**Assessing the heterogeneity of 27 Chinese scales for screening depression among children, adolescents, and young adults**

汪浩远1, 胡孟真1, 田柳青1, 刘伟彪1, 安媛媛1, 李瑛2, 胡传鹏1#

(1南京师范大学心理学院; 2首都医科大学附属北京儿童医院精神科)

**CrediT Author Statement**

**Wang Hao Yuan：**Conceptualization, Data curation, Investigation, Writing - Original Draft. **Hu Meng Zhen：**Data curation, Visualization, Investigation. **Tian Liu Qing:** Investigation. **Liu Wei Biao:** Investigation. **Yuanyuan An:** Writing- Reviewing and Editing. **Ying Li:** Investigation, Writing- Reviewing, and Editing. **Hu Chuan-Peng：**Conceptualization, Supervision**,** Investigation, Project administration, Writing-Reviewing and Editing.

Corresponding author: Hu Chuan-Peng, email: [hcp4715@hotmail.com](mailto:hcp4715@hotmail.com)

# 1. Introduction

[儿童青少年抑郁障碍的严重性（患病率、社会成本等）]

*“**Depression is a disorder of mood, so mysteriously painful and elusive in the way it becomes known to the self—to the mediating intellect—as to verge close to being beyond description.”*(William Styron 1990)

Depression (also known as major depression) is one of the most prevalent mental disorders (Fu and Zhang 2023; McGrath et al. 2023) and brings significant personal, social, and economic burden globally (Herrman et al. 2022). The age of onset for depression can be as early as around 10 years old (Dattani (2022)) and peaked at 19.5 (Solmi et al. 2022). Self-harm and suicide often co-occur with depression during adolescence (Zeynep Başgöze et al. 2021), resulting in over 800,000 deaths annually among individuals aged 15-29 (Amaltinga and Mbinta 2020). Preventing and alleviating depression is an imperative global issue (UNICEF n.d.)(UN).

[青少年的问题依赖自我报告问卷，加上心理病理学内容]

Despite severity and emergence of depression among children and adolescents, the fundamental issues of screening diagnose depression are often overlooked(Fried, Flake, and Robinaugh 2022), which might result in vast different estimate of the prevalence of depression. For example, in China, Deng et al. (2023) reported that the prevalence of MDD among 6 – 16 years old was 2.004%, 95% CI [1.902 to 2.106], Li et al. (2022)reported the prevalence of depressive disorders was 3.0% , 95% [CI, 2.8–3.1], while estimate of prevalence of the students with similar age range from recent meta-analyses, which synthesized data from 465 studies published during 2010-2020, was above 14.6% (14.6% among elementary school students, 23.6% ~ 24.2% among middle school students, 28.0% among high school students) (Chen, Zhang, and Yu 2022; Huang, Zhang, and Yu 2022; Yu, Zhang, and Yu 2022; Zhang, Jin, and Yu 2022).

The vast different estimate between self-reported scales and interview-based data cast double on the reliability of these diagnostic/screening tools and the underlying psychopathological assumptions. The classical psychopathological approach in clinical setting (DSM-5 or ICD-11) is dichotomous diagnoses based on several criterion. This approach has been challenged by new approaches such as network approaches, transdiagnostic dimensional approaches, and clinical staging approaches(Eaton et al. 2023). These new approaches call for attention to the symptoms of mental disorders. Empirical data also suggest that different scales are heterogeneity and brought significant variability in diagnosis and screening. For example, in all four meta-analysis, the authors found significant moderating effect of scales on prevalence rate (Chen et al. 2022; Huang et al. 2022; Yu et al. 2022; Zhang et al. 2022). Content analysis of Seve most-widely used depression scales revealed low overlap between different scales(Fried 2017). Similar results was found from medical record of patients who were diagnosed as major depression (Fried et al. 2016). These findings called for attention to the tools that used for screening depression among children, adolescents, and young adults.

[我们的工作及其意义]

To address this issue, we conducted a comprehensive content analysis of 27 Chinese depression scales that had been used in previous studies. We revealed the heterogeneity among scales that used for screening depression among Chinese children and adolescent. Also, our results provided a comprehensive list of symptoms that were used for screening depression. These results will provide insights for understanding the psychopathology of depression in Chinese society (and east Asian societies more generally) and will facilitate the improvement of scales used in clinical settings and public health policies.

