The Relationship Between School Connectedness and Depression: A Three-Level Meta-Analysis

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Abstract

Previous theoretical and empirical research on the relationship between school connectedness and depression has yielded inconsistent results. To clarify the overall relationship between these two constructs and explore the reasons for such discrepancies, a three-level meta-analysis was conducted on 87 included studies. The results revealed a significant negative correlation between school connectedness and depression ($r = -0.39$, $df = 205$, $p < 0.001$). Additionally, the relationship between school connectedness and depression was moderated by participant gender, age, depression measurement instruments, and study data properties, but not by school connectedness measurement instruments, cultural type, or publication year. This study represents the first integration of the relationship between school connectedness and depression using three-level meta-analytic techniques, providing a stage-level theoretical conclusion on their relationship and offering a reference basis for the prevention and intervention of individual depression in practice.

Full Text

The Relationship Between School Connectedness and Depression: A Three-Level Meta-Analysis

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Abstract

Previous theoretical and empirical studies on the relationship between school connectedness and depression have yielded inconsistent results. To clarify the

overall relationship between the two constructs and explore the sources of disagreement, we conducted a three-level meta-analysis of 87 included studies. The results revealed a significant negative correlation between school connectedness and depression ($r = -0.39$, $df = 205$, $p < 0.001$). Additionally, the relationship between school connectedness and depression was moderated by participant gender, age, depression measurement instrument, and study data characteristics, but not by school connectedness measurement instrument, cultural type, or publication year. This study is the first to use three-level meta-analytic techniques to integrate research on the relationship between school connectedness and depression, providing a provisional conclusion on their relationship theoretically and offering reference points for the prevention and intervention of individual depression practically.

Keywords: School Connectedness, Depression, Three-Level Meta-Analysis, Social Control Theory, Sociometer Theory, Self-Determination Theory

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The World Health Organization (2023) reports that depression is a major contributor to the global disease burden, with approximately 280 million people worldwide suffering from depression, representing 3.8% of the total population. Depression not only reduces individual learning and work efficiency but also leads to interpersonal difficulties and even suicide (Thapar et al., 2012; Kieling et al., 2019). To effectively prevent and intervene in depression, numerous studies have examined factors closely related to it, among which school connectedness has received considerable attention (He et al., 2019; Joyce & Early, 2014; Shochet et al., 2006). School connectedness refers to students' perceived acceptance, respect, support, and inclusion at school (Goodenow, 1993) and reflects students' cognitive connection to school and emotional bonds with school members (Yin & Jia, 2014). Currently, most theories consider school connectedness a protective factor that reduces depression levels (Gerard & Booth, 2015; Leary, 2005; Sandler, 2001). However, other theories suggest that school connectedness has no protective effect on depression and may even be counterproductive (Datu et al., 2022; Davis et al., 2019; Loukas et al., 2006). Consistent with this, empirical studies on school connectedness and depression have reported negative correlations, positive correlations, and null relationships. In summary, the relationship between school connectedness and depression remains controversial in both theoretical perspectives and empirical research. To resolve these controversies, this study employs meta-analytic techniques to quantitatively integrate findings on the relationship between school connectedness and depression and analyze factors that may influence this relationship, thereby providing evidence for depression prevention and intervention.

1.1 The Relationship Between School Connectedness and Depression: Theoretical Models

Four main theoretical frameworks address the relationship between school connectedness and depression: Social Control Theory, Sociometer Theory, Self-Determination Theory, and Source Congruence Theory of social support.

Social Control Theory posits that stronger connections between individuals and social organizations increase the organization' s influence on individuals' psychological functioning and behavior (Hirschi, 1996). According to this view, stronger school connectedness increases the school' s impact on students' emotions and health. Specifically, students with high school connectedness are more willing to follow school rules, form better connections with teachers and peers to obtain emotional support, and thus mitigate negative emotions arising from stressful events, reducing depression risk (McLaren et al., 2015). McLaren et al. (2015) found that school connectedness can effectively promote positive peer connections, thereby reducing depression.

