Current Psychology (2026) 45:579
https://doi.org/10.1007/s12144-025-08738-3

Dynamic relationships between emotional distress, self-esteem, loneliness, and hope in adolescents: A psychometric and network analysis

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Received: 22 October 2024 / Accepted: 8 October 2025
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Abstract

Emotional distress during adolescence can significantly affect well-being and future psychological development, making its study an urgent matter. The present study aimed to examine the dynamic relationships between emotional distress symptoms—depression, anxiety, and stress—and key psychological constructs including self-esteem, loneliness, and hope among Chinese senior high school students (n = 1862; Mean age = 16.22, SD = 0.56; 49.8% female). Using the Depression Anxiety Stress Scale for Youth (DASS-Y) to assess emotional distress, a comprehensive methodological approach was employed combining Rasch analysis, Structural Equation Modelling, Exploratory Structural Equation Modelling, and Network Analysis (NwA) to investigate how these psychological constructs interact. After confirming the factor structure of the DASS-Y, the convergent validity of distress, as well as of the depression, anxiety, and stress dimensions, was confirmed in relation to self-esteem, loneliness, and hope. NwA showed novel insights into the complex interactions among these constructs, particularly highlighting a significantly positive relationship between loneliness and stress, and identifying the central role of anxiety-related items *"I felt scared for no good reason"* and *"I felt terrified"*. These findings provide a deeper understanding of how emotional distress interacts with other psychological constructs among adolescents. This understanding suggests potential intervention strategies focusing on reducing fear and loneliness to alleviate anxiety and stress.

Keywords Senior high school students · Rasch analysis · CFA/SEM/ESEM · Network analysis · Convergent validity · Centrality symptoms

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Published online: 24 February 2026

Introduction

It is estimated that more than 13% (166 million worldwide) of adolescents aged 10 to 19 live with a mental health disorder, with anxiety and depression being the most prevalent at around 40% (Keeley, 2021). Consequently, it is estimated that 49% of child and adolescent mental health expenditure is allocated to treating these conditions (McDaid & Evans-Lacko, 2021). Evidence also indicates that investing in school interventions can be effective and cost-efficient (Courtney et al., 2024), particularly in low- and middle-income countries (Keeley, 2021).

In addition to early detection, it is essential to understand the psychological factors closely associated with emotional distress during adolescence, as these can play a key role in designing more effective interventions. Constructs such as self-esteem, loneliness, and hope have shown consistent associations with anxiety, depression, and stress (Haney & Durlak, 1998; Lasgaard et al., 2011; Snyder et al., 2002; Wang et al., 2023), and their analysis can offer valuable insights not only for treatment, but also for prevention and the promotion of mental well-being within school settings.

A step prior to prevention and treatment is detection. To this end, Szabo and Lovibond (2022) developed the Depression Anxiety Stress Scale for Youth (DASS-Y), specifically designed for younger children and adolescents. The DASS-Y retains the same structure as the original DASS (Lovibond & Lovibond, 1995) but includes modified items that are more easily understood by younger individuals (Cao et al., 2023).

Currently, the DASS-Y has undergone psychometric testing among children and adolescents in Australia (Szabo & Lovibond, 2022), Arabia (Obeid et al., 2024), and China (Cao et al., 2023). The initial studies have confirmed the factorial validity, reliability, and effectiveness of the DASS-Y in assessing depression, anxiety, and stress among children and adolescents. Also, it has been applied to samples of young Australians (Mackenzie et al., 2023), Afghans (Neyazi et al., 2024), and Mexicans (Rayas et al., 2023). However validation data from these studies have not been reported. Therefore, given the limited number and scope of existing studies, further exploration of the psychometric properties of the DASS-Y is warranted (Szabo & Lovibond, 2022; Cao et al., 2023).

A preliminary psychometric evaluation of the DASS-Y was conducted by Cao et al. (2023) among a sample of Chinese children and adolescents. However, the researchers acknowledged several limitations in their study that justify further validation in the Chinese context. Firstly, the sample included both primary and secondary school students, and the Rasch analysis showed validity issues in the items, with disordered categories being particularly frequent in the responses of primary school students. This suggests that the scale may function differently across age groups. Therefore, the present study focuses exclusively on secondary school adolescents, eliminating this source of variability and allowing for a more precise evaluation of the DASS-Y within this group. Secondly, their study assessed criterion validity only through its relationship with emotional exhaustion. To address this limitation, the present study expanded this analysis by examining the convergence of the DASS-Y with key constructs related to adolescent well-being, such as self-esteem, loneliness, and hope. Finally, as noted by Cao et al. (2023), the DASS-Y is a newly developed scale, and their study did not conclusively rule out the possible existence of alternative factorial structures inherent to the scale. In response to this limitation, the present study complements factorial analysis and Rasch analysis with more advanced approaches, such as Exploratory Structural Equation Modelling (ESEM) and Network Analysis (NwA), to provide a more detailed understanding of the scale's structure and item interactions.

In this context, following the recommendations of Nunnally and Bernstein (1994), it is imperative to expand the research using diverse methodological approaches to thoroughly explore additional psychometric properties of the DASS-Y. Recent research has employed Rasch analysis for item analysis (Cao et al., 2023), Confirmatory Factor Analysis (CFA) (Szabo & Lovibond, 2022; Obeid et al., 2024; Cao et al., 2023) and Structural Equation Modeling (SEM) (Cao et al., 2023) to analyze the factorial validity. CFA and SEM are recommended methodologies for confirming and validating pre-existing theories on the factorial structure and relationships among complex psychological constructs (Kline, 2016). These can be enhanced by applying ESEM and NwA (Asparouhov & Muthén, 2009; Epskamp et al., 2018). ESEM combines the flexibility of Exploratory Factor Analysis (EFA) with the confirmatory capacity of CFA, which is crucial for exploring new latent dimensions and gaining a deeper understanding of the interactions among items (Asparouhov & Muthén, 2009). Additionally, NwA provides a unique perspective by examining how individual items interact within the scale (Hevey, 2018). The variables are depicted as nodes in a graph, with connections or relationships between them represented as edges. These nodes and edges are organized into structured and interconnected subnetworks, resembling clusters akin to latent variables (Epskamp et al., 2017), illustrating the extent to which they represent a dimension and thereby demonstrating whether the components effectively assess a construct (Christensen et al., 2020). This approach not only facilitates the identification of core items within the network but also illuminates the dynamic nature of emotional disorders (Epskamp et al., 2018).

Another critical area of investigation concerns the convergent validity of the DASS-Y. Previous studies have established initial evidence for the scale's convergent validity with several constructs, including emotional exhaustion (Cao et al., 2023), positive affect, life satisfaction, and worry (Szabo & Lovibond, 2022), as well as suicidal ideation and academic performance (Obeid et al., 2024). While these findings support the scale's validity, expanding convergent validity testing to a broader range of theoretically related mental health constructs would provide more comprehensive evidence of the DASS-Y's psychometric properties (Dunn et al., 2014).

A review of the literature highlights that successful interventions for anxiety and depression among adolescents often focus on enhancing self-esteem (Haney & Durlak, 1998), reducing loneliness (Lasgaard et al., 2011) and fostering hope (Snyder et al., 2002; Wang et al., 2023). Therefore, these constructs have been identified as crucial variables that could offer valuable insights into the DASS-Y's convergent validity.

