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Effectiveness of Cognitive-Based Interventions on Psychological Distress in Adolescents With Physical Disabilities: A Systematic Review and Meta-Analysis

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ABSTRACT

Adolescents with physical disabilities experience common psychological distress that interacts with impaired physical function. While cognitive-based interventions have been implemented for adolescents with physical disabilities, their effects on enhancing psychological health remain uncertain. This systematic review aimed to synthesise the effects of cognitive-based interventions on the psychological distress of this population and identify optimal components for evidence-based interventions. Following the PRISMA guideline, nine databases were searched to identify eligible randomised controlled trials examining the effects of cognitive-based interventions for adolescents with physical disabilities from inception to October 2023. Data syntheses were performed using the R software, employing random-effects models. Twelve trials involving 1201 participants were identified. The pooled results revealed that cognitive-based interventions did not yield noticeable effects in reducing anxiety ($g = -0.43$ for postintervention; −0.14 for medium term; −0.37 for long term), depression ($g = -0.05$ for postintervention; −0.02 for medium term; −0.15 for long term) and stress levels ($g = -0.15$) over time. The secondary outcome (physical function) improved significantly in the long term compared to the control groups ($g = 0.31$). Furthermore, this review identified variations in the effectiveness of CBIs among different recipients, durations and modes of delivery. Given the limited number and overall low quality of identified studies for each outcome, conducting high-quality randomised controlled trials is recommended to validate the effectiveness of cognitive-based interventions in reducing psychological distress among adolescents with physical disabilities.

1 | Introduction

Adolescence, as defined by the World Health Organization as the period between 10 and 19 years of age, represents one of the most rapid and formative phases of human development (World Health Organization 2023). This stage is accompanied not only by distinct hormonal and physiological changes but also by notable shifts in social dynamics and emotional responses (Dahl et al. 2018). While most adolescents experience cognitive advancements and cultivate a positive self-identity, this period also carries a heightened susceptibility to mental health problems, with nearly half of all psychiatric disorders originating during adolescence (Rapee et al. 2019; Solmi et al. 2022). Thus, adolescence is a critical and vulnerable stage of development that warrants specific attention and support.

Based on the biopsychosocial model, physical disability refers to a condition where individuals experience significant deviation or impairment in body function or structure, with an impact on their physical activity (World Health Organization 2001). According to the latest report from the United Nations Children's Fund, nearly 240 million children worldwide suffer from disabilities, and 2% of children aged 5–17 have mobility impairments, negatively impacting various aspects of their well-being (United Nations Children's Fund 2021). The management of physical disabilities places an additional burden on adolescents, compounding the challenges they already face during their developmental years. As a result of functional limitations in recreational, domestic and school activities, adolescents with physical disabilities experience elevated psychological distress (Lal et al. 2022). Indeed, research has demonstrated that 46% of children and adolescents with cerebral palsy reported clinically significant anxiety (McMahon et al. 2020). Compared to their healthy counterparts, youth with scoliosis have an almost doubled risk of experiencing depression (Chang et al. 2016). Alarmingly, adolescents with physical disabilities were reported to have over a tripled risk of suicide attempts compared to those without disabilities (Jones and Lollar 2008). Therefore, effective psychological interventions are necessary to address the psychological needs and enhance the overall well-being of adolescents with physical disabilities.

The core concept of cognitive-based interventions (CBIs) is that negative thoughts about specific events produce dysfunctional emotional and behavioural responses, and the composite of these three elements constitutes psychological problems (Beck 1979; Beck and Haigh 2014). Different types of CBIs, such as cognitive behavioural therapy, mindfulness-based intervention, dialectical behaviour therapy and acceptance and commitment therapy, have been established. These interventions employ cognitive, behavioural and verbal strategies to specifically target negative cognition, and are commonly employed to address mental health challenges in individuals with physical disabilities. For instance, cognitive behavioural therapy integrates cognitive and behavioural techniques to modify maladaptive beliefs, cognitive distortions and problematic behavioural patterns that contribute to distress (Mehta et al. 2011). Moreover, acceptance and commitment therapy (part of third-wave cognitive behavioural therapy) emphasises the acceptance of inner experiences and value-based actions to enhance psychological flexibility, aiding individuals in establishing a relationship with their inner distress (Foote et al. 2022).