# 2. Methods

We took three steps to extract symptoms from all scales that measure depressions among the Chinese student’s population (see Fig 1 for the flowchart). Firstly, we identified all scales that has been used for screening depression. Secondly, we identified unique symptoms of each scale. Thirdly, we compared the symptoms across all scales. The latter two steps followed Fried (2017)but with modifications (see details below).

## 2.1 Identify and screen scales

We identified scales that measure depression from four recent meta-analyses which synthesized the prevalence of different mental health problems among four Chinese students populations: elementary school, middle school, high school, and college (于晓琪等, 2022; 黄潇潇等, 2022; 张亚利等, 2022; 陈雨濛等, 2022). We extracted all papers included in these meta-analyses and selected scales that were used for screening depression. In total, we identified 34 scales from 465 articles from all articles included in these four meta-analyses.

We then screened versions of scales and identified the most valid version for later analysis (See supplementary material for details). If a scale has multiple versions, we choose one of these version based on the following criteria: (1) If the reference(s) of the scale cited in articles was in English, we search for the Chinese versions because all participants in the above mentioned articles are Chinese students; (2) If the reference(s) of the scale included both English and Chinese versions of the scale, we included the Chinese version; (3) If there were multiple Chinese versions and the latter one(s) improved the previous ones for mythological reasons, we choose the latter version; (4) If there were multiple Chinese versions and no obvious methodological advances were reported, we included the one explicitly stated symptom names; (5) If all other condition were equal, we selected the most frequently cited one. For instance, CES-D was first translated by汪向东等(1999), which was used by 39 of all 465 papers included in the four menta-analyses. However, 章婕等(2010)improved the translation of the 20th item, thus, we chose the revised version by 章婕等(2010).

## 2.2 Identify symptoms within scales

In this phase, four trained coders focused on identifying items that assessed identical or similar symptoms within each scale. The process proceeded as follows: First, the four coders independently identified and consolidated items within each scale. Then, they formed two pairs, with each pair reviewing their results and resolving any discrepancies. Subsequently, the two pairs of coders cross-checked their findings and collaboratively addressed any remaining inconsistencies, seeking guidance from the corresponding author when necessary. The final, consolidated version of the results underwent independent verification by a clinically certified doctor (co-author \*\*\*), who made necessary revisions to ensure accuracy.

## 2.3 Compare symptoms across different scales

In this step, the same four coders compared symptoms across all scales. The procedure was the same as the identification of symptoms within scales: independent individual coding, discussion by pairs, cross-checking between pairs, discussion with the corresponding author, and verification by a clinically certificated doctor.

The coding processes were as follow. We first pooled symptoms from all scales together and identified unique symptoms. In this step, we retained both compound symptoms and specific symptoms, as in Fried (2017). Compound symptoms are symptoms that include a range of related symptoms, whereas specific symptoms are more concrete and describe specific patterns. For example, “appetite changes” is a compound symptom, it includes two specific symptoms: “appetite increased” and “appetite decreased”. And all three symptoms were treated as unique symptoms. We employed an approach that maximize the amount of different symptoms. More specifically, if the items describe similar symptom using different words and that the words have significantly different meanings under the Chinese context, we treat them as belonging to the same compound symptom but are different specific symptoms. For instance, there are many different words for describe depressed mood in different scales, we used 'depressed moods' as the compound symptom but distinguish different specific symptoms such as: 'blue', 'low mood', 'sad', and 'anhedonia'. This approach is slightly different from Fried (2017), where he coded all these item as a specific symptom 'Sad moods'.

Then, we coded each scale on all unique symptoms. More specifically, a scale was coded as “0” on a symtom if it does not have items that measures this symptom. If a scale has an item that directly measures a symptom, compound or specific, it was coded as 2 on that symptom. Note if a scale has an item measures a compound symptom, then, this scale not only had a score of 2 on that compound symptom but also has a score of 1 on each of the specific symptoms under this compound symptom. For instance, the CDI has no item for 'Depressed mood' , we assigned “0” for CDI on this symptom. For compound symptom “appetite change”, CDI has an item directly measures this symptom and was coded as 2 on this symptom. Importantly, even CDI does not have item for specific symptoms of “appetite changes”, i.e., 'appetite increased' and 'appetite decreased', it was coded as 1 on both two specific symptoms (see Supplementary Materials and Figure 2 for details). However, if the item measures a specific symptom under a compound symptom, this scale was coded “2” on that specific symptom but also coded as “0” on the corresponding compound symptom.

