janes & Pepe, 2008). Although the study met conventional benchmarks for diagnostic accuracy (Hanley & McNeil, 1982; Hosmer et al., 2013), its generalizability remains limited. Future research should recruit age-matched samples and evaluate the validity of age-specific cutoff points.

Second, the responsiveness of the symptom scale was not examined. It remains unclear whether HBSS scores adequately capture clinical improvement or deterioration in patients with Hwa-Byung. Longitudinal studies are therefore needed to investigate score changes in relation to clinical courses.

Overall, the HBSS demonstrates a clear two-factor structure distinguishing psychological and physical symptoms of Hwa-Byung, shows adequate convergent and discriminant validity, and provides screening performance comparable to or slightly exceeding that of the existing HBS, supporting its potential utility as a clinically informative symptom assessment tool.

Author contributions statement

Conceptualization: JSK, SAP, SYK; Methodology: JSK, SAP; Software: JSK; Validation: JSK, SAP; Formal analysis: JSK; Investigation: JSK, SAP, JWK, SYC, SIY, HYP; Resources: JSK, SAP; Data curation: JSK; Writing—Original Draft: JSK; Writing—Review &

Editing: SWC, HYS, SYP, SAP, SYK; Visualization: JSK; Supervision: SWC; Project administration: SWC; Funding acquisition: SWC.

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