Self-esteem, which refers to an individual's perceptions of their own worth and significance (Rosenberg, 1965), has consistently been associated with mental health in previous research. The importance of self-esteem in adolescent mental health is well established within Coopersmith's (1967) self-esteem theory, which highlights how self-worth develops through personal experiences, feedback from significant others, and social comparisons. According to this theory, low self-esteem is associated with greater emotional vulnerability, making it a crucial factor in understanding anxiety and depression. Several studies have concluded that interventions aimed at improving self-esteem enhance overall mental health and lead to significant reductions in anxiety and depression levels among youths (Liu et al., 2022).

Loneliness, defined as the subjective experience of inadequate social relationships (Peplau et al. 1979), is another critical factor to consider when evaluating the convergent validity of the DASS-Y. Loneliness is an emotional state that can arise from insecurities and a lack of meaningful relationships, both of which are closely associated with anxiety and depression (Weiss, 1975). Attachment theory suggests that difficulties in forming secure bonds can lead to loneliness, and these difficulties are also associated with high levels of stress and anxiety (Bowlby, 1969). It has been observed that strategies aimed at reducing loneliness by fostering social relationships and emotional support have been effective in alleviating symptoms of anxiety and depression among adolescents (Loades et al., 2020).

In addition to self-esteem and loneliness, hope is a positive cognitive construct that encompasses both the ability to identify feasible pathways to achieve goals and the motivation to pursue them (Snyder et al., 1991). Snyder et al.'s (1991) hope theory provides a conceptual framework for understanding hope as a cognitive-motivational construct that involves goal-setting, agency, and pathways thinking. This theory suggests that individuals with higher levels of hope are better equipped to cope with stressors, thereby reducing their susceptibility to anxiety and depression. Empirical research supports this, showing that fostering hope enhances resilience and psychological well-being among adolescents (Marques et al., 2022). In this context, several studies have found that programs designed to foster hope among high school students can have a significant positive impact on their mental health, helping them develop a more optimistic outlook, more effective coping strategies (Pleeging et al., 2021), and a significant positive impact on reducing anxiety and depression (Marques et al., 2022).

The division of the indicators measured by the DASS-Y into the three dimensions of self-esteem (self-perceived worth), loneliness (social connectedness), and hope (future-oriented motivation and resilience) is based on well-established psychological frameworks that explain their relationship with distress symptoms. Self-esteem reflects how an individual values and perceives themselves, a factor that has been shown to be closely associated with vulnerability to anxiety and depression (Coopersmith, 1967). A low sense of personal worth can increase susceptibility to these emotional symptoms. On the other hand, loneliness represents the quality and perception of social relationships, being a psychosocial risk factor for emotional disorders. The feeling of social disconnection has been consistently associated with higher levels of anxiety and depression (Cacioppo & Hawkley, 2009). Finally, hope, understood as the capacity to maintain motivation towards future goals and the ability to plan strategies to achieve them, acts as a protective resource that fosters resilience against emotional stress (Snyder et al. 2002). This dimension helps mitigate the effects of anxiety and depression by promoting adaptive coping mechanisms.Therefore, these three dimensions constitute a coherent and comprehensive theoretical framework that facilitates the interpretation of the convergent validity of the DASS-Y, by capturing distinct aspects relevant to understanding the complexity of anxiety and depressive symptoms among adolescents.

Building on these theoretical foundations, the present study aimed to explore the complex and dynamic relationships among emotional distress, self-esteem, loneliness, and hope among adolescents. These variables represent key psychological dimensions related to emotional functioning. Self-esteem reflects self-perceived worth, loneliness reflects the quality of social connectedness, and hope reflects future-oriented motivation and resilience. Given their strong empirical associations with anxiety, depression,

and stress, examining their interplay can offer a deeper and more nuanced understanding of adolescent mental health.

To this end, the primary objective was to analyse the dynamic interconnections between emotional distress and these related constructs through convergent validity testing and NwA. To achieve this objective, the study first assessed the construct and structural validity of the DASS-Y among a sample of Chinese high school students using Rasch analysis, CFA, SEM, ESEM, and NwA. This methodological combination enableds both the validation of the scale and a broader investigation into how emotional distress functions within a psychological network.

By integrating advanced psychometric techniques with a theoretically grounded exploration of key constructs, the present study contributes to a more comprehensive and clinically useful understanding of adolescent emotional well-being, informing both assessment and intervention strategies.

Method

Participants

The sample comprised 1862 high school Chinese students, aged 16 to 18 years (M_{age} = 16.22 years; SD = 0.56). Of these, 49.8% were female and 50.2% were male. The gender distribution in the sample closely aligns with the national population demographics of mainland China (50.45% male and 49.55% female) as reported by the National Bureau of Statistics of China (2025).

The sample size met the recommendations of Nunnally and Bernstein (1994), who suggest that a suitable sample size for CFA should be at least 10 times, and no less than five times, the number of participants per variable, with a minimum of 300 participants to ensure stability and reliability of the results. Given that the present study included a sample of 1,862 participants, this exceeds the recommended threshold, reinforcing the robustness of the findings. Additionally, the recommendations of Epskamp (2016) were followed, who suggests that for continuous data, a minimum sample size of 250 participants is appropriate for networks of up to 25 nodes. Therefore, the sample size used in the present study is considered methodologically sound.

Procedure

Data were collected from August to September 2023 at high schools in the northern provinces of Mainland China using convenience sampling. The inclusion criteria were: (i) being a high school student; (ii) understanding written Chinese; and (iii) having parental consent for participation in the study, with the corresponding informed consent signed before completing the survey.

With the assistance of ten high school principals, meetings were held to inform parents and students about the purpose of the survey. The meetings emphasized voluntary participation, the right to withdraw from the study at any time, and data privacy. After obtaining parental consent, teachers scheduled dedicated sessions in the school computer laboratories for data collection over a one-month period. Multiple computer labs were utilized simultaneously across participating schools to accommodate the large sample size. Students with parental permission were guided to the computer labs in groups of 25–30, where they completed the online survey under the supervision of their teachers. Each session lasted approximately 10–20 min, allowing students sufficient time to respond thoughtfully. The online survey platform required responses to all questions before submission, ensuring no missing data. Teachers were available throughout the sessions to address any technical issues or clarify questions about the survey process, while maintaining appropriate distance to ensure privacy during response submission. Ethical approval was obtained from the Institutional Review Board (IRB) of the Jiangxi Psychological Consultant Association (IRB reference: JXSXL-2022-CL15).

Instruments

Depression Anxiety Stress Scale for Youth (DASS-Y)

The Chinese version of the DASS-Y, developed by Cao et al. (2023), was used. This scale assesses depression, anxiety, and stress, comprising 21 items (seven items for each category) rated on a four-point scale (0 to 3), assessing the presence of symptoms over the previous week. Scores for each subscale range from 0 to 21, with higher scores indicating more severe distress. The cut-off scores are 6 for depression, 5 for anxiety, and 11 for stress. A total score above 23 indicates significant mental health distress. In the present study, the scale and its subscales demonstrated excellent internal consistency (McDonald's ω = 0.89–0.92).