[Insert Fig 2 later]

**Figure 2***. Number of articles that used each scale for screening depression.* Total number of articles were based on those included in four meta-analyses (XXX). Scales with \* were excluded from our analyses.

## 2.4 Data analyses

We reported the descriptive summary of scales as well as the symptoms within scale. We also highlighted symptoms that are used in DSM-5 for diagnosis of depression. More specifically, there are 28 symptoms are DSM-5 symptom, derived from the nine symptoms in DSM-5 and all their specific symptoms, see Fried & Nesse, (2015) for details.

We analyzed shared and distinct symptom across scales. We used Jaccard index for the degree of overlap between different scales (Fried, 2017). The formal of Jaccard index is s/(u1 + u2 + s), where "s" represents the number of items shared by two scales, and "u1" and "u2" denote the number of items that are exclusively present in each of the two scales. Jaccard index ranges from 0 (no overlap among scales) to 1 (complete overlap). We interpreted Jaccard index as in Fried (2017) guidelines: very weak 0.00–0.19, weak 0.20–0.39, moderate 0.40–0.59, strong 0.60–0.79, and very strong 0.80–1.0. We explored the relationship between the mean Jaccard coefficient and the scale length across 27 scales by employing Spearman correlation.

[Insert Fig later]

**Figure 1**

*Research flowchart*

# 3 Result

# 3.1 A summary of scales

Among all papers included in these four meta-analyses (citations), 465 reported depressions. We identified 34 unique scales in these articles. Among all these scales, the items of four scales, the Mini International Neuropsychiatric Interview for children and adolescents (Mini-KID), WHO-CIDI 3.0, Psychological Health Inventory (PHI), and the Symptom Checklist 45, were not findable. The items of the other two scales, the Beck Depression Inventory (Zhang Yuxin Revised Edition) and Short Depression Scale, were not available either because of unidentifiable citations. These six scales were excluded from furthered analyses. The items used in 'Gu & Chen (2020) 'and 'Ji (2007)' were identical but in different languages, thus we regarded these two studies used the same scale referred them as 'Ji (2007)'. Also, the boys’ and girls’ version of the Child Behavior Checklist (CBCL) were treated as one scale, CBCL. In short, 27 scales were included in the current study. See figure 2 for the number of usages of these scales among all 465 empirical papers in the meta-analyses (CITATIONS). The seven most frequently used scales in this study are SDS, SCL-90, CES-D, CDI, DSRSC, BDI-I, and MSSMHS, among which CES-D and SDS are consistent with the scales selected by Fried (2017).

# 3.2 Items and symptoms within scales

For the 27 scales included, there are 425 items in total. We merged 73 items into 31 symptoms when coding items within scales. Also, there were two cases where one item measured two symptoms. The item from Ji (2007), "During the past 12 months, did you ever feel so sad or hopeless almost every day for two weeks or more in a row that you stopped doing your usual activities?" measures both 'sad' and 'Sense of hopelessness'. And the 8th item from PHQ-9, "Actions or speech slowed down to a noticeable extent, or conversely—feeling restless or agitated, being unable to sit still, more than usual", measures both 'Agitation' and 'Retardation'. Thus, a total of 385 symptoms were identified across different scales (See supplementary materials for number of items and symptoms of each included scale).

The comparison of 385 symptoms across 27 scales resulted in unique 84 symptoms (see Figure 3). Among these, eight are compound symptoms, including *Depressive mood, Irritability*, *Self-abasement*, *Interest/pleasure loss*, *Somatization*, *Appetite changes*, *Somnipathy*, and *Reduced socialization* (See supplementary material for details). Among all 27 scales, 19 of them did not include any idiosyncratic symptoms. For the other eight scales the rate of idiosyncratic symptom varied from 3.9% to 22.2%. Interestingly, all scales include symptoms that were not used for diagnosis of depression in DSM-5. Among them, DSI has the highest proportion of DSM-5 symptoms for depression, 71.42% of the total nine DSM-5 depression symptoms. Please see the supplementary materials for detailed information.