Sociometer Theory proposes that individuals who value interpersonal relationships tend to establish positive relationships, gaining more social support and experiencing fewer negative emotions (Leary, 2005). Students with high school connectedness typically recognize and appreciate the importance of interpersonal relationships, which helps reduce negative emotions and depression risk. Shochet et al. (2011) found that higher perceived relationship quality and acceptance at school correlate with lower depression levels.

Self-Determination Theory suggests that individuals need to feel love and care from others and a sense of belonging to an organization. Satisfying this need for belonging helps reduce negative emotions and improve psychological well-being (Ryan & Deci, 2017). School connectedness fulfills individuals'need for belonging, thereby alleviating adverse emotional reactions to stress and reducing depression risk. Consistently, Parr et al. (2020) found that positive school connectedness reduces depression by satisfying individuals' general sense of belonging.

In contrast to these theories, the Source Congruence Theory of social support argues that when stressors and social support sources coincide, the buffering effect of social support may be ineffective (Lebow, 2005; Rueger et al., 2016). Specifically, school connectedness may lead individuals to pay more attention to evaluations from others in the school domain (Vannucci & McCauley Ohannessian, 2018). When depression-inducing stress originates from school (e.g., academic or interpersonal stress), students with high school connectedness may suppress depression expression to meet school expectations (Zhou, 2013). In such cases, school connectedness may not reduce depression but instead lead to its accumulation, manifesting as reverse buffering effects of social support (Lebow, 2005; Rueger et al., 2016). Consistently, Datu et al. (2022) found that during final exam periods, students reported higher depression levels as school connectedness increased.

These theories suggest that school connectedness influences depression through interactions with other factors, but the specific nature of this relationship and the factors affecting it remain unclear.

1.2 Moderators of the School Connectedness-Depression Relationship

Inconsistent findings regarding the relationship between school connectedness and depression may be related to participant characteristics (gender, age), measurement factors (measurement instruments, data characteristics), and contextual features (culture, era).

Gender may moderate the relationship. During socialization, females are encouraged to be dependent and form intimate relationships (Davis et al., 2019), whereas males are encouraged to be independent and autonomous (Bakan, 1966; Barbee et al., 1993). At school, females are more likely than males to seek support from teachers and peers to cope with stress-induced negative emotions (Yang et al., 2021). Therefore, school connectedness may have a stronger effect on depression for females than males. Consistently, He et al. (2019) found that school connectedness had a greater impact on female depression. We hypothesize that school connectedness affects female depression more strongly than male depression.

Age may also influence the relationship. As age increases, school-based stress intensifies (e.g., academic pressure, peer competition), reducing school identification and peer relationship maintenance, thereby weakening school connectedness (Oelsner et al., 2011) and reducing its protective effect against depression (Henrich et al., 2005; Xu & Fang, 2021). Similarly, Rose et al. (2022) found that school connectedness had a stronger protective effect on mental health for elementary students than for middle school students. We hypothesize that the protective effect of school connectedness on depression weakens with age.

Measurement factors (instruments and data characteristics) may affect the relationship. Different school connectedness measures include the Psychological Sense of School Membership Scale (PSSM) and School Connectedness Scale (SCS). The 18-item PSSM assesses perceived acceptance, teacher-student relationships, and peer relationships (Goodenow, 1993), while the 6-item SCS assesses school belonging and teacher support (Resnick et al., 1997). Differences in content and item number may affect results. Depression measures include the Children' s Depression Inventory (CDI), Centre for Epidemiological Studies Depression Scale (CES-D), and Orpinas Modified Depression Scale (OMDS). The 27-item CDI measures sadness, loneliness, self-image, and social adaptation (Sitarenios & Kovacs, 1999); the 20-item CES-D assesses depressive symptom frequency in the general population over one week, focusing on depressive mood and experience (Radloff, 1977); and the 8-item OMDS measures depressive emotions and behaviors over the past 30 days (Orpinas, 1993). Structural and content differences among these scales may influence the observed relationship. We hypothesize that both school connectedness and depression measurement

instruments moderate the relationship.

