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Participant and Intervention Characteristics that Moderate Treatment Outcomes among Adolescents with Anxiety and Anxiety-Related Symptoms among Adolescents Aged 12–18 Years

Priscillah Ndiangui^{1*}, Peter Laban Ayiro², Caroline Ayuya³

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ABSTRACT

Anxiety and anxiety-related symptoms are major mental health concerns during adolescence that impair psychosocial and academic functioning. This systematic review and meta-analysis synthesised therapeutic interventions for anxiety in adolescents aged 12–18 years and investigated moderators. We conducted the review following PRISMA 2020 guidelines, and searches across major databases identified eligible studies published from January 2004 to December 2024. Effects were expressed as Hedges' g and pooled using random-effects models, with risk of bias and certainty assessed via RoB 2 and GRADE. Fourteen independent studies from 10 countries were included (12 psychological, 1 pharmacological and 1 combined). The overall pooled effect was statistically significant (Hedges' $g = 0.417$, 95% CI [0.203, 0.632], $p < .001$), with substantial heterogeneity ($I^2 = 74.41\%$) and a prediction interval of -0.352 to 1.186 . Valid between-category comparisons across intervention types were precluded because the pharmacological and combined categories each contained only one study. Delivery format showed a significant omnibus association among psychosocial categories, Q between (2) = 8.94, $p = .011$, without establishing pairwise superiority. Trim-and-fill analysis adjusted the pooled effect to $g = 0.295$. The overall certainty of the evidence was rated as moderate. The findings indicate a positive average intervention effect with considerable variability. Because the prediction interval crossed zero, effects in future comparable settings may vary, highlighting the need to interpret outcomes as an average association rather than uniform effectiveness and underscoring the need for further research on pharmacological and combined approaches.

INTRODUCTION

Adolescence spans ages 10 to 19 (WHO, 2023a, 2024). It is a critical developmental period marked by rapid neural, hormonal, physical, cognitive, and emotional changes (Mansoor, 2024; Steinberg, 2023). Current research evidence divides this period into three distinct sub-stages. Early adolescence (ages 9–12) marks the onset of puberty, increased social awareness, and early changes in emotional regulation (Steinberg, 2023). Subsequently, middle adolescence (ages 13–15) is signified by a deeper sense of personal identity, heightened peer influence, and intensified concerns about social acceptance and self-image (Steinberg, 2023; Wang *et al.*, 2023). Finally, late adolescence (ages 16–18) represents a critical transitional phase wherein adolescents navigate intense pressures to establish independence. During this stage, adolescents face critical choices regarding university education, tertiary education paths, and professional training that can strain their ability to cope and trigger deep anxiety (Steinberg, 2023). This study focused specifically on the broader 12- to 18-year-olds.

Anxiety is a natural emotion experienced by adolescents aged 12–18 in their daily lives, which can sometimes progress into a lasting illness that severely impairs functioning (Penninx *et al.*, 2021). As a result, adolescents experiencing these difficulties present with a range of

physical and emotional symptoms, including excessive worry, persistent sadness, irritability, restlessness, and feelings of worthlessness and hopelessness. Furthermore, they lose interest in activities they previously enjoyed, such as games and hobbies, and display changes in appetite, with some experiencing a drop and others an increase. Consequently, they face challenges with concentration and decision-making, which, in severe cases, may result in suicidal thoughts (Penninx *et al.*, 2021). The American Psychiatric Association's DSM-5-TR defines anxiety disorders as persistent and extreme fear, anxiety, and associated behavioural disturbances that severely affect activities of daily living (ADLs) (APA, 2022; Barnhill, 2024). Similarly, the ICD-10 classifies them as ailments where anxiety is the prime feature and is not limited to any specific set of circumstances (WHO, 2024). For adolescents aged 12–18, these symptoms exceed their ability to cope with everyday stress. While anxiety helps adolescents remain focused, it changes into a clinical concern when neural systems struggle to regulate emotional stimulation, leading to persistent tension and avoidance behaviours (Penninx *et al.*, 2021). Clinicians generally classify these disorders according to specified criteria and symptom duration. For instance, generalised anxiety disorder (GAD) is signified by excessive worry for at least six months, while social anxiety disorder (SAD) is

¹ Doctor of philosophy student in Clinical Psychology, Daystar University, Kenya

² Professor of Research Methods and Statistics, Daystar University, Kenya

³ Senior Lecturer, Clinical Psychology, Daystar University, Kenya

* Corresponding author's e-mail: gathigia.pn@gmail.com

characterised by an intense fear of being evaluated (APA, 2022; Barnhill, 2024).

Globally, 15.2% of adolescents experience a mental condition, and anxiety ranks as the most widespread at 4.9% when assessed against diagnostic criteria (Tinsae *et al.*, 2024; WHO, 2024). Diagnostic interview studies report a lifetime anxiety disorder rate of 31.9% among U.S. adolescents aged 13–18 as per the foundational study by Kessler *et al.*, (2005). Symptom-based school surveys, by contrast, report elevated anxiety symptoms in 24.0% of secondary school students in China (Chen *et al.*, 2023) and 19.3% of adolescents in the United Kingdom (WHO, 2023a). Regional diagnostic evidence from Africa indicates a 12-month anxiety disorder rate of 11.2% in South Africa (Greene *et al.*, 2021). School-based screening research in Kenya identified anxiety symptoms in 22.4% of adolescents aged 13–18 (Osborn *et al.*, 2022). Additionally, anxiety is the leading adolescent mental health concern, as per the Kenya National Adolescent Mental Health Survey (APHRC, 2022), and broader surveys show that 30.38% of Kenyan adolescents meet clinical thresholds for anxiety symptoms (Osborn *et al.*, 2022). These figures illustrate why the present review distinguishes diagnosed anxiety disorders from elevated anxiety symptoms when synthesising intervention evidence.