CBIs have shown promising results in reducing psychological distress among adolescents with various physical health conditions (Hughes et al. 2023). Furthermore, there is accumulating evidence supporting the positive impact of CBIs on adolescents with physical disabilities. A mindfulness-based stress reduction program has shown preliminary effectiveness in improving physical function and anxiety among adolescents with functional somatic syndromes (e.g. chronic fatigue syndrome and fibromyalgia; Ali et al. 2017). Internet- and mobile-based cognitive behavioural therapy, designed to address symptoms of anxiety and depression in young people with chronic conditions like juvenile idiopathic arthritis, has also revealed promising medium-term benefits (Geirhos et al. 2022).

However, there is a gap in the literature regarding the synthesis of evidence on CBIs for adolescents with physical disabilities. Given the potential benefits of CBIs in addressing psychological distress in this population, it is important to consolidate existing knowledge on the use of CBIs for this overlooked group. Specifically, identifying the common and effective intervention elements can guide the development of psychologically supportive programs that are tailored and beneficial for this population.

1.1 | Aims

Therefore, this systematic review aimed to (1) provide a comprehensive and critical summary of the effects of CBIs on the psychological distress (primary outcome) and physical function (secondary outcome) of adolescents with physical disabilities compared to active or inactive controls and (2) investigate the optimal characteristics of the effective CBIs found.

2 | Methods

We conducted this review in accordance with the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) guideline (Page et al. 2021) and adhered to the recommendations outlined in the Cochrane Handbook for Systematic Reviews of Interventions (Higgins, Li, and Deeks 2023). The protocol for this systematic review has been registered with PROSPERO (CRD42023478609), and any amendments made between the protocol and the review have been documented in Table S1.

2.1 | Search Strategy

Nine online databases were systematically searched from inception to October 2023, including seven English databases (Embase, PubMed, CINAHL, PsycINFO, Scopus, The Cochrane Library and Web of Science) and two Chinese databases (China National Knowledge Infrastructure and Wanfang Data). Search terms were structured according to the PICOS framework (Table S2). The target population consisted of adolescents aged 10–19 years with physical disabilities. Various search terms related to 'physical disability', such as 'disabled persons', 'mobility limitation', 'handicap' and 'physically challenged' were used to identify the population. Since studies on individuals with physical disabilities often use condition-specific keywords rather than general disability terms, common paediatric health conditions associated with impairments in body structure and function were included in the search (World Health Organization 2001). This list encompassed conditions such as 'cerebral palsy', 'spinal dysraphism', 'spinal cord injury', 'scoliosis', 'arthritis', 'stroke' and 'multiple sclerosis'. Search terms such as 'cognitive therapy', 'behavior therapy', 'cognitive behavioral therapy', 'mindfulness' and 'acceptance and commitment therapy' were utilised to identify relevant interventions. The study design was limited to randomised controlled trials (RCTs). No restrictions were placed on the search terms used for controls and outcomes to ensure a comprehensive range of relevant articles. Tables S3–S11 outlined the search strategies and findings across all databases.

Furthermore, a manual search of the reference lists of the included publications was conducted to identify any additional relevant articles.

2.2 | Eligibility Criteria

Studies were included when they met the following criteria: (1) Populations: Adolescents between 10 and 19 years of age with congenital or acquired physical disabilities. (2) Interventions: The CBIs were categorised based on either explicit statements from the original article or a joint decision by the assessing authors regarding the treatment's components (i.e. cognitive and behavioural elements). (3) Controls: The CBIs were compared to control groups receiving either active interventions (e.g. attention control) or inactive interventions (e.g. usual care, standard practices, waitlist control and placebo). (4) Outcomes: Psychological distress, including symptoms associated with mood fluctuations and clinical mental health conditions (e.g. depression, anxiety, stress and distress; American Psychological Association 2018), should be assessed based on the study's outcome measures. (5) Study design: Only RCTs were included. (6) Only peer-reviewed studies published in English or Chinese were included as eligible for this review. Studies were excluded if they met any of the following criteria: (1) Functional limitations in daily activities due to intellectual/sensory/mental/mixed impairments. (2) Treatment group sample size smaller than five. (3) Unavailability of full-text or final results.