Rosenberg Self-Esteem Scale (RSES)

The RSES; (Rosenberg, 1965) was administered using its Chinese adaptation (Wang et al. 2010). The scale comprises 10 items, equally divided between positively and negatively worded statements, rated on a four-point Likert scale (1 = strongly disagree, 4 = strongly agree). Of note, Item 8, originally designed as negative in Rosenberg's scale, functions as a positive item in the Chinese context due to cultural interpretations (Jiang et al., 2023; Wu et al., 2017).

After reverse-scoring the four negative items, the scale demonstrated satisfactory internal consistency (McDonald's ω = 0.86).

Three-item Version of the UCLA Loneliness Scale Version 3 (UCLA-3–3 Items)

The present study employed the three-item version of the UCLA Loneliness Scale Version 3, developed by Hughes et al. (2004) based on Russell's (1996) original scale. This abbreviated version consists of three questions: *"How often do you feel that you lack companionship?"* (Item 2), *"How often do you feel left out?"* (Item 11), and *"How often do you feel isolated from others?"* (Item 14), each rated on a four-point Likert scale from 1 (*never*) to 4 (*always*). The psychometric properties of this abbreviated version have been well-established through multiple validation studies. Liu et al. (2020) validated its Chinese version, demonstrating satisfactory internal consistency, significant correlations with depressive symptoms, and excellent model fit indices in CFA. Their study also showed that the Chinese adaptation proved effective as a culturally sensitive screening instrument for mild depressive symptoms among older Chinese adults. Additional validation by Lin et al. (2022) with participants diagnosed with schizophrenia and schizoaffective disorder confirmed acceptable to satisfactory concurrent validity, internal consistency, and test–retest reliability for both the three-item and alternative versions (original and eight-item). In the present study, this abbreviated version demonstrated good internal reliability (ω = 0.80).

Dispositional Hope Scale (DHS)

The Chinese version of the DHS (DHS-C), developed by Sun et al. (2012), was applied. The scale comprises two subscales: agency and pathways, each containing four items. The DHS-C is scored on a four-point Likert scale from 1 (*definitely false*) to 4 (*definitely true*), with higher total scores indicating higher levels of hope. The subscales demonstrated very good internal consistency in the present study (McDonald's ω = 0.85 [agency] and 0.86 [pathways]).

Data analysis

In the present study, a multi-step analytical approach was employed to validate the DASS-Y instrument comprehensively. This included descriptive statistics and correlation analyses, Rasch analyses to evaluate psychometric properties (e.g., unidimensionality, person reliability, and item fit) as part of construct validity, CFA and ESEM with related models to assess factorial structure within construct validity, SEM for convergent validity, and NwA for non-linear associations. Data were analyzed using SPSS version 27.0 for descriptive statistics and correlations, jamovi version 2.3.28 for Rasch analysis, CFA, ESEM, and SEM, and JASP version 0.19.3 for NwA.

Prior to the primary analyses, a comprehensive measurement model incorporating all study variables (depression, anxiety, stress, self-esteem, loneliness, hope-pathway, and hope-agency) was tested to evaluate factorial validity. The average variance extracted (AVE) was computed for each construct, and discriminant validity was assessed using Henseler's heterotrait-monotrait ratio of correlations (HTMT). Following these evaluations, descriptive statistics and correlation analyses were conducted for the DASS-Y items and all scales and subscales.

Rasch analyses, guided by Tennant and Conaghan (2007), were then performed to assess the psychometric properties of the measures. This involved evaluating unidimensionality through eigenvalue criteria (>4.00), assessing category ordering via person-item mapping, and examining item validity using INFIT and OUTFIT fit statistics, with valid responses defined within the range of 0.50 to 1.50 (Jafari et al., 2012). Person separation reliability was checked against a criterion of 0.50 (Boone et al., 2013).

To examine construct validity, CFAs were implemented using the Robust Maximum Likelihood (MLR) estimation method. The decision to use the MLR estimator was based on several methodological considerations. Firstly, this approach is consistent with that adopted by Szabo and Lovibond (2022), Shabani et al. (2025), and Obeid et al. (2024) in their psychometric studies of the DASS-Y. Secondly, previous research has demonstrated that when ordinal variables have four or more response categories, treating them as approximately continuous does not introduce significant estimation bias and yields results comparable to those obtained with estimators designed for categorical data (Rhemtulla et al., 2012; Zumbo & Zimmerman, 1993). This evidence is particularly relevant when using complex models, such as ESEM with cross-loadings and bifactor structures, which may face convergence difficulties or instability under WLSMV and similar estimators (Morin et al., 2020).

Common models from DASS research were tested, including the oblique three-factor model and the bifactor model (Szabo & Lovibond, 2022; Zhou et al., 2024). ESEM with Geomin rotation and bifactor ESEM with orthogonal rotations were subsequently applied to explore models that better capture the multidimensional nature of depression, anxiety, and stress. Model fit was determined using the Comparative Fit Index (CFI) and Non-Normed Fit Index (NNFI) with values ≥ 0.90 considered acceptable, alongside Root Mean Square Error of Approximation (RMSEA) and Standardised Root Mean Square Residual (SRMR) values < 0.10 (Kline, 2016). The explained common variance (ECV) and

omega hierarchical (ωH) were calculated to assess the dominance of the general factor (Reise et al., 2012).

SEM was used to evaluate convergent validity by examining correlations between DASS-Y subscales and related constructs such as self-esteem (RSES), loneliness (three-item UCLA Loneliness Scale), and hope (DHS-C), with gender as a control. This allowed assessment of the independent effects of depression, anxiety, and stress on these outcomes while controlling for intercorrelations among the disorders. To mitigate wording effects in the RSES (DiStefano & Motl, 2006), correlated measurement errors were incorporated for reverse-scored items, an approach shown to improve model fit.

Finally, NwA was conducted, incorporating gender as a factor, to identify non-linear and emergent patterns among the psychological variables, following Epskamp et al. (2018). A Mixed Graphical Model (MGM) with extended Bayesian information criterion (EBIC) regularization was applied to a polychoric correlation matrix, appropriate for ordinal Likert-type items (Haslbeck & Waldorp, 2020). In the first NwA, DASS-Y items were represented as nodes connected by edges forming clusters akin to latent variables, indicating dimensional structure (Epskamp et al., 2017; Christensen et al., 2020). Node relevance was quantified via centrality indices: betweenness, closeness, strength, and expected influence (Epskamp et al., 2018). A second analysis explored relationships between DASS-Y items and self-esteem, loneliness, and hope to assess discriminant and convergent validity, focusing on edge weights and signs. Node stability was verified using a subset bootstrap procedure with 1000 iterations (Epskamp et al., 2018; Hevey, 2018).

Results

Preliminary analyses

The measurement model showed acceptable fit: χ^2 (792) = 1826.21, CFI = 0.937, NNFI = 0.931, RMSEA = 0.046, SRMR = 0.092. Most items had strong factor loadings (> 0.70), except for negatively worded RSES items, which had lower loadings despite accounting for correlated measurement errors (see Supplementary Table S1 & S2). AVE values were 0.52 (depression), 0.54 (anxiety), 0.61 (stress), 0.43 (self-esteem), 0.58 (loneliness), 0.61 (hope-pathway), and 0.57 (hope-agency). Cronbach's alpha indicated good internal consistency: 0.88 (depression), 0.89 (anxiety), 0.91 (stress), 0.84 (self-esteem), 0.80 (loneliness), 0.86 (hope-pathway), and 0.84 (hope-agency). HTMT analysis (Table 1) confirmed discriminant validity for most constructs (HTMT < 0.85), except for a high correlation between hope-pathway and hope-agency (0.989), leading to the use of a composite hope construct in later analyses.