There is considerable evidence to suggest that cognitive behavioural therapy (CBT) is an effective intervention for adolescent anxiety because it equips them with skills that help them with cognitive restructuring and behaviour modification (Pegg *et al.*, 2022; James *et al.*, 2020). It has been suggested that in cases where psychological intervention alone is ineffective for severe anxiety symptoms in adolescents aged 12–18 years, combining psychological interventions such as Cognitive Behavioural therapy (CBT) with pharmacological interventions provides relief (Strawn *et al.*, 2022). Notably, selective serotonin reuptake inhibitors (SSRIs) like fluoxetine, sertraline, and escitalopram (Casares *et al.*, 2024). Consequently, adolescents presenting with severe symptoms benefit from combining SSRIs with CBT, which produces larger quantifiable symptom reduction than individual intervention (Rapee *et al.*, 2023; Strawn *et al.*, 2022; Yumkhaibam *et al.*, 2024). Despite the availability of these interventions, existing therapeutic intervention evidence remains fragmented, leaving clinicians without clarity on effective interventions for anxiety symptoms and disorders affecting adolescents aged 12–18 years. Therefore, this meta-analysis addressed this gap by systematically synthesising the effectiveness of current interventions for adolescent anxiety symptoms and identifying moderators that affect the success of the interventions, as well as identifying participant and intervention characteristics that moderate treatment outcomes among adolescents with anxiety and anxiety-related symptoms among adolescents aged 12–18 years.

LITERATURE REVIEW

The literature demonstrates that adolescent anxiety is a substantial mental health concern and that psychological,

pharmacological, and combined interventions have all been evaluated as treatment approaches. The evidence is unevenly distributed across intervention categories, populations, settings, and geographic regions, with direct implications for the interpretation of the present meta-analysis. Psychological interventions constitute the largest and most methodologically mature evidence base. The magnitude of effects varies substantially depending on whether the intervention is targeted or universal, whether delivery is task-shifted or specialist, and whether the sample is clinically diagnosed or drawn from the general population. The pharmacological evidence base is concentrated in fewer trials than the psychological literature, and it carries safety signals that require monitoring alongside estimates of effectiveness.

Across the moderator syntheses, delivery format and facilitator characteristics emerge as the most consistent sources of variation in treatment effects, while demographic characteristics such as age and gender produce inconsistent findings across reviews (Norris & Kendall, 2021; Zhou *et al.*, 2025). This pattern supports the present review's decision to examine delivery format and intervention duration as pre-specified moderators, while interpreting demographic moderators with caution. These methodological observations collectively support the present review's decision to extract adverse events where reported, to examine delivery format and intervention duration as pre-specified moderators, and to interpret moderator findings cautiously in light of the small evidence base and the uneven reporting across studies.

MATERIALS AND METHODS

Philosophical Underpinnings

This study was grounded in the positivist paradigm, which views reality as measurable and independent of human interpretation (Dulal, 2025). Positivism supports the use of randomised controlled trials (RCTs) and meta-analysis to generate objective and verifiable evidence. It aligns with evidence-based practice (EBP), which integrates empirical data with clinical expertise and patient needs.

Research Design

This was a systematic review coupled with meta-analytic techniques, a methodological approach widely recognised as the highest level of evidence synthesis within the empirical research hierarchy (Borenstein *et al.*, 2021; Higgins *et al.*, 2022). The systematic review component followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework (Page *et al.*, 2021), ensuring a methodical and replicable search and selection process. A structured search strategy was executed across multiple electronic databases, including PubMed, PsycINFO, Scopus, and the Cochrane Library, to capture both clinical and community-based research on adolescent anxiety interventions. Database-specific search terms and Boolean operators (e.g., “adolescent anxiety” AND “therapy” AND “clinical trial”) were optimised to maximise retrieval sensitivity and specificity.

Meta-Analysis

The meta-analysis employed a random-effects model, recognising that true effect sizes may vary across studies due to differences in sample populations, intervention protocols, and outcome measures. Effect sizes were calculated as standardised mean differences (SMDs) to enable comparisons between studies that employed different scales and metrics. Heterogeneity was quantitatively assessed using the I^2 statistic, which estimates the percentage of variance attributable to true differences rather than chance variation. Elevated I^2 values indicated substantial heterogeneity, necessitating further exploration through subgroup analyses. Cochran's Q test assessed whether observed variability exceeds that expected from sampling error alone. Publication bias was examined through visual inspection of funnel plots, which may indicate selective reporting of significant results, and statistically evaluated using Egger's regression test. Sensitivity analyses were conducted by systematically excluding individual studies to evaluate the stability of pooled estimates. Forest plots provided visual summaries of individual study effects and overall pooled effect sizes, facilitating interpretation of treatment effect magnitude and consistency. The integration of these methodological approaches ensures rigorous and nuanced synthesis of evidence concerning therapeutic intervention efficacy for adolescent anxiety disorders.