2.3 | Study Selection

To identify duplicate publications, all retrieved records were imported into Endnote X9 (Clarivate Analytics, 2018). After removing duplicates, two reviewers (JYL and XXM) independently assessed the abstracts and titles using Endnote, following the predetermined eligibility criteria. Eligible records were then exported to Excel (Microsoft, 2019), and articles were identified through a comprehensive examination of the full text of the records.

2.4 | Data Extraction

Data extraction was conducted using a data extraction form adapted from the Cochrane Handbook for Systematic Reviews of Interventions (Li, Higgins, and Deeks 2023). This form was initially tested on five randomly selected full-text studies and subsequently revised based on the pilot results. The following information was collected: (1) general information (author, publication year, country, setting, study design and measurements); (2) participants' characteristics (disease type, sample size, age range and gender distribution); (3) details of the interventions (the content of CBIs and comparators, theoretical basis, intervention aims, recipients, dosage, interventionist, delivery mode, feasibility and acceptability); (4) outcomes and measurement tools and (5) main findings. Two reviewers (JYL and XXM) independently extracted the data, and any disagreements were resolved through discussion or consultation with a third reviewer (YL). Corresponding authors were contacted for missing data or additional unpublished information. In cases of unresolved missing data, calculations were made using available values and established formulas to estimate the effect (Higgins et al. 2023).

2.5 | Quality Appraisal

The risk of bias was evaluated using the revised Cochrane risk-of-bias tool for randomised trials (RoB 2; Sterne et al. 2019). Both reviewers (JYL and XXM) independently assessed the risk of bias in each specific outcome of a trial according to these domains: randomisation process, deviations from intended interventions, missing outcome data, outcome measurement and selective reporting. Each domain required the reviewers to respond with 'Yes', 'Probably yes', 'No', 'Probably no' or 'No information' for specific questions. An overall level of risk of bias ('High', 'Low' or 'Some concerns') was assigned to each included outcome. A pilot test with five studies was conducted to ensure assessment consistency. Discrepancies between the reviewers were resolved through discussions with a third reviewer (YL).

2.6 | Certainty of Evidence

The quality of the evidence (i.e. meta-analysis results) was presented using the Grading of Recommendation, Assessment, Development and Evaluation (Guyatt et al. 2011). Two independent assessors (JYL and XXM) evaluated the level of certainty of the evidence using five domains: risk of bias, indirectness, inconsistency, imprecision and publication bias. The evidence was then classified into four categories: 'high', 'moderate', 'low' and 'very low'.

2.7 | Data Synthesis

The data analysis was conducted using R software (Version 4.3.2), which involved computing the Hedges' g standard mean differences along with 95% confidence intervals (CIs) for each study. Due to variations in study populations and methods, a random-effects model was employed for all analyses. Effect sizes were calculated at postintervention (less than 8 weeks after the intervention), medium-term (3–5 months) and long-term (6 months or more) follow-ups, and categorised as small ($g = 0.2$), medium ($g = 0.5$) or large ($g = 0.8$; Cohen 1988). In the meta-analysis, only outcomes with data from two or more studies were included and pooled in the model. To ensure clarity, certain change scores were reversed, ensuring that negative effect sizes consistently represented relief from psychological distress. Three predefined subgroup analyses were conducted to explore potential variations in efficacy and heterogeneity: recipients (child-only/parent–child dyad), intervention durations (1–8/over 8 weeks) and delivery modes (face-to-face/online/video).

