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

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# 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 and brings significant personal, social, and economic burden globally (Herrman et al. 2022). Globally, the lifetime prevalence of depression is 7.5% (7.2–7.7%) for male respondents and 13.6% (13.3–13.9%) for females (McGrath et al. 2023), it . Similarly, the prevalence rate of elevated self-reported depressive symptoms in China is 10.6% (Fu and Zhang 2023). 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).All these data suggest it is crucial to screen depression among children, adolescents, and young adults so that disastrous consequences could be prevented.

[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 of depression among children and adolescents, there are few national surveys focus on them in China. For example, a recent national survey only contained data from respondents older than 17 years old (Fu and Zhang 2023). Only recently, Deng et al (2023) reported the prevalence of major depressive disorder among 6 – 16 years old was 2.004% (95 % CI: 1.902 to 2.106). This study employed a two-stage procedure to estimate the prevalence of mental disorder: first using Child Behavior Checklist (CBCL) for preliminary screening and then followed by diagnostic interviews. This result is different from recent meta-analyses (Chen, Zhang, and Yu 2022; Huang, Zhang, and Yu 2022; Yu, Zhang, and Yu 2022; Zhang, Jin, and Yu 2022), which synthesized data from 465 studies published during 2010-2020 and found a self-reported prevalence rate of depression is 14.6% among elementary school students, 23.6% ~ 24.2% among middle school students, 28.0% among high school students, and 20.8% among college.

The contrast between large number of small-scale studies using self-reported scale of depression and the scarcity of interview-based data is intriguing. Although diagnostic interview is preferred over self-report scales for clinical purpose (Lu et al. 2021; McGrath et al. 2023); this approach also has its own limitations. For instance, it takes more time and need professional interviewers. Prevalence rate based on diagnostic interviews, therefore, may suffer from the problem of representativeness (Kang and Yang 2022). On the other hand, surveys with self-report scales are more feasible for quick screen, and these scales might be the only available method in regions where the per capita psychiatrists is low or lack of professionals (e.g.,(Geng et al. 2022). The global prevalence data we mentioned above (XXX) are most aggregated from self-reported data from different countries. Large-scale surveys primarily rely on self-report instruments in China, especially for those survey for research purpose (see Supplementary materials). The these large-scale surveys may have great impact on the public-health related policy-making (Ma et al. 2023). At the same time, many studies in adolescent depression pathology also utilize depression measurement scales(Cullen et al. 2014; Davey et al. 2015; Yang et al. 2009).

[自我报告问卷的问题：临床、心理病理等]

In the realm of psychopharmacotherapy, diagnostic tools play a pivotal role in categorizing patients and assessing the intensity of psychopathological syndromes over time (Stieglitz and Volz 2022). The measurement of depression faces challenges due to unreliable methodological and theoretical foundations, resulting in limited evidence of validity and reliability (Fried, Flake, and Robinaugh 2022). With numerous instruments for measuring depression, the question arises: are they measuring the same mental disorder? In his seminal work, Fried (2017) examined the hidden assumption that different depression scales are measuring the same latent mental disorder. After analyzing seven common depression scales, Fried (2017) identified 52 different depressive symptoms and found that the overlap between these seven scales was low, indicating heterogeneity among different scales. Relatedly, Fried also found that the symptoms on which patients were diagnosed as major depression was also heterogeneous (Fried et al. 2016). This conclusion poses a significant challenge to the interchangeable use of depression tools in clinical and pathological research. Recent meta-analyses on prevalence rate of mental health issues among Chinese students population found a significant moderating effect of measurement tools, particularly in the context of depression (Huang et al. 2022; Yu et al. 2022; Zhang et al. 2022).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]

Despite previous studies analyzing the degree of content overlap among seven depression scales, there has yet to be research specifically focused on commonly used scales for Chinese adolescents. To fill the gap, we looked into 27 Chinese depression scales that had been in previous studies and (1) assessed the overlap of symptoms measured among these scales, (2) examined the extent to which DSM-5 symptoms, which are used for diagnostic purpose, are measured across scales. Our results not only provided the initial evidence for the heterogeneity of Chinese depression scales but also provide a comprehensive list of symptoms that were used for screening depression. These results will provide insight for both psychopathology of depression in Chinese society (and east Asian societies more generally) and will facilitate the usage of scales in clinical setting 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: indepenedent 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 highlightd symptoms that are used in DSM-5 for diagonosis 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 depression. 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 furthere analyses. The items used in 'Gu & Chen (2020) 'and 'Ji (2007)' were identifical 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-analyes (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?" meausres 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 matierals 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 splitted 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 include 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 chidlren. 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* = 0.54, 95% CI [0.14, 0.78]. Similarly, the correlation between mean overlap of scales and the number of captured symptoms is *r* = 0.70, 95% CI [0.39, 0.87]. 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]

研究分析了多个常用的抑郁量表，并发现它们在捕捉抑郁症状方面存在较大的异质性。这些量表之间的项目内容重叠度较低。这对于使用和解释相关数据有重要的启示作用。

[第二段: 与已有研究进行比较]

Fried (2017).的研究中Ces-d与其他量表有着最差的平均重叠率（0.27），而Ces-d在本研究中表现出最高的平均重叠率（0.25），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。

[第三段: 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构念的不清晰，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。

[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。

[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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