Inclusion and Exclusion Criteria

Studies involving adolescents aged 12–18 years were eligible if they evaluated a psychological, pharmacological, or combined intervention and reported anxiety symptoms or anxiety-related outcomes using a validated measure or clinical assessment. Studies included adolescents with a diagnosed anxiety disorder (separation anxiety, selective mutism, social anxiety, generalized anxiety disorder (GAD), and panic disorder), clinically significant anxiety symptoms, or broader adolescent populations where anxiety was a prespecified outcome of the intervention. Studies were excluded if they were not primary empirical data on human subjects, if the principal diagnosis was not a primary anxiety disorder, if participants fell outside the 12-18 age range or have severe developmental disorders, if the design is non-randomized, if interventions are part of multi-component programs without disaggregated data, if there is a lack of sufficient quantitative data or use of non-validated anxiety measures, or if they are grey literature or non-English publications.

Search Strategy

In alignment with PRISMA 2020 guidelines (Page *et al.*, 2021) and established methodological standards (Higgins *et al.*, 2022), this investigation employed a comprehensive and transparent search process to capture all pertinent literature that met the predefined eligibility criteria. Such rigour is essential for minimising selection bias and enhancing the validity, reliability, and reproducibility of the review findings. The search focused on peer-reviewed empirical studies evaluating psychological interventions for

adolescent anxiety disorders. It included multiple electronic bibliographic databases Cochrane Library, Google Scholar, Jstor, PubMed, PsycINFO, Scopus, and Web of Science selected for their complementary strengths: Cochrane Library for systematic reviews and high-quality clinical evidence, PubMed and PsycINFO for comprehensive coverage of medical and psychological research, Scopus and Web of Science for multidisciplinary indexing and citation tracking, and Google Scholar and Jstor for broader access to academic literature.

A Boolean search framework was employed, integrating terms relating to the population (e.g., “adolescent”), the condition under study (e.g., “anxiety disorders”), the interventions of interest (e.g., “cognitive behavioural therapy,” “psychotherapy,” “pharmacotherapy,” “combined therapy”), and methodological filters for randomised controlled trials and clinical trials. Controlled vocabulary (e.g., MeSH terms in PubMed) was combined with free-text keywords to optimise both sensitivity and specificity. Search parameters were constrained to English-language publications released between January 2000 and December 2025 to ensure that the evidence base reflects contemporary clinical practices and intervention modalities.

Statistical Analysis

The data analysis in this systematic review and meta-analysis employed a multi-tiered statistical framework designed to ensure methodological rigour, analytical precision, and interpretive validity. Descriptive statistics were computed to characterise the included studies, thereby providing a foundational understanding of the dataset before meta-analytic synthesis. To assess the comparative effectiveness of psychological interventions for adolescent anxiety disorders, Hedges' g was computed for each study. Effect sizes were interpreted according to conventional benchmarks: $g \approx 0.20$ (small), $g \approx 0.50$ (medium), and $g \geq 0.80$ (large). The primary outcome variable was anxiety symptom reduction, as measured by validated and standardised instruments. Where necessary, effect sizes were recalculated from reported statistics (e.g., t -tests, F -tests, means and SDs) to enable comparability across diverse outcome metrics. A p -value threshold of 0.05 was used to assess statistical significance in all primary analyses, with two-tailed testing. 95% confidence intervals (95% CIs) were reported for all effect size estimates to convey precision. All analyses were conducted using Comprehensive Meta-Analysis (CMA) v4 and R (packages metafor and meta), ensuring computational accuracy and reproducibility. Comprehensive Meta-Analysis (CMA) version 4 was used for all statistical tests in this work, and R statistical software was employed with relevant packages, including meta, metafor, and dmetar, to ensure accuracy, transparency, and reproducibility in computational procedures.

RESULTS AND DISCUSSIONS

Search Results

A rigorous literature search was performed across seven databases: PubMed, Scopus, Medline, Cochrane Library, Web of Science, JSTOR, and Google Scholar. The search

strategy combined keywords such as ‘adolescent anxiety,’ ‘cognitive behavioral therapy,’ ‘pharmacological treatment,’ and ‘meta-analysis.’ The systematic search initially identified 1,154 records. After cross-database comparison, 96 duplicate studies, primarily overlapping between Scopus and Web of Science, were removed using both EndNote software and manual verification to ensure precision. This process resulted in 1,058 unique records. From the initial 1,154 records, 96 duplicates were removed, leaving 1,058

unique papers. Title and abstract screening excluded 274 studies focused on adult populations. Of 784 full-text articles, 231 were excluded for lacking adolescent anxiety outcomes. After methodological and statistical screening, 198 were further excluded for missing control groups or inconsistent outcome metrics. Following quality appraisal using the ROB 2 and ROBINS-I tools, 25 studies were retained for synthesis.