Descriptive statistics and correlation analysis

Descriptive statistics for DASS-Y items (Table S3, Supplementary Materials) showed mean scores ranging from 0.12 to 0.51, with skewness (1.067 to 3.068) and kurtosis (−0.204 to 11.281) indicating non-normal data. Spearman's Rho was used due to this non-normality, showing significant positive correlations among items (*rho* = 0.31 to 0.68). Table S4 (Supplementary Materials) summarizes correlations between DASS-Y (distress, depression, anxiety, stress) and related constructs (self-esteem, loneliness, hope). Psychological distress correlated negatively with self-esteem (*rho* = −0.37) and hope (*rho* = −0.30), and positively with loneliness (*rho* = 0.59).

Rasch analysis

To test the unidimensionality assumption necessary for Rasch analysis, eigenvalue ratios were calculated for the three subscales. Values higher than 4.00 indicate unidimensionality, and the results were 5.67, 5.09, and 8.69 for depression, anxiety, and stress subscales, respectively, confirming this assumption.

Item difficulties were identified as follows: the most difficult items were Item 3 (0.59 logits) in the depression subscale, Item 7 (0.39 logits) in the anxiety subscale, and

Table 1 Heterotrait-monotrait ratio of correlations (HTMT) between depression, anxiety, stress, self-esteem, loneliness, hope-pathway, and hope-agency

	Depression	Anxiety	Stress	Self-esteem	Loneliness	Hope-Pathway	Hope-Agency
Depression	1.00						
Anxiety	0.84	1.00					
Stress	0.80	0.83	1.00				
Self-esteem	0.52	0.46	0.45	1.00			
Loneliness	0.56	0.53	0.65	0.53	1.00		
Hope-Pathway	0.25	0.20	0.23	0.77	0.33	1.00	
Hope-Agency	0.25	0.21	0.24	0.77	0.34	0.99	1.00

The HTMT analysis demonstrated satisfactory discriminant validity for most constructs (HTMT < 0.85), except for the notably high correlation between hope-pathway and hope-agency (0.989), suggesting these two components might not be clearly distinct

Item 12 (0.35 logits) in the stress subscale; the easiest items were Item 5 (−0.82 logits) in the depression subscale, Item 15 (−0.70 logits) in the anxiety subscale, and Item 1 (−0.40 logits) in the stress subscale (see Table 2). Monotonicity was assessed using the person-item map (Figure S1, Supplementary Materials), which showed non-monotonic behavior in several items: depression (Items 3, 10, 16, 17, 21), anxiety (Items 7, 9, 15), and stress (Item 6). Category collapsing (merging Categories 2 and 3) resolved this issue, and the revised person-item map (Figure S2, Supplementary Materials) confirmed monotonicity across all items in the three subscales. All INFIT and OUTFIT values were within the acceptable range (0.5 to 1.5), supporting the retention of all items (see Table 2). Person separation reliability were 0.65, 0.60, and 0.77 for the depression, anxiety, and stress subscales, respectively, reflecting the DASS-Y's ability to distinguish varying degrees of psychological distress.

Table 2 Fit statistics of Rasch analysis for the DASS-Y Items in Senior high school students (n = 1862)

	Difficulty	Point biserial	Infit MnSq	Outfit MnSq
Subscale of Depression				
Item 3: Felt joyless	0.59	0.73	0.96	0.94
Item 5: Despised life	−0.82	0.76	1.33	1.44
Item 10: Lacked anticipation	−0.18	0.69	1.17	1.30
Item 13: Persistently sad	0.37	0.78	0.90	0.93
Item 16: Self-loathing	−0.02	0.76	0.90	0.81
Item 17: Felt worthless	0.26	0.77	0.83	0.80
Item 21: Life seemed bleak	−0.20	0.81	0.84	0.77
Subscale of Anxiety				
Item 2: Dryness of my mouth	0.17	0.74	1.00	1.02
Item 4: Experienced breathing difficulty	0.30	0.71	0.94	0.99
Item 7: Experienced trembling	0.39	0.69	1.05	1.10
Item 9: Felt terrified, worried about situations of panic and making a fool of myself	−0.25	0.78	0.93	0.87
Item 15: Feeling of close to panic	−0.70	0.78	1.04	1.01
Item 19: Aware of the action of my heart	−0.02	0.77	1.08	1.11
Item 20: Felt scared without any good reason	0.10	0.79	0.93	0.90
Subscale of Stress				
Item 1: Hard to wind down	−0.40	0.82	0.97	0.94
Item 6: Tended to over-react	0.05	0.79	0.84	0.75
Item 8: Using a lot of nervous energy	−0.17	0.81	1.00	0.95
Item 11: Getting agitated	−0.20	0.81	0.99	0.94
Item 12: Difficult to relax	0.35	0.76	1.07	1.04
Item 14: Intolerant of anything	0.30	0.74	1.27	1.32
Item 18: Felt rather touchy	0.06	0.85	0.72	0.68

Factorial validity assessment of the DASS-Y

Factorial validity was assessed using a range of models, including one-factor, two-factor, oblique three-factor, bifactor, ESEM, and bifactor ESEM (Table 3). Models with revised items (post-Rasch category collapsing) had lower AIC ($\Delta AIC > 10$), supporting Rasch adjustments. One- and two-factor models had poor fit (CFI, NNFI < 0.90), while oblique three-factor, bifactor, ESEM, and bifactor ESEM models showed acceptable fit. ESEM outperformed the oblique three-factor model ($\Delta\chi^2 = 245.55$, $p < 0.001$, $\Delta CFI > 0.015$, $\Delta RMSEA > 0.01$). It is important to note that the high interrelationship between the three types of psychological distress was reduced from the oblique three-factor structure to ESEM, addressing the issue of excessively high correlations (refer to Table 3). The bifactor ESEM model had a lower χ^2 ($\Delta\chi^2 = 109.48$, $p < 0.001$) but similar fit indices.

To further investigate the bifactor and bifactor ESEM models, ECV and ωH were calculated based on the factor loadings (Table S1 in Supplementary Materials). ECV represents the proportion of common variance explained by the general factor, with higher values indicating a stronger general factor. ωH estimates the reliability of the general factor, accounting for the variance attributed to it. The ECV for the general factor was 0.78 in the bifactor model and 0.79 in the bifactor ESEM model, while ωH was 0.90 and 0.88, respectively. These high values supported the presence of a substantial general factor underlying the constructs. For the specific factors, ωH values in the bifactor model were 0.21 for depression, 0.06 for anxiety, and 0.24 for stress. In the bifactor ESEM model, these values were 0.32 for depression, 0.31 for anxiety, and 0.02 for stress, indicating that the bifactor ESEM model better captured the variance unique to the specific factors compared to the bifactor model. Based on the superior fit indices, reduced intercorrelations, and better capture of specific factors, the ESEM and bifactor ESEM models were selected for further examination of convergent validity using SEM.