Data characteristics may also moderate the relationship. Studies can be categorized as cross-sectional (variables measured at one time point) or longitudinal (variables measured at multiple time points) (Chen et al., 2016). Data characteristics substantially impact variable relationships, with longitudinal data having stronger causal associations than cross-sectional data (Zhang et al., 2020). Compared to cross-sectional data, relationships in longitudinal data often show attenuation or cumulative effects. Multiple longitudinal studies have found that the negative correlation between school connectedness and depression weakens over time (Goering & Mrug, 2022), suggesting a temporal attenuation effect. We hypothesize that the correlation between school connectedness and depression is weaker in longitudinal than in cross-sectional data.

Contextual features (culture and era) may influence the relationship. Regarding culture, Chinese collectivist culture emphasizes interdependence, whereas Western individualist culture emphasizes independence (Huang et al., 2018; Hofstede, 1980). Compared to Western culture, which values individual freedom and choice (Huang et al., 2018; Hofstede, 1980), Chinese individuals with interdependent self-construal focus more on connections with others and desire collective acceptance and support (Chen et al., 2003; Markus & Kitayama, 1991). Therefore, positive school connectedness may be more beneficial for Chinese individuals' psychosocial adaptation and depression reduction. Similarly, research shows that positive emotional connections correlate more strongly with mental health in collectivist than individualist cultures (Park et al., 2013). We hypothesize that the relationship between school connectedness and depression is stronger in Chinese culture than in Western culture.

Regarding era, the chronosystem in ecological systems theory emphasizes examining individual psychological and behavioral development by combining time and environmental contexts. With societal development and changes, school-based stress has increased (e.g., academic pressure, peer competition) (Yu & Wang, 2020), which may weaken the protective effect of school connectedness on depression. We hypothesize that the correlation between school connectedness and depression weakens with increasing publication year.

1.3 Research Objectives and Questions

In summary, this study uses meta-analysis to systematically review and analyze existing research on the relationship between school connectedness and depression, quantitatively confirming the strength of this relationship and its potential influencing factors from a macro perspective. This approach helps clarify theoretical controversies and provides evidence for depression interventions. Using meta-analytic methods, this study addresses two core questions: (1) whether and to what extent school connectedness is related to depression; and (2) whether this relationship is moderated by participant characteristics (gender, age), measurement factors (measurement instruments, data character-

istics), and contextual features (culture, era).

2 Methods

To ensure systematicity and replicability, this study followed the PRISMA 2020 guidelines for literature search, screening, coding, quality assessment, and publication bias evaluation (Page et al., 2021).

2.1 Literature Search and Screening

This study aimed to examine the relationship between school connectedness and depression. Since school connectedness and school belonging are often used interchangeably in research (Baumeister & Leary, 1995; Goodenow & Grady, 1993; Libbey, 2004; Korpershoek et al., 2020), we conducted comprehensive searches. In Chinese databases (CNKI, Wanfang, VIP), we combined "学校联结" or "学校归属" with "抑郁." In English databases (Web of Science, PubMed, Science Direct), we combined "school connectedness" or "school belonging" with "depress" or "depression." Additional relevant studies were identified through reference lists. The search concluded on June 19, 2023, yielding 1,131 articles.

Literature was imported into EndNote X9 and screened according to these criteria: (1) quantitative empirical studies only, excluding theoretical reviews, conference abstracts, case studies, and qualitative research; (2) studies reporting correlation coefficients (r) between school connectedness and depression; (3) clear sample sizes; (4) duplicate publications excluded (when a dissertation was published as a journal article, the published version was used); (5) studies not reporting required effect sizes but providing them upon author request were included. The screening process is shown in Figure 1 [Figure 1: see original paper].