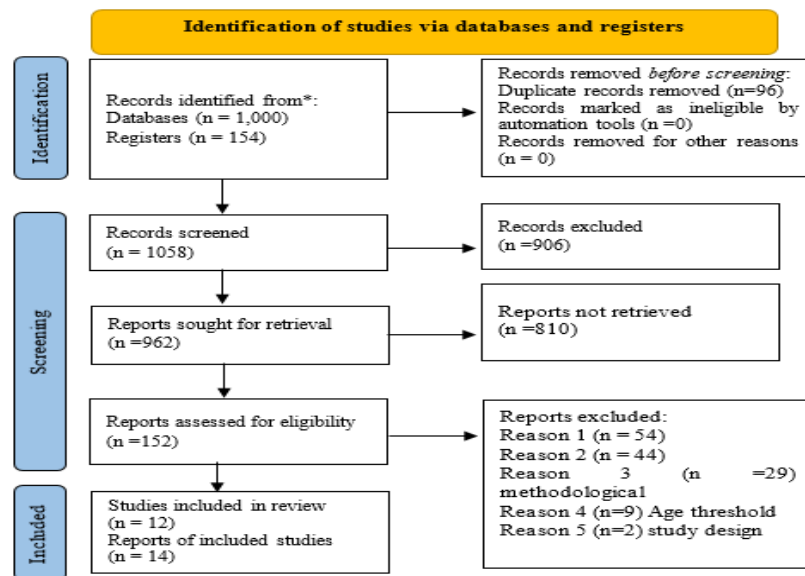


Figure 1: PRISMA Flow Summary of Study Selection

Metanalysis Results

Psychological interventions were present in 12 of the 14 studies, thereby providing the largest body of evidence. The category included face-to-face, digital or online, and blended or mixed delivery interventions. The breadth of

this category suggests that the psychological evidence should not be interpreted as a single, uniform intervention protocol. Psychological interventions ($k = 12$) produced $g = .398$, 95% CI [.165, .630], $p < .001$.

Table 1: Metanalysis Results

Category	k	g	SE	95% CI	p	τ	τ^2
Psychological	12	.398	.119	[.165, .630]	< .001	.344	.118

Assessment of Heterogeneity

Heterogeneity was assessed using Cochrane’s Q-statistic ($Q = 31.62$, $df = 22$, $p = .052$) and $I^2 = 35\%$, indicating moderate heterogeneity, with approximately one-third of the variability in observed effects attributable to genuine study differences rather than random error. This

moderate level of heterogeneity is typical in psychosocial meta-analyses and underscores realistic diversity among intervention settings and populations.

Publication Bias Assessment

Begg and Mazumdar’s test was not statistically significant,

Table 2: Publication Bias Assessment

Analysis	Statistic/result	p	Interpretation
Begg & Mazumdar	$\tau = .189$; $z = .931$	.352	Not statistically significant
Begg, continuity corrected	$\tau = .176$; $z = .876$	.381	Not statistically significant
Egger regression	Intercept = 2.362; SE = 1.341; $t(12) = 1.762$	.104	Not statistically significant
Classic fail-safe N	178 hypothetical null-effect studies	—	Supplementary robustness indicator
Trim and fill	2 studies imputed	—	Possible asymmetry
Observed random-effects	$g = .417$, 95% CI [.203, .632]	< .001	Primary pooled estimate
Adjusted random-effects	$g = .295$, 95% CI [.043, .548]	—	Attenuated but CI remains above zero

Kendall's $\tau = .189$, $p = .352$, and Egger's regression test was also not statistically significant, intercept = 2.362, $p = .104$. Duval and Tweedie's trim-and-fill procedure imputed two studies and reduced the random-effects estimate to $g = .295$, with a 95% CI of [.043, .548]. The adjusted confidence interval remained above zero, although the reduction indicates uncertainty about the precise magnitude of the pooled effect. The classic fail-

safe N was 178 and is treated as supplementary rather than decisive evidence.

Sensitivity Analysis

The pooled Hedges' g estimates ranged from .319 to .461 across the leave-one-out analyses, compared with .417 in the primary model. Removal of Ijaz *et al.* (2024) produced the largest reduction in the pooled estimate, to $g = .319$

Table 3: Primary Model and Sensitivity Model Excluding Ijaz *et al.* (2024)

Study Removed	k	Hedges' g	95% CI
None: Primary model	14	.417	[.203, .632]
Arman <i>et al.</i> (2017)	13	.424	[.199, .650]
Ding & Yao (2020)	13	.411	[.179, .644]
Gaesser & Karan (2017)	13	.406	[.181, .632]
Haugland <i>et al.</i> (2020)	13	.436	[.191, .681]
Herbert <i>et al.</i> (2009)	13	.444	[.217, .670]
Ijaz <i>et al.</i> (2024)	13	.319	[.175, .463]
O'Dea <i>et al.</i> (2020)	13	.453	[.221, .686]
Osborn <i>et al.</i> (2023)	13	.415	[.177, .653]
O'Connor <i>et al.</i> (2020)	13	.445	[.223, .667]
Schleider & Weisz (2018)	13	.434	[.202, .666]
Spence <i>et al.</i> (2011)	13	.437	[.209, .666]
Sportel <i>et al.</i> (2013)	13	.461	[.241, .682]
Stjerneklar <i>et al.</i> (2019)	13	.399	[.174, .624]
Strawn <i>et al.</i> (2020)	13	.392	[.171, .613]

Note: The sensitivity model removes only Ijaz *et al.* (2024); all other studies are retained.

(95% CI [.175, .463]). This analysis also produced the largest reduction in heterogeneity, with I^2 decreasing from 74.41% in the primary model to 43.59%.

Moderator Analyses

Pre-specified moderator analyses were conducted to examine whether selected study characteristics were associated with variation in intervention effects. The analyses included the anxiety population, the comparator condition, the intervention delivery format, and the intervention duration.