Convergent validity applying SEM

SEM was conducted to examine the associations between DASS-Y dimensions (depression, anxiety, and stress) and theoretically related constructs (self-esteem, hope, and loneliness), with sex included as a control variable (Table 4). The models demonstrated satisfactory fit across all indices, although the SRMR values (0.10) in both ESEM and

Table 3 Model fit across various factor structures

	χ^2 (*df*)	CFI	NNFI	RMSEA (90% Confidence Interval)	SRMR	AIC	Latent factor correlations		
							D-A	D-S	A-S
One-factor	1711.18 (189)	0.866	0.851	0.066 (0.064–0.068)	0.052	41,783.20			
	1785.71(189)	0.870	0.856	0.067 (0.065–0.069)	0.051	35,929.69			
Two-factor	1280.30 (188)	0.904	0.892	0.056 (0.054–0.058)	0.045	40,847.62			
	1338.66 (188)	0.906	0.895	0.057 (0.055–0.059)	0.045	35,077.26			
Three-factor	781.62 (186)	0.947	0.941	0.041 (0.039–0.044)	0.033	39,789.66	0.85	0.80	0.83
	866.62 (186)	0.945	0.938	0.044 (0.042–0.047)	0.034	34,184.00	0.85	0.80	0.83
Bifactor	409.71 (168)	0.979	0.973	0.028 (0.025–0.030)	0.025	39,016.28			
	448.53 (168)	0.977	0.971	0.030 (0.027–0.032)	0.025	33,424.77			
ESEM	629.55 (150)	0.958	0.941	0.041 (0.039–0.044)	0.024	39,462.50	0.54	0.52	0.53
	621.07 (150)	0.962	0.946	0.041 (0.039–0.044)	0.023	33,766.23	0.51	0.52	0.53
Bifactor ESEM	322.04 (132)	0.983	0.973	0.028 (0.025–0.031)	0.016	38,898.87			
	339.05 (132)	0.983	0.973	0.029 (0.026–0.032)	0.016	33,292.11			

D-A = The relationship between depression and anxiety; D-S = The relationship between depression and stress; A-S = The relationship between anxiety and stress. CFI, comparative fit index; NNFI, non-normed fit index; RMSEA, root mean square error of approximation; SRMR, standardized root mean square residual; AIC, Akaike Information Criterion

Table 4 Analyzing the interrelations of self-esteem, loneliness, and hope through structural equation modeling

DV	Bifactor-ESEM								
	Self-esteem			Loneliness			Hope		
Model fit	χ^2 (*df*) = 1182.49 (428), CFI = 0.95, NNFI = 0.94, RMSEA = 0.05, SRMR = 0.10			χ^2 (*df*) = 446.77 (238), CFI = 0.98, NNFI = 0.97, RMSEA = 0.04, SRMR = 0.02			χ^2 (*df*) = 904.63 (373), CFI = 0.97, NNFI = 0.97, RMSEA = 0.03, SRMR = 0.03		
	Estimate (se)	β	*t*	Estimate (se)	β	*t*	Estimate (se)	β	*t*
Sex (Male)	0.00 (0.02)	0.00	0.15	0.04 (0.02)	0.03	1.77	−0.05 (0.02)	−0.04	−1.89
General factor	−0.08 (0.03)	−0.08	−3.13	0.17 (0.04)	0.13	3.73	−0.13 (0.06)	−0.13	−2.17
Depression	−0.14 (0.03)	−0.14	−4.97	0.11 (0.04)	0.09	2.86	−0.11 (0.03)	−0.11	−3.08
Anxiety	−0.21 (0.03)	−0.20	−8.17	0.05 (0.05)	0.03	0.95	−0.04 (0.04)	−0.04	−0.84
Stress	−0.02 (0.03)	−0.02	−0.77	0.84 (0.05)	0.63	17.03	−0.22 (0.10)	−0.21	−2.25
DV	ESEM								
	Self-esteem			Loneliness			Hope		
Model fit	χ^2 (*df*) = 1350.22 (440), CFI = 0.94, NNFI = 0.92, RMSEA = 0.05, SRMR = 0.10			χ^2 (*df*) = 636.86 (250), CFI = 0.96, NNFI = 0.95, RMSEA = 0.03, SRMR = 0.02			χ^2 (*df*) = 1235.09 (385), CFI = 0.96, NNFI = 0.95, RMSEA = 0.03, SRMR = 0.03		
	Estimate (se)	β	*t*	Estimate (se)	β	*t*	Estimate (se)	B	*t*
Sex (Male)	0.01 (0.03)	0.01	0.20	0.04 (0.02)	0.03	1.63	−0.05 (0.02)	−0.04	−1.84
Depression	−0.19 (0.04)	−0.18	−5.48	0.31 (0.05)	0.23	6.18	−0.15 (0.04)	−0.15	−4.08
Anxiety	−0.09 (0.03)	−0.09	−2.94	0.14 (0.06)	0.11	2.33	−0.05 (0.04)	−0.04	−1.04
Stress	−0.01 (0.04)	−0.01	−0.42	0.57 (0.05)	0.43	11.13	−0.12 (0.04)	−0.12	−3.15

CFI, comparative fit index; NNFI, non-normed fit index; RMSEA, root mean square error of approximation; SRMR, standardized root mean square residual

bifactor ESEM analyses of self-esteem slightly exceeded the conventional cut-off criterion (<0.10).

For self-esteem in the ESEM model, depression (β = −0.18, t = −5.48, p < 0.001) and anxiety (β = −0.09, t = −2.94, p = 0.003) showed negative associations. In the bifactor ESEM model, depression (β = −0.14, t = −4.97, p < 0.001), anxiety (β = −0.20, t = −8.17, p < 0.001), and the general factor (β = −0.08, t = −3.13, p = 0.002) were negatively associated with self-esteem. Stress was not significantly related in either model.

For loneliness, the ESEM model indicated positive relationships with depression (β = 0.23, t = 6.18, p < 0.001), anxiety (β = 0.11, t = 2.33, p = 0.020), and stress (β = 0.43, t = 11.13, p < 0.001). The bifactor ESEM model showed positive associations with the general factor (β = 0.13, t = 3.73, p < 0.001), depression (β = 0.09, t = 2.86, p = 0.004), and stress (β = 0.63, t = 17.03, p < 0.001), but not anxiety.

For hope, the ESEM model showed negative associations with depression (β = −0.15, t = −4.08, p < 0.001) and stress (β = −0.12, t = −3.15, p = 0.001). In the bifactor ESEM model,

hope was negatively correlated with depression (β = −0.11, t = −3.08, p = 0.001), stress (β = −0.21, t = −2.25, p = 0.012), and the general factor (β = −0.13, t = −2.17, p = 0.015).

Network analysis (NwA)

The results of the NwA for total sample, after including all the items of DASS-Y, are depicted in Fig. 1. The other NwA data can be seen in Supplementary Materials (Tables, S5, S6, S7 & S8, and Figure S3, S4, S5, S6 & S7).

As can see in network plot, the items were clearly grouped into ordered and related subnetworks, forming clusters corresponding to the latent variables of depression and stress. Anxiety formed a separate and clearly defined cluster (Items 2,4,7, and 19), while items 9, 15 and 20 appeared in an intermediate zone between the depression and stress clusters. At the same time, the clusters were close enough to form a continuum representative of a general factor. The results demonstrated that the components significantly assessed their respective constructs, while also forming a general factor consistent with the previous bifactor and bifactor ESEM model findings.