[Insert Fig later]

**Figure 3***. Content Overlap Across* *Twenty-seven Depression Scales.* Each row represents a symptom, each column represents a scale.If a scale measures a symptom, then there is a dot or a circle on that row. The former represent compound symptoms and the latter represent specific symptoms. Symptoms in bold font are from DSM-5. ADI: Adolescent Depression Inventory, CDI: Children's Depression Inventory, HAMD: Hamilton Depression Rating Scale for Depression, DSI: Depression Status Inventory, SDS: Self- Rating Depression Scale, MFQ-C: Mood and Feelings Questionnaire, CBCL: Child Behavior Checklist, BDI-II：Beck Depression Inventory-II, DSRSC: Depression Self-rating Scale for Children, BDI-I: Beck Depression Inventory, KADS-11: Kutcher Adolescent Depression Scale, CES-D: The Center for Epidemiological Studies Depression Scale, PHQ-9: Patient Health Questionnaire-9 items, CSSDS: China Middle school students' depression scale, CES-D-C: Center for Epidemiologic Studies Depression Scale for Children, UPI: University Personality Inventory, SMFQ: Short Mood and Feelings Questionnaire, SCL-90: Symptom Checklist 90, CES-D-13: Short version of Center for Epidemiologic Studies Depression Scale, CCSMHS: Chinese College Student Mental Health Scale, DASS-21: The Depression Anxiety Stress Scale, BSRS-5: Brief Symptom Rating Scale, Sakuma\_2010: Sakuma et al.(2010) self-designed questionnaire, MSSMHS: Middle-school students Mental Health Scale, CEPS: China Education Panel Survey, HADS: Hospital Anxiety and Depression Scale, Ji\_2007: Comprehensive Survey Report on Health-Related/Risk Behaviors among Chinese Adolescents.The right side of the figure is *Number of symptoms that appear across combinations of scales.* There are 18 symptoms that appear only in one scale; these symptoms are referred to as idiosyncratic symptoms.

# 3.3 Symptoms across scales

Among the 84 symptoms, 18 (21.43%) were idiosyncratic symptoms and only appeared in one scale. None of the symptoms were present on all scales. The most frequently symptom, appeared in 22 out of 27 scales, was *Sense of hopelessness*. The second most measured symptom, 18 out of 27, was *Interest loss*. Note that *markedly diminished interest or pleasure*, a key symptom of diagnosis of major depression in DSM-5, is splatted into two specific symptoms: *interest loss* and *pleasure loss* in this study*.* We found *Pleasure loss* was observed less frequently than *Interest loss*, being measured in 9 out of 27 scales. Another frequently measured symptom is the compound symptom *Depressed mood*, which was directly measured in 5 scales. However, this compound symptom includes several specific symptoms: *blue* appeared in 10 scales, *low mood* in 15 scales, *sad* in 13 scales, and *anhedonia* in 16 scales*.* Combined as a cluster, depressed mood and related specific symptom are the most frequently measured.

The degree of overlap between scales was calculated using the Jaccard coefficient. The mean overlap across all scales was 0.19, range from 0.09 to 0.25, indicating a very low level of similarity between these scales (see Figure 5). CES-D has the highest average degree of overlap with other scale. The highest overlap, 0.75, appeared between two versions of CES-D: CES-D for adults and CES-D-C for children. The second highest overlap, 0.72, was between DSI and SDS. Many scales that have no overlap with each other. For example, there was no overlap between China Education Panel Survey with Middle-school students Mental Health Scale, PHQ-9, CSSDS, SMFQ, CSSMHS. Note that because Ji\_2005 has only one item that measures two symptoms, it has no overlap with PHQ-9, KADS-11.

We found a correlation between the mean Jaccard coefficient of each scale and the scale length, *r* = 0.70, 95% CI [0.39, 0.87]. Similarly, the correlation between mean overlap of scales and the number of captured symptoms is *r* = 0.54, 95% CI [0.14, 0.78]. These findings suggests that longer scales exhibit increased overlap with other scales, thus demonstrating enhanced representativeness.