Heterogeneity was assessed using I^2 and Cochrane's Q statistics. I^2 values were categorised as 'might not be important' (0%–40%), 'moderate' (30%–60%), 'substantial' (50%–90%) or 'considerable' (75%–100%) heterogeneity (Deeks, Higgins, and Altman 2023). Sensitivity analyses were conducted using the leave-one-out method to examine the impact of excluding individual trials and identify potential sources of heterogeneity. The publication bias test was not performed as there were

fewer than 10 studies in the meta-analysis for each outcome. Narrative synthesis was performed for studies that were not pooled for meta-analysis.

3 | Results

3.1 | Study Selection

A total of 3507 records (3470 from nine main databases, 37 from reference lists) were identified. Following the removal of duplicate records ($n = 1242$) and the screening of titles and abstracts ($n = 2078$), a total of 187 relevant articles were identified for full-text screening. Ultimately, 12 RCTs were deemed eligible for inclusion in this review. Figure 1 presents the PRISMA flow chart illustrating the search and selection process. Table S12 lists all excluded articles during the full-text screening stage.

3.2 | Study Characteristics

The characteristics of the included 12 RCTs are summarised in Table 1. Studies were published from 2003 to 2023, with most of them conducted in the United States ($n = 5$, 41.6%; Betz, Smith, and Macias 2010; Connelly et al. 2019; Kashikar-Zuck et al. 2005, 2012; LaMontagne et al. 2003). Other research locations included Canada ($n = 3$, 25.0%; Charette et al. 2015; Stinson et al. 2020, 2010), the United Kingdom ($n = 2$, 16.7%; Chalder et al. 2010; Crawley et al. 2018) and China ($n = 2$, 16.7%; Li et al. 2023; Xu 2007). Only one study was reported in Chinese (Xu 2007), and the remaining studies were reported in English. Most studies were two-arm parallel-design RCTs, while one study utilised a four-arm trial design (LaMontagne et al. 2003) and another study employed a crossover design (Kashikar-Zuck et al. 2005). Except for three pilot studies (Charette et al. 2015; Kashikar-Zuck et al. 2005; Stinson et al. 2010) and one unspecified (Xu 2007), the remaining eight trials were full-scale RCTs.

3.2.1 | Characteristics of Participants

The 12 RCTs included 1201 participants ($n_{treatment} = 610$, $n_{control} = 591$) with sample sizes per trial ranging from 30 (Kashikar-Zuck et al. 2005) to 289 (Connelly et al. 2019). The average age of adolescents ranged from 13 to 17 years, with girls accounting for the majority (75.2%). Five diseases leading to physical disability were identified among the included studies: adolescent idiopathic scoliosis ($n = 4$, 33.3%), juvenile idiopathic arthritis ($n = 3$, 25%), juvenile fibromyalgia syndrome ($n = 2$, 16.7%), chronic fatigue syndrome ($n = 2$, 16.7%) and spina bifida ($n = 1$, 8.3%).

3.2.2 | Characteristics of Interventions

Table S13 summarises the key characteristics of CBIs. Eleven included studies incorporated techniques from cognitive behavioural therapy, while only one study utilised a mindfulness-based approach (Li et al. 2023). The interventions encompassed various components and strategies, including: (a) identification and restructure of unhelpful/biased cognition/thinking; (b) psychoeducation; (c) expressive exercises (e.g. guided imagery, positive self-talk) and peer group experience sharing; (d) relaxation exercises and meditative techniques (e.g. breathing meditation and body scan); (e) coping skills training (e.g. problem-solving, symptom and stress management) and social support promotion; (f) role-playing activities and (g) homework assignment.