2.2 Literature Coding and Quality Assessment

Two authors independently coded each study on: (A) author; (B) data characteristics (cross-sectional/longitudinal); (C) publication year; (D) cultural context (using Hofstede' s (1984) cultural data, classifying the US, Australia, Canada, UK, and Germany as Western); (E) gender (percentage of females); (F) mean age (at depression measurement); (G) school connectedness measure (e.g., PSSM, SCS); (H) depression measure (e.g., CDI, CES-D); and (J) effect size (correlation coefficient). Coding principles: (1) if a study reported separate effect sizes for different participant groups, each was coded separately; (2) each independent sample was coded once, with multiple independent samples coded individually; (3) multiple variable indicators were coded separately. Inter-coder reliability was high (Kappa = 0.963), with discrepancies resolved through discussion.

Quality assessment used the NIH Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies, scoring each criterion as met (1) or not

met (0). Cross-sectional study scores ranged 0–8; longitudinal study scores ranged 0–14. Quality scores are reported in Appendix A, with higher scores indicating better quality.

2.3 Effect Size Calculation

Correlation coefficients between school connectedness and depression were extracted from each study. Since correlation coefficients are not normally distributed, all correlations were converted to Fisher' s z scores for main effect and moderator analyses (Cooper et al., 2019), then converted back to correlation coefficients for interpretation. Following Cohen (1992), correlations of 0.10, 0.30, and 0.50 were considered small, medium, and large effects, respectively.

2.4 Model Selection

Most primary studies reported multiple effect sizes from the same sample, creating dependency among effect sizes. Traditional meta-analysis assumes independence and extracts only one effect size per study, ignoring this dependency and potentially overestimating overall effects (Lipsey & Wilson, 2001). In contrast, three-level meta-analysis accounts for effect size dependency by decomposing variance into three levels: Level 1 (sampling error), Level 2 (within-study variance across effect sizes), and Level 3 (between-study variance) (Cheung, 2014). This approach maximizes information retention and statistical power (Assink & Wibbelink, 2016). Therefore, this study used three-level meta-analysis for main effect tests, heterogeneity tests, moderator analyses, publication bias assessment, and sensitivity analysis.

2.5 Heterogeneity and Moderator Analyses

One-tailed log likelihood ratio tests assessed whether Level 2 and Level 3 variances were significant, indicating heterogeneity warranting moderator analysis (Gao et al., 2023). Moderators were entered as covariates in three-level models to estimate their effects. Moderators included: (1) continuous variables: percentage of female participants, mean age, publication year; and (2) categorical variables: school connectedness measure, depression measure, data characteristics, cultural context. Following Card (2012), moderator levels with fewer than 5 effect sizes were excluded to ensure representativeness.

2.6 Publication Bias Assessment

Publication bias (the tendency for statistically significant results to be published) was assessed using multiple methods (Reed et al., 2015). Funnel plots, Egger-MLMA regression (Rodgers & Pustejovsky, 2021), and trim-and-fill methods were used. Symmetrical funnel plots indicate minimal bias. Egger-MLMA regression is superior to traditional Egger regression when effect sizes are non-independent. A non-significant Egger-MLMA result suggests minimal bias.

When Egger-MLMA was significant ($p < 0.05$) or funnel plots were asymmetrical, trim-and-fill analysis assessed publication bias impact; if trimmed effect sizes did not substantially change, results were considered robust (Duval & Tweedie, 2000).

2.7 Sensitivity Analysis

With correlation coefficients ranging from -0.74 to 0.14, outlier effects could risk spurious conclusions (Kepes & Thomas, 2018). Sensitivity was assessed using leave-one-out and three-level Cook' s distance methods. Leave-one-out sequentially removed each effect size and each primary study, re-analyzing the data until all had been removed once (Dodell-Feder & Tamir, 2018). Cook' s distance removed effect sizes or studies with distances > 4/(n-k-1) (Fox, 2019).

2.8 Data Processing

Analyses were conducted in R 4.2.0 using the metafor package (Viechtbauer, 2010), with code adapted from Assink and Wibbelink (2016) and Rodgers and Pustejovsky (2021). All model parameters were estimated using restricted maximum likelihood. Two-tailed $p < 0.05$ was considered significant. Formulas are provided in Appendix C.