Anxiety Population

The studies were classified into three mutually exclusive anxiety-population categories: diagnosed anxiety disorder, elevated or symptom-defined anxiety, and broader adolescent populations. Studies involving diagnosed anxiety disorders produced a pooled Hedges' g of 0.411 (95% CI [.0135, 0.688]). Studies involving elevated or symptom-defined anxiety produced a pooled g of 0.514 (95% CI [.0121, 0.907]). Studies involving broader adolescent populations produced a pooled g of 0.303 (95% CI [-0.108, 0.713]). The omnibus test did not

Table 4: Subgroup Analysis by Anxiety Population

Population Status	k	Hedges' g	95% CI	p
Diagnosed	5	.411	[.135, .688]	.003
Symptom-defined/elevated	7	.514	[.121, .907]	.010
General/broader	2	.303	[-.108, .713]	.148
Between-group test	—	—	Qbetween(2) = .533, $p = .766$	—

Note: Source: Researcher analysis.

indicate a statistically significant difference among the three population categories, $\chi^2_{\text{between}}(2) = 0.533$, $p = .766$. The subgroup findings are presented in Table 4.

Comparator Condition

Studies using active or placebo comparators produced a pooled Hedges' g of 0.409 (95% CI [.0236, 0.582]). Studies using waitlist or no-treatment comparators

produced a pooled g of 0.520 (95% CI [.0137, 0.903]). The difference between the two comparator categories was not statistically significant, $Q_{\text{between}}(1) = 0.267$, $p = .605$. The subgroup findings are presented in Table 5.

Intervention Delivery Format

The studies were classified according to the pre-specified mode of intervention delivery. Seven studies were

Table 5: Subgroup Analysis by Comparator Condition

Comparator	k	Hedges' g	95% CI	p
Active/placebo	7	.409	[.236, .582]	< .001
Waitlist/no treatment	7	.520	[.137, .903]	.008
Between-group test	—	—	Qbetween(1) = .267, p = .605	—

Note: Source: Researcher analysis.

classified as face-to-face, four as digital, and two as blended. The pharmacological study was excluded from this analysis because medication administration does not constitute a psychosocial delivery format. The face-to-face subgroup produced a pooled Hedges' g of 0.611 (95% CI [0.261, 0.961]). The digital subgroup produced a pooled g of 0.246 (95% CI [-0.030, 0.523]). The blended subgroup produced a pooled g of 0.014 (95% CI [-0.227, 0.254]).

The omnibus test indicated a statistically significant difference among the three psychosocial delivery categories, χ^2 between (2) = 8.94, p = .011. Since the categories differed in intervention type, this finding should be interpreted as an association between the predefined delivery categories rather than as evidence that delivery format alone accounted for differences in effect size. The subgroup findings are presented in Table 6.

Table 6: Subgroup Analysis by Psychosocial Intervention Delivery Format

Delivery Format	k	Hedges' g	95% CI	p
Face-to-face	7	.611	[.261, .961]	< .001
Digital/online	4	.246	[-.030, .523]	.081
Blended	2	.014	[-.227, .254]	.911
Between-group test	—	—	Qbetween(2) = 8.94, p = .011	—

Note: The pharmacological study (Strawn *et al.*, 2020) was excluded from the delivery-format analysis because medication administration does not constitute a psychosocial delivery format. Its effect estimate (g = .808, 95% CI [.236, 1.380]) is reported separately in the intervention-category analysis. Source: Researcher analysis.

Intervention Duration

The intervention-duration meta-regression was conducted using the complete-case subset of studies for which treatment duration could be reliably coded in weeks. Of the 14 studies included in the primary meta-

analysis, 10 provided sufficient information to quantify intervention duration in weeks, thereby contributing to the duration meta-regression. Four studies did not provide sufficiently reliable treatment-period information that could be expressed in weeks without introducing

Table 7: Study-Level Intervention Duration and Inclusion in the Duration Meta-Regression

Study	Reported Intervention Duration	Duration Coded in Weeks	Contributed to Duration Meta-Regression
Arman <i>et al.</i> (2017)	4 weekly CBT sessions; D-cycloserine/ placebo for 1 month	4	Yes
Ding & Yao (2020)	8 weeks	8	Yes
Gaesser & Karan (2017)	Pilot intervention; treatment period not reported in weeks	Not codable	No
Haugland <i>et al.</i> (2020)	5- or 10-session programme; treatment period not reported in weeks	Not codable	No
Herbert <i>et al.</i> (2009)	12 weeks	12	Yes
Ijaz <i>et al.</i> (2024)	8 weekly sessions	8	Yes
O'Dea <i>et al.</i> (2020)	4 weeks	4	Yes
Osborn <i>et al.</i> (2023)	1 week; daily sessions	1	Yes
O'Connor <i>et al.</i> (2020)	8 weeks	8	Yes
Schleider & Weisz (2018)	Single session	Not codable	No
Spence <i>et al.</i> (2011)	10 weekly sessions	10	Yes
Sportel <i>et al.</i> (2013)	Treatment period not reported in weeks	Not codable	No
Stjerneklar <i>et al.</i> (2019)	14 weeks	14	Yes
Strawn <i>et al.</i> (2020)	8 weeks	8	Yes

Note: Duration was coded in weeks where the reported treatment period could be reliably established from the study report. Studies for which duration could not be reliably expressed in weeks without unsupported assumptions were treated as missing for the duration moderator analysis. These studies remained in the systematic review and primary meta-analysis. Ten studies contributed to the duration meta-regression; four did not. Source: Researcher analysis.

unsupported assumptions. These studies remained eligible for, and were retained in, the systematic review and primary meta-analysis but were not included in the duration-specific meta-regression. The duration coding for each included study is summarised in Table 7.