Of the 11 studies that reported on intervention recipients, seven used a parent–child dyad format (Chalder et al. 2010; Connelly

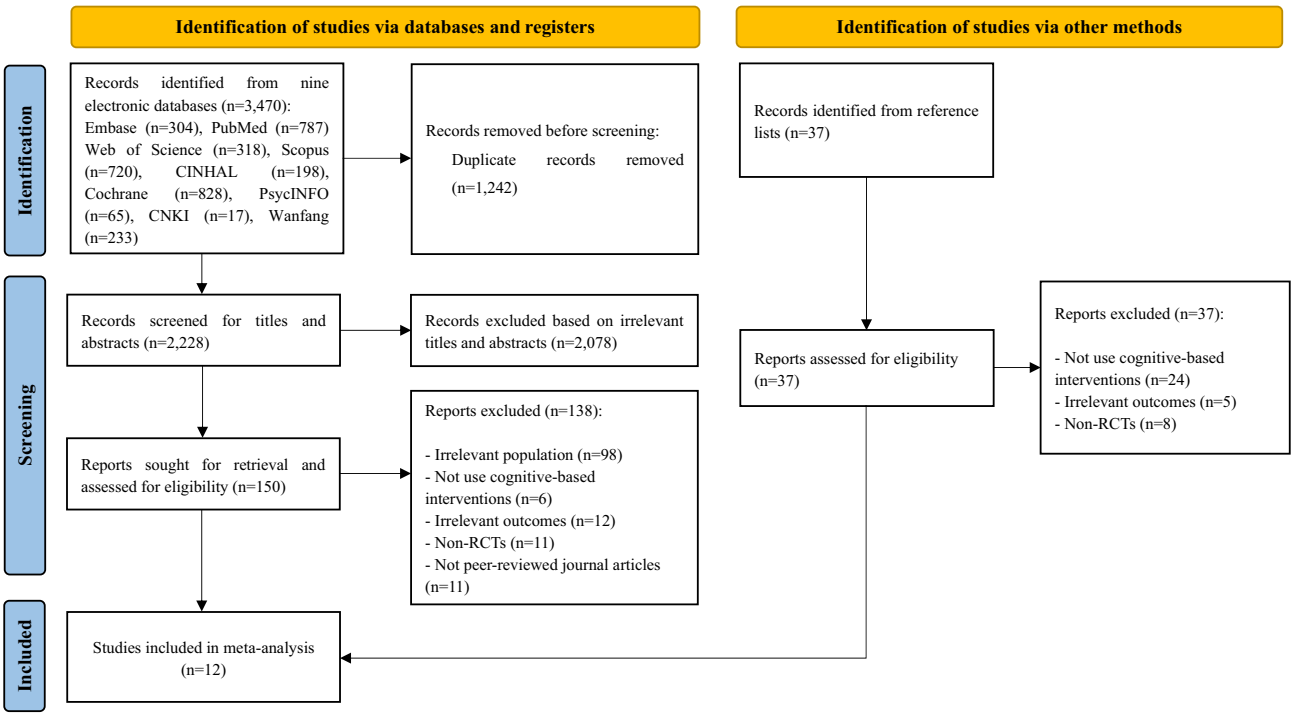

FIGURE 1 | PRISMA flow diagram of study selection.

TABLE 1 | Characteristics of the included studies ($n = 12$).