The network plots depending of sex showed the same clusters. Data present a sparsity (related nodes/total nodes) of 0.462 among males and 0.371 among females, being 0.367 in the total sample. This suggested an adequate interrelation among items from three different sub-scales among females than among males. In the edge stability analysis, good results were obtained in both cases. In turn, for nodes, both networks showed stability in terms of strong connections (strength), but this stability is lower in terms of betweenness and closeness, which could indicate that the network is robust in strong connections but susceptible to changes in how intermediate nodes connect and the overall proximity between them. In these cases, considering the expected influence can offer a more comprehensive view of how the network might react to changes or perturbations, providing additional information about the network's robustness (Epskamp et al., 2018). In this context, in both sexes, Item 20 (*"I felt scared for no good reason"*) followed by Item 9 (*"I felt terrified"*) of the anxiety subscale presented good indices of centrality and of expected influence. Consequently, they can be considered notable symptoms in both sexes. It is important to note that the centrality and expected influence observed for these anxiety symptoms reflected strong associations within the network structure, rather than causal effects, given the cross-sectional nature of the data.

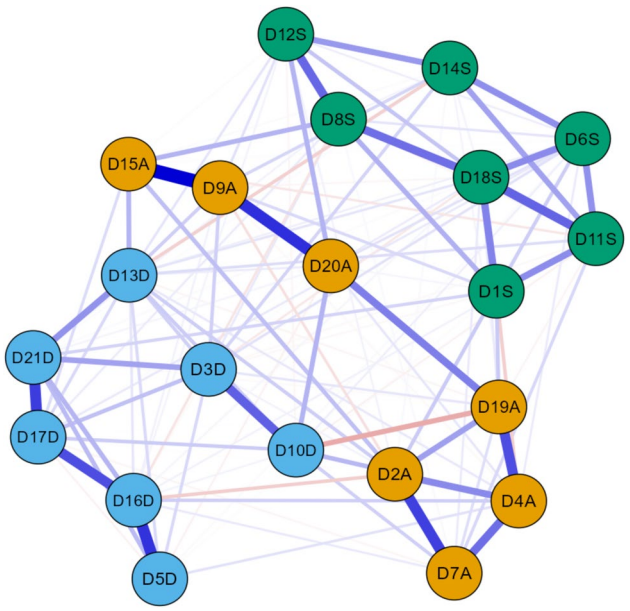

Fig. 1 Network obtained for DASS-Y (n = 1862). Depression items: D3D, D5D, D10D, D13D, D16D, D17D & D21D. Stress items: D1S, D6S, D8S, D11S, D12S, D14S & D18S. Anxiety items: D2A, D4A, D7A, D9A, D15A, D19A & D20A

Discriminant/convergent validity applying NwA

The results of the NwA incorporating score items from the DASS-Y, RSES, UCLA-3–3 Items, and DHS-C can be seen in the Supplementary Materials (Tables S9, S10, S11 & S12, and Figure S8 & S9). Results confirm the discriminant validity of DASS-Y. With a sparsity of 0.621, the network exhibited a structure where items from different scales clustered into clearly differentiated groups. This pattern suggests that the scales effectively assess distinct constructs and consistently reflect these differences in their observed interactions. The results showed no differences depending on sex. These findings enhance confidence in the robustness and accuracy of the conducted measurements.

The results of the NwA incorporating depression, anxiety and stress scores assessed with DASS-Y, self-esteem assessed with RSES, loneliness assessed with UCLA-3–3 Items, and hope measured with DHS-C are depicted in Fig. 2. The other NwA data can be seen in the Supplementary Materials (Tables S13, S14, S15, S16 & S17, and Figure S10, S11, S12, S13, S14 & S15).

The node showing the highest centrality (across all four indices) in the network was stress. As expected, strong relationships were also found between the DASS-Y subscales (r = 0.29 to 0.44; p < 0.05). Moreover, as indicated in the 'Data analysis' section, to analyse the convergent validity of the DASS-Y subscales in relation to self-esteem, loneliness, and hope, the relationships between nodes were examined. The most significant was the one presented by loneliness, which was positively connected with stress (r = 0.29 for total sample; r = 0.28 for males, r = 0.29 for females); and also, although with a strong but not significant connection with depression, and with anxiety among

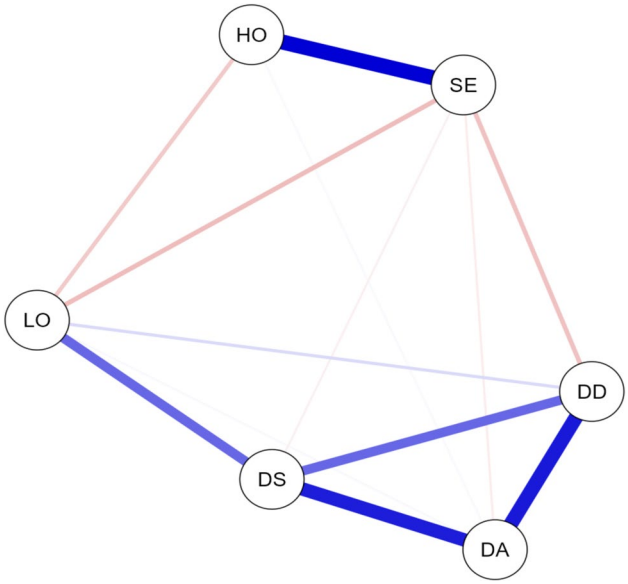

Fig. 2 Network plot obtained for depression (DD), anxiety (DA), stress (DS), self-esteem (SE), loneliness (LO) and hope (HO) in total sample

females. Self-esteem and hope showed slightly negative but not significant relationships with depression. Moreover, a strong and positive relationship was observed between hope and self-esteem ($r=0.48$ for total sample; $r=0.48$ for males, $r=0.50$ for females); and a negative, although weak, relationship between hope and loneliness. Therefore, the significant relationships observed between the factors of the DASS-Y (depression, anxiety, and stress) and other established psychological measures (self-esteem, loneliness, hope) supported the convergent validity of the DASS-Y. The strong correlation between loneliness and stress, as well as the relationships between self-esteem, hope, and depression, suggest that the subscales of the DASS-Y were consistent with what would be expected according to existing theory and literature on these constructs.

Discussion

The present study comprehensively evaluated the item validity, factorial validity, and convergent validity (in relation to self-esteem, loneliness, and hope) of the DASS-Y by combining IRT as Rasch analysis, SEM, including CFA and ESEM, and NwA.

The study first assessed the item validity of the DASS-Y. The infit and outfit values were within an acceptable range, indicating a good fit of the scale items. The person separation reliability scores of the depression, anxiety, and stress subscales exceeded 0.6, verifying the DASS-Y's ability to differentiate between varying degrees of psychological distress, which is consistent with previous research by Cao et al. (2023). Furthermore, similar to the study by Cao et al. (2023), the technique of category collapsing was employed, combining Categories 2 and 3 into a single category to increase monotonicity. However, the items collapsed in the present study (five depression items, four anxiety items, and one stress item) differ from the item collapsed by Cao et al. (2023) in their study (three depression items, three anxiety items, and one stress item). The practice of collapsing items is widely recommended and accepted in the literature to improve data quality, ensure response categories are more distinguishable, and address differential item functioning issues, thereby enhancing the reliability and validity of measurements (Tennant & Conaghan, 2007). Reviewing and refining problematic items and redefining response categories could be a recommendation for future studies, thereby ensuring better interpretation of the results.