The use of the 10-study subset was therefore determined by the availability and codability of the pre-specified moderator variable rather than by study effect size, statistical significance, intervention category, or study quality. A random-effects meta-regression was used to examine the linear association between intervention duration and effect size. The regression coefficient was interpreted as the expected change in Hedges' g per one-week increase in intervention duration. Residual heterogeneity was assessed using the residual τ^2 and Q statistic. Given that only 10 studies contributed data to this moderator analysis, the findings were interpreted with caution due to the limited statistical power of meta-regression with a small sample size.

A random-effects meta-regression was conducted to examine whether intervention duration was associated with the magnitude of the intervention effect. Among the 10 studies with reliably coded duration data, the regression coefficient was $B = 0.0089$ ($SE = 0.0401$),

with a 95% confidence interval of $[-0.0696, 0.0874]$. The test of the regression coefficient was not statistically significant ($z = 0.22, p = .825$). The overall moderator test was likewise not statistically significant, $QM(1) = 0.05, p = .825$. These findings provide no statistical evidence that longer intervention duration was associated with larger intervention effects across the studies included in the meta-regression.

Residual heterogeneity remained after accounting for intervention duration ($Q(8) = 19.25, p = .014$). Thus, intervention duration did not adequately account for the observed variation in effect sizes. Given the small number of studies included in the meta-regression, the finding should be interpreted with caution. It should not be taken as evidence that the duration of intervention is irrelevant to treatment effectiveness. Rather, the analysis indicates that the available evidence does not demonstrate a statistically significant linear association between treatment duration and intervention effect size. A consolidated summary of all four pre-specified moderator analyses is presented in Table 8.

As shown in Table 8, delivery format was the only moderator that produced a statistically significant omnibus result. At the same time, anxiety population

Table 8: Summary of Moderator Analyses

Moderator	k	Test Statistic	p	Interpretation
Anxiety population status	14	$Q_between(2) = 0.533$	.766	Not statistically significant
Comparator type	14	$Q_between(1) = 0.267$	.605	Not statistically significant
Delivery format (psychosocial)	13	$Q_between(2) = 8.94$	.011	Statistically significant omnibus; no pairwise superiority established
Intervention duration	10	$QM(1) = 0.05; B = 0.0089$	.825	Not statistically significant

Note: k = number of studies contributing to the analysis. The delivery-format analysis excluded the pharmacological study (Strawn et al., 2020) because medication administration does not constitute a psychosocial delivery format. The duration analysis included Strawn et al. (2020) because the study reported an eight-week treatment period. The duration analysis used a random-effects meta-regression, where B represents the expected change in Hedges' g per one-week increase in intervention duration—source: Researcher analysis.

status, comparator type, and intervention duration were not statistically significant moderators.

The study examined whether selected study and intervention characteristics are associated with variation in intervention effects. The analysis examined anxiety population status, comparator type, delivery format, and intervention duration. Anxiety population status, comparator type, and intervention duration were not statistically significant moderators, whereas the omnibus test for delivery format was statistically significant. The effect was statistically significant within the diagnosed subgroup, $g = .411$, 95% CI $[.135, .688]$, and within the symptom-defined or elevated-anxiety subgroup, $g = .514$, 95% CI $[.121, .907]$. The broader population subgroup produced $g = .303$, 95% CI $[-.108, .713]$. The between-group test was not statistically significant, $Q_{between}(2) = .533, p = .766$.

This finding is consistent with the empirical literature reviewed in Chapter Two. Studies included in the review evaluated interventions across different levels of clinical need, including formally diagnosed samples (Herbert et al.,

2009; Spence et al., 2011; Stjerneklar et al., 2019; Strawn et al., 2020), symptom-defined or elevated-anxiety samples (Ding & Yao, 2020; Gaesser & Karan, 2017; Haugland et al., 2020; Ijaz et al., 2024; O'Connor et al., 2020; Schleider & Weisz, 2018; Sportel et al., 2013), and broader adolescent populations (O'Dea et al., 2020; Osborn et al., 2023). The absence of a significant between-group difference suggests that the observed intervention effects were not demonstrably dependent on whether participants were formally diagnosed, had elevated anxiety symptoms, or came from broader adolescent populations. This pattern is consistent with Zhou et al. (2025), who found no evidence for child baseline anxiety as a moderator across prevention and treatment contexts. The pattern is also consistent with Panchal et al. (2023), who demonstrated that risk and protective factors operate across multiple socio-ecological domains rather than clustering within a single clinical threshold.

Cognitive-Behavioural Theory proposes that maladaptive threat appraisals, avoidance, and related behavioural processes can maintain anxiety across different levels

of symptom severity (Beck, 1976; Curtiss *et al.*, 2021). The finding that intervention effects were significant within both diagnosed and symptom-defined subgroups is consistent with this proposition. Ecological Systems Theory suggests that treatment response may depend on contextual conditions rather than diagnostic status alone (Bronfenbrenner, 1979; Crawford, 2020). The present results do not support treating diagnostic status as a sufficient explanation for variation in intervention response. The conceptual framework's distinction between anxiety population categories is therefore retained as a descriptive feature of the evidence base. However, the analysis did not establish it as a statistically significant moderator.