3 Results

3.1 Literature Inclusion and Quality Assessment

The meta-analysis included 87 studies (87 independent samples, 206 effect sizes, N = 177,828), published 1999–2023. Study characteristics are summarized in Table 1 . The 61 cross-sectional studies scored 5–8 (M = 6.46), above the theoretical mean of 4; the 26 longitudinal studies scored 7–12 (M = 10.23), above the theoretical mean of 7. Overall, included studies were of good quality.

3.2 Main Effect and Heterogeneity

Three-level meta-analysis revealed a significant negative correlation between school connectedness and depression ($r = -0.39$, $df = 205$, $p < 0.001$), 95% CI [-0.41, -0.34], representing a medium effect (Cohen, 1992).

One-tailed log likelihood ratio tests showed significant within-study (Level 2) variance ($\sigma^2 = 0.01$, $p < 0.001$) and between-study (Level 3) variance ($\sigma^2 = 0.02$, $p < 0.001$). Variance decomposition indicated 1.86% from sampling error (Level 1), 31.41% from within-study variance (Level 2), and 66.73% from between-study variance (Level 3). Thus, moderator analyses were warranted.

3.3 Publication Bias and Sensitivity

The funnel plot (Figure 2 [Figure 2: see original paper]) showed asymmetry. Egger-MLMA regression was significant ($t = -2.41$, $df = 204$, $p = 0.02$), intercept

= -1.27, 95% CI [-2.31, -0.23]. Trim-and-fill analysis required adding 55 effect sizes to the right side to achieve symmetry. After trimming, the main effect was reduced (r = -0.20, p < 0.001) but remained significant.

Leave-one-out analysis showed that removing one effect size from Midgett and Doumas (2019) yielded the weakest correlation (r = -0.39, df = 204, p < 0.001), while removing one from Datu et al. (2022) yielded the strongest (r = -0.40, df = 204, p < 0.001). Removing entire studies showed similar robustness, with correlations ranging from r = -0.39 to -0.40, all significant and medium in magnitude.

Three-level Cook' s distance identified 10 potentially influential effect sizes; removing them yielded r = -0.37, with significant Level 2 (σ^2 = 0.01, p < 0.001) and Level 3 (σ^2 = 0.01, p < 0.001) variance. Removing 4 influential studies yielded r = -0.38, also with significant heterogeneity. Sensitivity analyses confirmed robust results minimally affected by outliers.

3.4 Moderator Effects

Meta-regression results are shown in Table 2 . **Gender** significantly moderated the relationship, F(1, 197) = 4.84, p = 0.03, with stronger negative correlations as female proportion increased (β = -0.00, p = 0.03). **Data characteristics** significantly moderated the relationship, F(1, 204) = 58.75, p < 0.001, with stronger correlations in cross-sectional (r = -0.42) than longitudinal data (r = -0.27). **Depression measurement instrument** significantly moderated the relationship, F(4, 137) = 6.83, p < 0.001. CDI showed the strongest correlation (r = -0.62), OMDS the weakest (r = -0.15). CDI effects were significantly stronger than CES-D (β = -0.20, p < 0.001), while OMDS effects were significantly weaker (β = 0.20, p < 0.05). MFQ and RADS did not differ significantly from CES-D. **Age** marginally moderated the relationship, F(1, 175) = 3.83, p = 0.052, with weaker negative correlations as age increased (β = 0.01, p = 0.052). No other moderators were significant.

4 Discussion

4.1 The Relationship Between School Connectedness and Depression

Despite numerous theoretical and empirical studies, results remain inconsistent, necessitating integration for clearer conclusions. Our three-level meta-analysis found a medium-strength significant negative correlation, supporting our hypothesis that stronger school connectedness reduces depression. This provides a provisional conclusion that school connectedness is an important protective factor against depression, consistent with Social Control Theory, Sociometer Theory, and Self-Determination Theory. However, funnel plot and Egger-MLMA results suggest possible publication bias, with trim-and-fill indicating potential overestimation of the main effect.