Having confirmed the validity of the items, the factorial validity and reliability of the DASS-Y in assessing depression, anxiety, and stress in secondary school adolescents in China was affirmed. The application of classical test theory found results similar to those reported by Szabo and Lovibond (2022), Obeid et al. (2024), and Cao et al. (2023). Notably, one of the most significant contributions of the present study was the application of ESEM, which reduced the high correlation between the factors of depression, anxiety, and stress observed in the oblique three-factor model. This reduction has improved the discrimination between the dimensions of the scale. Additionally, the high values of the ECV and ωH in the bifactor and bifactor ESEM models suggest the presence of a substantial general factor, supporting the multidimensional structure of the DASS-Y and its ability to capture both general and specific factors of psychological distress.

In turn, the results of the NwA indicated that the items of the DASS-Y were clearly grouped into ordered and related subnetworks, forming clusters corresponding to the latent variables of depression, anxiety, and stress. Although anxiety formed a separate and clearly defined cluster (Items 2, 4, 7, and 19), Items 9, 15, and 20 appeared in an intermediate zone between the depression and stress clusters. Furthermore, Items 20 and 9 presented good centrality indices for betweenness, closeness, strength, and expected influence, outlining the presence of a general factor. This aligns with the ESEM analysis findings, which indicated the presence of a substantial general factor underlying the specific factors. Therefore, the results of the ESEM and the NwA complement each other, demonstrating the multidimensional structure of the DASS-Y and its ability to assess both general and specific factors of psychological distress. The distinct but interconnected clusters observed in the NwA reinforced the ESEM findings, providing a comprehensive understanding

of the interrelations between depression, anxiety, and stress within the DASS-Y framework.

The present study integrates findings from both SEM and NwA to explore discriminant validity between related psychological constructs. SEM analysis showed a negative correlation between self-esteem and psychological distress (depression and anxiety). However, stress did not show a significant correlation with self-esteem in the present study, possibly due to cultural differences in coping mechanisms. Similarly, the study identified a negative correlation between hope and psychological distress, particularly pronounced with stress and depression, reflecting active coping strategies and emotional resilience (Visser et al., 2013). Conversely, the impact of hope on anxiety reduction was limited, which may relate to the pervasive uncertainties of adolescence (Michałowska et al., 2022). Furthermore, consistent with Quynh Ho and Nguyen (2023), loneliness exhibited a positive correlation with psychological distress, notably with stress and depression, highlighting its association with social dissatisfaction and emotional strain (Park et al., 2023). The weaker correlation between loneliness and anxiety suggests, as proposed by Lovibond and Lovibond (1995), that the DASS-Y assesses broader anxiety symptoms rather than specific anxieties such as social anxiety.

These SEM findings were supported and expanded upon by NwA, which integrated scores from DASS-Y, RSES, UCLA, and DHS-C. The network exhibited a sparse structure (sparsity = 0.64) where items from different scales clustered distinctly, affirming the discriminant validity of DASS-Y and the effectiveness of these measures in capturing unique psychological constructs. Notably, stress emerged as the node with the highest centrality across all indices, underscoring its pivotal role. Loneliness showed a significant positive connection with stress across genders, while self-esteem and hope demonstrated slightly negative but non-significant relationships with depression. The robust positive relationship between self-esteem and hope, coupled with their patterns of association with DASS-Y dimensions, suggests these constructs may play important protective roles against psychological distress, particularly stress-related symptoms.

Building on these integrated SEM and NwA insights into the interplay of psychological constructs, these findings should be interpreted within the specific cultural context of Chinese adolescents, where cultural norms may modulate the observed relationships and highlight the DASS-Y's adaptability across diverse settings. While the high intercorrelations among depression, anxiety, and stress align with findings from Australian (Szabo & Lovibond, 2022) and Arabian (Obeid et al., 2024) samples, supporting cross-cultural validity, notable cultural variations emerged. The non-significant correlation between stress and self-esteem contrasts with Western studies that typically report stronger negative associations, such as those found in UK high school students (McKay et al., 2014) and Polish high school students (Kaczmarek and Trambacz-Oleszak 2021), possibly reflecting Chinese cultural coping mechanisms where academic stress is often normalized or viewed as necessary for success. Similarly, the prominence of fear-based anxiety items (*"I felt scared for no good reason"* and *"I felt terrified"*) in the NwA may reflect the high-pressure academic environment characteristic of Chinese secondary education. These cultural considerations underscore the importance of contextualizing psychological assessment instruments within specific sociocultural frameworks when interpreting scores and designing interventions.

The present study's findings contribute meaningfully to the theoretical understanding of psychological distress by situating them within well-established frameworks such as Coopersmith's self-esteem theory and Snyder's hope theory. According to Coopersmith (1967), self-esteem arises from an individual's perception of personal competence and social acceptance, which fundamentally shapes emotional well-being. The observed negative correlations between self-esteem and psychological distress in the adolescent sample reflect this dynamic, suggesting that diminished self-esteem may intensify vulnerability to emotional difficulties. These results underscore the importance of fostering positive self-regard and social validation in adolescence, a critical developmental period marked by identity formation and social comparison. Complementing this, Snyder et al.'s (2002) hope theory conceptualizes hope as a cognitive-motivational construct encompassing goal-directed energy (agency) and planning to meet goals (pathways). The findings that higher levels of hope were significantly associated with lower levels of distress align with this framework, highlighting hope's role as a protective factor that promotes resilience in the face of psychological distress. This suggests that adolescents who maintain a hopeful outlook are better equipped to navigate challenges, regulating emotional responses and sustaining adaptive coping strategies.

By explicitly linking the empirical data to these foundational theories, the present study not only reinforces their relevance in diverse cultural contexts such as mainland China but also enriches the conceptual discourse surrounding emotional distress. Integrating these perspectives provides a more nuanced understanding of how self-esteem and hope interplay with anxiety, depression, and stress, and offers valuable insights for designing targeted interventions that bolster these psychological resources among adolescents.

In conclusion, the significant associations observed between DASS-Y factors (depression, anxiety, and stress) and other psychological measures (self-esteem, loneliness,

hope) validate the instrument's convergent validity. These findings contribute to a comprehensive understanding of how these constructs interact among high school students, informing future interventions and research efforts. Therefore, given the connections between depression, anxiety, and stress with self-esteem, loneliness, and hope, school-based interventions can be designed to target these psychological factors. Psychologists and educators could implement programs that focus on enhancing self-esteem through positive reinforcement and skill-building activities. Interventions aimed at reducing loneliness may include promoting peer relationships, creating support groups, or fostering inclusive environments. Additionally, hope-focused programs can help students develop future-oriented goals and strategies for overcoming challenges, therefore fostering resilience and coping mechanisms. These interventions could ultimately contribute to reducing emotional distress and improving overall mental health outcomes among adolescents.