First author (year) [Country, setting]	Study design and measurements	Participants	Interventions	Interested outcomes (instruments)	Main findings
Betz (2010) [USA, Hospital]	Two-arm RCT at baseline, 4 months after baseline	*Disease*: Spina bifida *n*, *Age* (*Mean* ± *SD*): IG: $n = 31$, (16.19 ± 1.33) years CG: $n = 34$, (15.71 ± 1.43) years *Gender*: IG: 41.9% male CG: 38.2% male	*IG*: Transition Preparation Training + spina bifida management *CG*: Spina bifida management	Distress (PARS III)	*4 months after baseline*: No significant differences between groups in the Anxiety-Depression subscale of PARS III
Chalder (2010) [UK, Hospital]	Two-arm RCT at baseline, postintervention and 3, 6 and 12 months postintervention	*Disease*: Chronic fatigue syndrome *n*, *Age* (*Median*, *IQR*): IG: $n = 32$, (15, 14–16) years CG: $n = 31$, (15, 13–17) years *Gender*: IG: 34.4% male CG: 29.0% male	*IG*: Family-focused cognitive behavioural therapy *CG*: Psychoeducation	Distress (SDQ) Physical function (SF-36 subscale)	*Outcomes over time*: No significant differences between groups in the Child Emotional SDQ score. The time effect for physical function was significant ($p < 0.01$).
Charette (2015) [Canada, Home]	Two-arms RCT at baseline, post-discharge, 14 days and 1-month post-discharge	*Disease*: Adolescent idiopathic scoliosis *n*, *Age* (*Mean* ± *SD*): IG: $n = 20$, (15.50 ± 2.07) years CG: $n = 20$, (14.50 ± 2.16) years *Gender*: IG: 10.0% male CG: 25.0% male	*IG*: Guided imagery, relaxation and education + standard care *CG*: Standard care	Anxiety (STAI)	*1-month post-discharge*: After Bonferroni's adjustments for multiple comparison, no between-group difference in anxiety
Stinson (2010) [Canada, Home]	Two-arm RCT at baseline and postintervention	*Disease*: Juvenile idiopathic arthritis *n*, *Age* (*Mean* ± *SD*): IG: $n = 22$, (14.4 ± 1.3) years CG: $n = 24$, (14.8 ± 1.7) years *Gender*: IG: 31.8% male CG: 33.3% male	*IG*: 'Teens Taking Charge: Managing Arthritis Online' *CG*: Attention control	Stress (PSQ)	*Postintervention*: No between-group differences in stress
Stinson (2020) [Canada, Home]	Two-arm RCT at baseline, postintervention and 3- and 9-month postintervention	*Disease*: Juvenile idiopathic arthritis *n*, *Age* (*Mean* ± *SD*): IG: $n = 88$, (14.0 ± 1.5) years CG: $n = 131$, (14.5 ± 1.7) years *Gender*: IG: 28.0% male CG: 30.5% male	*IG*: 'Teens Taking Charge' self-management program *CG*: Web-based education control condition	Anxiety (PROMIS Anxiety Short-Form) Depression (PROMIS Depressive Symptoms Short Form) Physical function (PedsQL Rheumatology Module)	*Outcomes over time*: No significant between-group differences in anxiety and depression and the group effect for physical function was significant ($p = 0.01$)

(Continues)

TABLE 1 | (Continued)

First author (year) [Country, setting]	Study design and measurements	Participants	Interventions	Interested outcomes (instruments)	Main findings
Connelly (2019) [USA, Home]	Two-arm RCT at baseline, postintervention and 3- and 9-month postintervention	*Disease*: Juvenile idiopathic arthritis *n*, *Age* (*Mean* ± *SD*): IG: $n = 144$, (14.6 ± 1.8) years CG: $n = 145$, (14.5 ± 1.7) years *Gender*: IG: 32.0% male CG: 23.0% male	*IG*: 'Teens Taking Charge' self-management program *CG*: Online education control	Anxiety (PROMIS Anxiety Short-Form) Depression (PROMIS Depressive Symptoms Short Form) Physical function (PedsQL Rheumatology Module)	*Outcomes over time*: No significant between-group differences in all outcomes
Crawley (2018) [UK, Not mentioned]	Two-arm RCT at baseline, 3, 6 and 12 months after baseline	*Disease*: Chronic fatigue syndrome *n*, *Age* (*Mean* ± *SD*): IG: $n = 51$, (14.7 ± 1.4) years CG: $n = 49$, (14.5 ± 1.6) years *Gender*: IG: 25.5% male CG: 22.4% male	*IG*: Lightning process + specialist medical care *CG*: Specialist medical care	Anxiety (SCAS) Depression (HADS-D) Physical function (SF-36 subscale)	*Outcomes over time*: At 6 months after baseline, the IG had better anxiety (mean difference = −8.7, $p = 0.04$) and physical function (mean difference = 12.5, $p = 0.003$). At 12 months after baseline, the IG had better anxiety (mean difference = −12.1, $p = 0.004$), depression (mean difference = −1.7, $p = 0.03$) and physical function (mean difference = 15.1, $p = 0.002$)
Kashikar-Zuck (2005) [USA, Hospital][a]	Two-arm RCT at baseline, 8 and 16 weeks after baseline	*Disease*: Juvenile fibromyalgia syndrome *n*, *Age* (*Mean* ± *SD*): IG: $n = 15$, not mentioned CG: $n = 15$, not mentioned (15.8 ± 1.3) years for all *Gender*: IG: 0% male CG: 0% male	*IG*: Coping skills training *CG*: Self-monitoring	Depression (CDI)	*Postintervention*: No significant between-group differences in depression