[Insert Fig later]

**Figure 5.** *Overlap of item content of 27 depression scales.* ADI: Adolescent Depression Inventory, CDI: Children's Depression Inventory, HAMD: Hamilton Depression Rating Scale for Depression, DSI: Depression Status Inventory, SDS: Self- Rating Depression Scale, MFQ-C: Mood and Feelings Questionnaire, CBCL: Child Behavior Checklist, BDI-II：Beck Depression Inventory-II, DSRSC: Depression Self-rating Scale for Children, BDI-I: Beck Depression Inventory, KADS-11: Kutcher Adolescent Depression Scale, CES-D: The Center for Epidemiological Studies Depression Scale, PHQ-9: Patient Health Questionnaire-9 items, CSSDS: China Middle school students' depression scale, CES-D-C: Center for Epidemiologic Studies Depression Scale for Children, UPI: University Personality Inventory, SMFQ: Short Mood and Feelings Questionnaire, SCL-90: Symptom Checklist 90, CES-D-13: Short version of Center for Epidemiologic Studies Depression Scale, CCSMHS: Chinese College Student Mental Health Scale, DASS-21: The Depression Anxiety Stress Scale, BSRS-5: Brief Symptom Rating Scale, Sakuma\_2010: Sakuma et al.(2010) self-designed questionnaire, MSSMHS: Middle-school students Mental Health Scale, CEPS: China Education Panel Survey, HADS: Hospital Anxiety and Depression Scale, Ji\_2007: Comprehensive Survey Report on Health-Related/Risk Behaviors among Chinese Adolescents. Mean overlap is detailed in the supplementary materials.

# 4 讨论

[第一段: 总结结果，并强调本研究的特色（基于中国实际研究的情况）]

We identified 27 scales used in actual Chinese research for measuring depression from the most recent four meta-analyses, and derived 84 different symptoms from them. The mean overlap among all scales is 0.19, with 21.43% of the symptoms appearing only in a single scale, and no symptom presenting in all the scales. Our results are similar to those of Fried (2017), who evaluated the overlap among 52 depression symptoms across seven common depression scales. Fried (2017) demonstrated that 40% of symptoms appeared exclusively in one scale, while 12% were common across all instruments. We highlight that in the study of depression among Chinese students, the use of depression scales as interchangeable measurements is problematic. This could potentially jeopardize the universality and reproducibility of depression disorder research.

[第二段: 介绍具体量表的结果，并与已有研究进行比较]

Our results suggest that CES-D has the highest average overlap with other scales(0.25), while in Fried (2017) research, CES-D has the lowest average overlap with other scales(0.27). This is not surprising, probably because this study also included CES-D-C and CES-D-13, in addition to CES-D itself. Moreover, in this study, as the scale of inclusion increased, CES-D had no idiosyncratic symptoms, but in Fried (2017), CES-D displayed 33% of idiosyncratic symptoms.

可能是由于：1、本研究中除Ces-d以外还纳入了Ces-d简版以及Ces-d儿童版。2、在他的研究中Ces-d有33%的独特症状，而本研究中，随着纳入的量表增加，Ces-d的独特症状为0。本研究中ji\_2005量表与其他量表有着最差的平均重叠率（0.09），这并不奇怪，该量表只包括了一个问题。较长与重叠率为正相关。

尽管先前研究发现问卷短比较好，但是过短的问卷可能损失了很多信息。

Dms-5的结果，有趣的是基于dsm-5编造的phq-9量表，只有xx。这是因为中文版的phq-9量表相对dsm-5失去了很多信息。例如第七条dsm-5是xx

则包括了feelings of worthlessness or inappropriate guilt;这两个症状，中文版对应的题目是6·觉得自己很糟，或很失败，或让自己或家人失望则没有内疚的意味了，因此没测到内疚这个症状。

[第三段: 分析异质性的原因，以及重新阐述问题的严重性, 尤其是与大规模调查进行结合]

抑郁量表的异质性来源可能是由于1构念的不清晰，2编造目的不一样，3文化背景的影响。因此，在合并来自不同量表的研究结果时（例如元分析），特别是那些几乎没有重叠的量表时，可能不明智。目前仍普遍认为量表可以互相替代，研究结果表明量表之间异质性非常强。因此在推广结果中应该强调这是某个量表的结果。目前中国有很多大规模调查，例如，推广结果时并不会强调该结果xx

[第四段：如何解读结果，call for better standards]

不能认为低重叠就是糟糕的量表，高重叠就是好的量表。选择测量工具时应考虑多种因素，并根据评估的目的和目标进行选择。本研究建议使用多个量表。

[第五段: 展望未来]

可以强调本土编制的症状。例如本土编制的才测到跟学习有关的内容。

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