Interventions compared with active or placebo conditions produced $g = .409$, 95% CI [.236, .582], whereas those compared with waitlist or no-treatment conditions produced $g = .520$, 95% CI [.137, .903]. The difference between comparator groups was not statistically significant, $Q_{\text{between}}(1) = .267$, $p = .605$. The larger point estimate observed against waitlist or no-treatment conditions is consistent with the empirical literature reviewed in Chapter Two. James *et al.* (2020) noted that intervention effects varied according to comparison conditions. Dülse and Baumeister (2025) reported a moderate effect of internet- and mobile-based interventions compared with passive controls ($g = -0.69$, 95% CI [-0.94, -0.45]) but no significant effect compared with active controls. Li *et al.* (2024) reported that therapist guidance and session structure moderated digital intervention outcomes, and the magnitude of effects was substantially larger when the comparator was passive rather than active. These findings suggest that comparator type may influence the magnitude of observed effects even when the moderator test is not statistically significant. However, the non-significant between-group test in the present review means that the comparator type was not established as a moderator in this meta-analysis.

This finding is relevant to interpretation of the empirical literature because psychological intervention trials frequently use waitlist controls (Haugland *et al.*, 2020; Ijaz *et al.*, 2024; Spence *et al.*, 2011; Stjerneklar *et al.*, 2019), while pharmacological trials may use placebo conditions (Arman *et al.*, 2017; Strawn *et al.*, 2020) and some behavioural trials use active comparators (Ding & Yao, 2020; O'Dea *et al.*, 2020; O'Connor *et al.*, 2020; Schleider & Weisz, 2018; Sportel *et al.*, 2013). Venturo-Conerly *et al.* (2025) additionally demonstrated that symptom reduction in an active study-skills control group outpaced pre-COVID-19 trials by 31% for anxiety and 60% for depression, suggesting that active control conditions teaching life skills may produce mental health benefits when they convey skills of particular contextual relevance. These differences can influence the context in which treatment effects are estimated. The current findings nevertheless indicate that the comparator type did not statistically explain the observed differences

across the included studies. The conceptual framework's inclusion of comparator type as a potential moderator is therefore retained for descriptive purposes but not supported as a statistically significant source of variation. Delivery format was the only moderator that produced a statistically significant omnibus test among the psychosocial delivery categories, χ^2 between (2) = 8.94, $p = .011$. Face-to-face interventions produced $g = .611$, 95% CI [.261, .961]; digital interventions produced $g = .246$, 95% CI [-0.030, .523]; and blended interventions produced $g = .014$, 95% CI [-0.227, .254]. The pharmacological study (Strawn *et al.*, 2020) was excluded from this analysis because medication administration does not constitute a psychosocial delivery format.

This finding is consistent with the empirical literature reviewed in Chapter Two. Studies included in the review evaluated face-to-face interventions (Arman *et al.*, 2017; Ding & Yao, 2020; Gaesser & Karan, 2017; Haugland *et al.*, 2020; Herbert *et al.*, 2009; Ijaz *et al.*, 2024; Osborn *et al.*, 2023), digital interventions (O'Dea *et al.*, 2020; O'Connor *et al.*, 2020; Schleider & Weisz, 2018; Stjerneklar *et al.*, 2019), and blended interventions (Spence *et al.*, 2011; Sportel *et al.*, 2013). The finding that face-to-face interventions produced a larger point estimate than digital interventions is consistent with the literature review's proposal that therapist-led and interpersonal treatment environments may provide more direct opportunities for modelling, feedback, and social reinforcement than fully self-directed digital formats (Cardy *et al.*, 2020; Weisz *et al.*, 2022). This pattern is corroborated across multiple syntheses. Li *et al.* (2024) reported that guided digital programmes ($g = 0.92$, 95% CI [0.52, 1.31]) outperformed unguided programmes ($g = 0.25$, 95% CI [0.02, 0.48]). Tran *et al.* (2025) found that psychological interventions delivered by a live therapist were associated with greater effects ($g = -0.48$, 95% CI [-0.71, -0.25]). Zhang *et al.* (2023) reported that interventions delivered by clinicians produced larger effects at the secondary school level than teacher-delivered interventions, with notably larger impacts on anxiety outcomes than on depression outcomes. Osland *et al.* (2025) reported that school nurse-delivered interventions produced a moderate effect ($d = 0.65$, 95% CI [0.37, 0.92]), though with high heterogeneity ($I^2 = 90\%$). Zhou *et al.* (2025) identified delivery format and facilitator contact time as moderators in the treatment context.