The NwA also provided additional information about the interrelations and stability of these constructs in different sexes. Although the items group into the same clusters in both sexes, the sparsity (related nodes/total nodes) was 0.462 among males and 0.361 among females, with a total sample sparsity of 0.367, indicating better interrelation among the items from the three subscales in females than in males. These stronger interrelations among anxiety, depression, and stress observed in girls may be explained by established gender differences in emotional development and coping styles. Adolescent girls are more likely to internalise distress and report emotional symptoms than boys, who tend to adopt more externalising or avoidant strategies (Zahn-Waxler et al., 2008; Eschenbeck et al., 2007). Girls also show greater emotional awareness and a tendency to ruminate on negative affect, which can amplify and link emotional symptoms more tightly (Nolen-Hoeksema, 2001). These patterns may contribute to the denser symptom network found among female adolescents, suggesting that emotional constructs may be more interdependent in this group due to psychosocial and cognitive processing differences.

The edge stability analysis showed strong connections (strength) but lower stability for betweenness and closeness, suggesting that while strong connections are robust, the overall structure of the network and intermediate connections may be more susceptible to changes. On other hand, the NwA further indicated that, in terms of expected influence, both Item 20 (*"I felt scared for no good reason"*) and Item 9 (*"I felt terrified"*) from the anxiety subscale showed strong centrality and expected influence indices. This underscores their significance as notable symptoms among both sexes.

Building on these findings, the NwA offers valuable insights into the complex interrelationships among psychological constructs, emphasizing the central role of anxiety symptoms within this framework. While the high centrality of anxiety items such as *"I felt scared for no good reason"* highlights their strong associations with other symptoms, it also points to potential targets for intervention. Addressing these central anxiety symptoms may disrupt the broader network of psychological distress, potentially leading to more effective and efficient treatment outcomes. Furthermore, understanding the interplay between anxiety, stress, depression, and protective factors such as self-esteem and hope underscores the necessity of comprehensive, multifaceted intervention strategies. Such approaches should not only aim to alleviate specific symptoms but also enhance psychological resilience by fostering protective constructs. Future research should implement longitudinal and experimental designs to clarify causal pathways and optimize intervention development. This integrative perspective enriches the understanding of adolescent psychological health and informs tailored prevention and treatment efforts.

Limitations

The study presents several limitations that should be considered. Firstly, the use of convenience sampling in specific regions of mainland China may limit the generalization of the results to broader populations or diverse cultural contexts, despite the sample's gender distribution aligning with national demographics (National Bureau of Statistics of China, 2025). Furthermore, due to the cross-sectional nature of the study, causal conclusions about the relationships between variables over time cannot be established. Potential measurement issues were also observed. The RSES showed lower factor loadings for negatively worded items, suggesting cultural interpretation difficulties. Although correlated error terms were included to control for method effects, these issues highlight the need for further investigation into culturally specific responses to negatively phrased items. Future studies incorporating qualitative approaches or culturally adapted instruments could provide deeper insight into these measurement nuances. Regarding measurement-related issues, the decision to use the abbreviated three-item version of the UCLA Loneliness Scale was driven by psychometric challenges encountered with the full version. This reduction, while improving reliability in the sample, may compromise the breadth and depth of construct coverage, potentially limiting the generalizability of findings related to loneliness. The need to collapse items in the DASS-Y also suggests possible issues in the differentiation and clarity of items and/or response categories.

Despite the limitations, the results obtained have important theoretical and practical implications. The comprehensive evaluation conducted provided solid evidence supporting the validity and reliability of the DASS-Y in the analysed sample; and, from a theoretical standpoint, these findings advance the understanding of the relationships between emotional distress (depression, anxiety, and stress) and other key psychological constructs such as self-esteem, loneliness, and hope among adolescents. Following the confirmation of the DASS-Y's factorial structure among Chinese adolescents, evidence of its convergent validity with these constructs was provided, establishing a solid foundation for future research into how interactions between these factors may influence the emotional well-being of adolescents in China. Furthermore, these results not only pave the way for future refinements and applications of the DASS-Y in diverse cultural contexts but also inform potential strategies and intervention pathways in clinical practice. This is based on the significantly positive relationship observed between loneliness and stress, as well as the notable centrality and expected influence of items such as *"I felt scared for no good reason"* and *"I felt terrified"* from the anxiety subscale.

In terms of practical implications, the results underline the relevance of the DASS-Y as an effective instrument for assessing emotional distress among adolescents, especially in non-Western contexts. This opens up possibilities for its application in clinical practice, as well as in the design of psychoeducational and therapeutic interventions targeted at adolescents. The identification of the relationship between loneliness and stress, along with the centrality of items related to fear and anxiety, provides valuable guidance for the development of specific programmes aimed at addressing these aspects.

Future research directions

Future research should aim to address the limitations identified in the present study. Given the use of convenience sampling in specific regions of mainland China, future research should include more diverse geographic and cultural samples to enhance the generalizability of the findings. Additionally, the cross-sectional nature of the present study prevents the establishment of causal relationships between variables. Longitudinal studies would be essential to examine the temporal dynamics of emotional distress among adolescents in relation to other constructs, providing a deeper understanding of their causal interactions and long-term impact on adolescent well-being. Another identified limitation relates to measurement issues, particularly the item wording effect in the RSES and the need to restructure response categories in the DASS-Y. Future studies should explore possible modifications to problematic items and/or response categories, conducting further psychometric evaluations to improve the scale's validity and reliability.

Beyond addressing these limitations, NwA findings highlighted the central role of fear and terror in anxiety symptoms, suggesting the need for further investigation into how these symptoms interact with other mental health factors among adolescents. Given the significant role of hope in the present study, future research should examine its function as a protective factor against emotional distress. Finally, the present study provides the first evidence regarding the correlation of DASS-Y scores with self-esteem, loneliness, and hope. It would be interesting to conduct studies that allow for comparisons between the findings of the present study and those in other cultural contexts. For instance, analyzing whether there are differences in the correlations between DASS-Y scores and these psychological constructs, or whether the non-significant correlation between stress and self-esteem aligns with or diverges from findings in other cultures.

Conclusion

In summary, the findings of the present study not only contribute to the theory of the relationships between emotional distress and key psychological factors but also provide a solid foundation for future research and practical applications in the field of adolescent mental health in China. The DASS-Y appears to be a useful psychometric instrument for both assessing emotional distress and guiding interventions aimed at addressing the psychological challenges faced by adolescents in this cultural context.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s12144-025-08738-3.

Acknowledgements The authors thank all the participants for taking part in the study.

Author contributions Conceptualization, Y.L, X.W., C-H.C. and I-H.C.; methodology, O.M., C-H.C. and X-L.L.; formal analysis and investigation, Y.L., O. M., X–Y.J. and I-H.C.; writing—original draft preparation, Y.L., X.W., O.M. and I-H.C.; writing—review and editing, O.M, M-D.G. and C-Y. L; funding acquisition, I-H.C.; resources, Y.L., X-L.L. and X–Y.J.; supervision, I-H.C. and C-Y.L. All authors have read and agreed to the published version of the manuscript.

Funding Open Access funding provided thanks to the CRUE-CSIC agreement with Springer Nature. This research was supported by the 2024 Key Project of Jiangsu Provincial Education Science Planning (No. B-b/2024/04/50).

Data availability The datasets used during the present study are

available from the corresponding author upon reasonable request.

Declarations

Institutional review board statement The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board (IRB) of the Jiangxi Psycho-logical Consultant Association (IRB reference: JXSXL-2022-CL15) in 2022. Informed consent was obtained from all participants involved in the study.

Conflicts of interest The authors declare no conflicts of interest.

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