Significant heterogeneity at both within- and between-study levels indicates

that the main effect should not be interpreted in isolation (Harrer et al., 2021). Depression results from cumulative factors rather than single causes (Wright & Masten, 2005), and school connectedness' s protective effect may be enhanced or diminished by other factors. Therefore, examining moderators is essential for a comprehensive understanding.

4.2 Moderating Variables

Gender significantly moderated the relationship, with stronger negative correlations as female proportion increased, indicating that school connectedness affects female depression more strongly than male depression. This supports our hypothesis. During socialization, females tend to define themselves as part of relationships, while males define themselves as separate from relationships (Davis et al., 2019; Yang et al., 2021). Females are more likely to seek support from teachers and peers to cope with stress (Yang et al., 2021), making school connectedness more protective for females. This aligns with Allen et al.' s (2018) meta-analysis finding that females report higher school connectedness.

Age also moderated the relationship as hypothesized: the negative correlation weakened as mean age increased, indicating that school connectedness' s protective effect diminishes with age. As school stress increases with age, school connectedness may weaken (Oelsner et al., 2011), reducing its protective effect (Henrich et al., 2005; Xu & Fang, 2021). This aligns with Rose et al. (2022) and partially supports Source Congruence Theory: when stress and protective factors both originate from school, protection diminishes as stress increases. High school connectedness may lead students to suppress depression to meet expectations, causing accumulation (Datu et al., 2022). Future research should directly examine school stress' s role.

Depression measurement instrument significantly moderated the relationship, with CDI showing the strongest effects and OMDS the weakest. CDI comprehensively measures sadness, loneliness, self-image, and social adaptation with more items, making it widely used for youth depression (Liu et al., 2019). OMDS, with fewer items measuring only recent depressive emotions and behaviors, may be less comprehensive. Our findings align with Fried (2017), who found different depression scales yield different results. Notably, **school connectedness measurement instrument** did not moderate the relationship, possibly because different measures share core content and converge sufficiently.

Data characteristics moderated the relationship: cross-sectional data showed stronger correlations than longitudinal data, supporting our hypothesis. As time passes, more factors influence depression (Goering & Mrug, 2022), weakening the school connectedness-depression correlation. This suggests cross-sectional data may inflate correlations, and future research should collect data at multiple time points to capture dynamic trends.

Contrary to hypotheses, **culture** did not moderate the relationship. Two explanations are possible: (1) school connectedness is a protective factor in both

Western and Chinese cultures, with consistent overall effects despite cultural differences in independence-interdependence (Huang et al., 2018; Hofstede, 1980); or (2) the effect size distribution was unbalanced, with Chinese culture studies comprising only 15.27% of effect sizes, limiting moderator detection. More cross-cultural research is needed.

Publication year also did not moderate the relationship, consistent with Allen et al. (2018). This may indicate that the relationship strength is stable across time. Alternatively, while school stress has increased (Yu & Wang, 2020), other protective factors (e.g., positive parenting) have also become more effective at buffering school stress (Sari & Sulistiyaningsih, 2023; Liu & Rahman, 2022), potentially offsetting effects on the school connectedness-depression relationship. However, few studies reported data collection years, limiting temporal analysis. Using publication year as a temporal indicator is simplistic (Xin et al., 2013) and may underestimate data timeliness (Oliver & Hyde, 1993). Future research should examine additional temporal indicators.

4.3 Implications

This three-level meta-analysis integrates quantitative research on school connectedness and depression, examining their relationship and moderators. Theoretical and practical implications include: First, age and gender moderate the relationship, but publication year and culture do not, indicating that school connectedness' s protective effect is influenced by individual characteristics while remaining consistent across time and culture. This provides explanations for inconsistent findings and suggests that interventions should consider social environments and individual psychological/physiological characteristics. Second, data characteristics and depression measurement instruments affect relationship strength, highlighting the need to consider measurement timing and instrument selection when evaluating this relationship. Third, the main effect showed medium negative correlation, but trim-and-fill added 55 positive correlations, suggesting possible "double-edged sword" effects. Future interventions should not only enhance school connectedness but also reduce school stress and account for individual differences.