Social Learning Theory provides a theoretical explanation for this finding. The theory emphasises modelling, observation, social reinforcement, feedback, and opportunities for interpersonal learning (Firmansyah & Saepuloh, 2022; Koutroubas & Galanakis, 2022). These mechanisms may be more directly available in therapist-led or interpersonal treatment environments than in fully self-directed digital formats. Ecological Systems Theory provides a complementary interpretation: treatment delivery is embedded within the adolescent's everyday environment, and face-to-face interventions may involve direct interaction with therapists, peers, teachers, or other

social actors, whereas digital interventions may alter the accessibility and location of treatment (Bronfenbrenner, 1979; Crawford, 2020). The observed variation across formats is therefore consistent with the theoretical proposition that treatment effectiveness is partly shaped by the environment in which therapeutic processes occur. However, the statistically significant omnibus result should not be interpreted as demonstrating that one. The digital category included studies with different levels of therapist support, ranging from self-guided programmes (O'Connor *et al.*, 2020; Schleider & Weisz, 2018) to guided interventions with therapist contact (Stjerneklar *et al.*, 2019). Cardy *et al.* (2020) concluded that the evidence does not permit the conclusion that parental involvement improves outcomes, which limits the interpretation of family-involved formats within the delivery-format analysis. The appropriate interpretation is therefore that the predefined delivery categories were associated with different effect-size distributions. Pairwise superiority cannot be inferred from the omnibus test alone. The conceptual framework's inclusion of delivery format as a moderator is supported by the omnibus finding. However, the specific pattern of differences warrants further investigation with a larger, more homogeneous evidence base.

Intervention duration was not a statistically significant moderator of treatment effects in the present meta-analysis. Among the 10 studies for which treatment duration could be reliably coded in weeks, the meta-regression indicated a small positive but statistically nonsignificant association between intervention duration and effect size, $B = .0089$, $SE = .0401$, 95% CI $[-.0696, .0874]$, $z = .22$, $p = .825$. The confidence interval crossed zero, indicating insufficient evidence of a linear relationship between intervention length and treatment effectiveness. The duration model did not account for a substantial proportion of the between-study variance, and significant residual heterogeneity remained after accounting for duration, $Q(8) = 19.25$, $p = .014$. This indicates that factors other than intervention length continued to contribute to differences in observed treatment effects.

The finding should not be interpreted as evidence that intervention duration is irrelevant to treatment effectiveness. Rather, it indicates that the current evidence base does not provide sufficient support for a linear duration-effect relationship. The analysis was based on only 10 studies, which limits statistical power and precision. In addition, treatment duration may interact with other characteristics of interventions, such as treatment intensity, session frequency, intervention modality, adherence, participant characteristics, and clinical severity. Consequently, the absence of a statistically significant linear association should be interpreted cautiously.

This finding differs somewhat from the empirical literature reviewed in Chapter Two. Haugland *et al.* (2020) examined brief and standard school-based CBT and

found that brief CBT was not non-inferior to standard CBT, suggesting that shorter interventions may not yield equivalent outcomes. Zhou *et al.* (2025) found that intervention duration moderated outcomes in targeted prevention but not in universal prevention or treatment contexts. Li *et al.* (2024) reported that the number of sessions moderated digital intervention outcomes, with 6–9 sessions producing the largest effects ($g = 0.97$, 95% CI $[0.58, 1.36]$). Zhang *et al.* (2026) found that the effects of school-based CBT were maintained over longer follow-up periods, although the quality of the evidence was rated as low. Ganzevoort *et al.* (2024) reported null between-group findings for intensive treatments. These findings suggest that duration may matter in specific contexts but does not operate as a linear determinant of treatment effect across the evidence base.

The discrepancy may reflect differences between individual studies and the pooled evidence. Cognitive-Behavioural Theory emphasises the content and mechanisms of treatment rather than duration in isolation (Beck, 1976; Curtiss *et al.*, 2021). Ecological Systems Theory suggests that the context in which treatment is delivered may interact with duration (Bronfenbrenner, 1979; Crawford, 2020). A longer intervention that is poorly matched to the adolescent or poorly implemented may not necessarily produce a larger effect than a shorter, well-targeted intervention. The non-significant finding on duration, therefore, suggests that treatment length should not be interpreted as an independent determinant of treatment success based on the present evidence. The conceptual framework's inclusion of intervention duration as a potential moderator is retained for descriptive purposes, but the analysis did not establish it as a statistically significant source of variation.

CONCLUSION

The analysis did not identify anxiety population status, comparator type, or intervention duration as statistically significant moderators of treatment effectiveness. Specifically with respect to intervention duration, meta-regression showed no statistically significant linear association between intervention duration and effect size. Therefore, longer interventions cannot be assumed, based on the present evidence, to produce larger treatment effects. However, the limited number of studies contributing duration data reduces the statistical power of this analysis. The finding should consequently be interpreted as insufficient evidence of a linear duration-effect relationship rather than evidence that intervention duration does not influence treatment effectiveness. Delivery format was statistically significant in the omnibus moderator analysis. However, this finding should be interpreted cautiously. The analysis established variation across coded delivery categories but did not establish statistically significant pairwise differences. Some categories included relatively few studies, and classifying the pharmacological study added interpretive complexity. The findings, therefore, suggest that the manner in which

an intervention is delivered may be relevant to treatment outcomes. However, further adequately powered research is required to determine which characteristics of delivery account for the observed variation.

The findings do not provide sufficient evidence to justify organising adolescent anxiety services around a single broad intervention category. Adolescent anxiety programmes should incorporate validated outcome measures, treatment-completion monitoring, assessment of accessibility and acceptability, and follow-up where feasible. Programme implementation should also consider provider training, treatment fidelity, culturally responsive adaptation, and routine outcome monitoring. The expansion of digital mental-health services should be accompanied by appropriate clinical governance, safeguarding, privacy protection, referral mechanisms, and outcome evaluation.

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