4.4 Limitations and Future Directions

This study has several limitations. First, most primary studies used self-report measures for both variables, risking common method bias and accuracy issues due to memory or social desirability. Future research should combine self-report, other-report, and physiological measures to validate findings. Second, school connectedness comprises three dimensions: school belonging, attitudes about school importance, and social affiliation (Marraccini & Brier, 2017). Dimensions may moderate relationships with mental health (Rose et al., 2022), and differences across dimensions could contribute to heterogeneity. However, most studies only reported total scores, preventing dimensional analysis. Future research should examine dimension-specific relationships. Third, bidirectional relation-

ships may exist (Davis et al., 2019; Klinck et al., 2020), but our correlational design cannot determine directionality. Future research should use cross-lagged designs. Fourth, potential moderators like race (Eugene et al., 2021), hope (Gerard & Booth, 2015), and academic aspirations (Gerard & Booth, 2015) could not be examined due to insufficient reporting. Future meta-analyses should explore these moderators.

Conclusion

This three-level meta-analysis found a significant negative correlation between school connectedness and depression, with higher school connectedness associated with lower depression. The relationship was moderated by gender (stronger for females), age (weakening with age), depression measurement instrument, and data characteristics (stronger in cross-sectional data). No significant moderation was found for publication year, culture, or school connectedness measurement instrument.

References

Allen, K., Kern, M. L., Vella-Brodrick, D., Hattie, J., & Waters, L. (2018). What schools need to know about fostering school belonging: A meta-analysis. Educational Psychology Review, 30, 1–34. https://doi.org/10.1007/s10648-016-9389-8

Anderman, E. M. (2002). School effects on psychological outcomes during adolescence. Journal of Educational Psychology, 94(4), 795. https://doi.org/10.1037/0022-0663.94.4.795

[···remaining references follow the same format as in the original, with English references kept as-is and Chinese references translated appropriately ···]

Appendix A: Quality Assessment of Included Studies

[Quality assessment table content would be presented here, showing study names and scores based on NIH criteria]

Appendix B.1: School Connectedness Measures Summary

[Table summarizing each measure' s name, source, dimensions, scoring, and reliability]

Appendix B.2: Depression Measures Summary

[Table summarizing each measure' s name, source, dimensions, scoring, and reliability]

Appendix C: Data Analysis Formulas

Conversion of r to Fisher' s z (Hedges & Olkin, 1985):

$$z_r = \frac{1}{2}\log_e\left(\frac{1+r}{1-r}\right) = \frac{1}{2}[\log_e(1+r) - \log_e(1-r)]$$

where r is the Pearson correlation coefficient and z_r is the Fisher' s z transformation.

Standard error of the main effect:

$$SE(T) = \sqrt{v}$$

where SE(T) is the standard error and v is the variance of the main effect.

Conversion of z_r back to r:

$$r = \frac{e^{2z_r} - 1}{e^{2z_r} + 1}$$

where e is the exponential function.

Three-level meta-analysis model:

Level 1: $y_{ij} = \lambda_{ij} + e_{ij}$

Level 2: $\lambda_{ij} = \kappa_j + u_{ij}^{(2)}$

Level 3: $\kappa_j = \beta_0 + u_j^{(3)}$

where y_{ij} is the ith effect size in study j, λ_{ij} is the "true"effect size, e_{ij} is sampling error, κ_j is study j's average effect, β_0 is the overall mean effect, and $Var(u_{ij}^{(2)}) = \tau^{(2)}$ and $Var(u_j^{(3)}) = \tau^{(3)}$ represent Level 2 and Level 3 heterogeneity.

Mixed-effects model with covariate:

$$y_{ij} = \beta_0 + \beta_1 X_{ij} + u_{ij}^{(2)} + u_j^{(3)} + e_{ij}$$

where X is the covariate and other terms are as defined above.

Note: Figure translations are in progress. See original paper for figures.