(Continues)

TABLE 1 | (Continued)

First author (year) [Country, setting]	Study design and measurements	Participants	Interventions	Interested outcomes (instruments)	Main findings
Kashikar-Zuck (2012) [USA, Hospital]	Two-arm RCT at baseline, postintervention and 6-month postintervention	*Disease*: Juvenile fibromyalgia syndrome *n*, *Age* (*Mean* ± *SD*): IG: $n = 57$, (15.2 ± 1.8) years CG: $n = 57$, (14.9 ± 1.7) years *Gender*: IG: 5.3% male CG: 10.5% male	*IG*: Cognitive behavioural therapy *CG*: Fibromyalgia education	Depression (CDI)	*Outcomes over time*: The group*time interaction effect for depression was significant ($p = 0.04$)
LaMontagne (2003) [USA, Hospital][b]	Four-arm RCT at baseline, 4 and 6 days after baseline	*Disease*: Adolescent idiopathic scoliosis *n*, *Age* (*Mean* ± *SD*): IG 1: $n = 27$, (13.93 ± 1.77) years IG 2: $n = 27$, (13.89 ± 1.89) years IG 3: $n = 30$, (14.10 ± 1.73) years CG: $n = 25$, (13.56 ± 1.76) years *Gender*: All: 19.3% male	*IG* 1: Concrete-objective information IG 2: Coping instruction IG 3: Concrete-objective information + coping instruction CG: Standard information	Anxiety (STAI)	*Outcomes over time*: The IG 3 provided the most benefit in anxiety reduction when preoperative anxiety was high ($F[1105] = 13.28$, $p < 0.01$)
Li (2023) [China, Public health institution]	Two-arm RCT at baseline, postintervention and 6-month postintervention	*Disease*: Adolescent idiopathic scoliosis *n*, *Age* (*Mean* ± *SD*): IG: $n = 45$, (13.41 ± 1.35) years CG: $n = 38$, (13.62 ± 1.17) years *Gender*: IG: 24.4% male CG: 26.3% male	*IG*: MBrace *CG*: Supervised physiotherapy exercise	Stress (PSS)	*Outcomes over time*: No significant between-group differences in stress
Xu (2007) [China, Hospital]	Two-arm RCT at baseline and 4 days after baseline	*Disease*: Adolescent idiopathic scoliosis *n*, *Age* (*Mean* ± *SD*): IG: $n = 21$, not mentioned CG: $n = 22$, not mentioned (13.9 ± 2.3) years for all *Gender*: All: 23.3% male	*IG*: Cognitive behavioural intervention *CG*: Usual care	Anxiety (STAI)	*3-days after baseline*: The IG had significantly lower anxiety levels than the CG ($p < 0.05$)

Abbreviations: CDI, children's depression inventory; CG, control group; HADS, Hospital Anxiety and Depression Scale; IG, intervention group; IQR, interquartile range; PARS III, Personal Adjustment and Role Skills Scale; PedsQL, paediatric quality of life inventory; PROMIS, patient-reported outcomes measurement information system; PSQ, perceived severity of stress questionnaire; PSS, Perceived Stress Scale; SCAS, Spence Children's Anxiety Scale; SD, standard deviation; SDQ, strengths and difficulties questionnaire; SF-36, the short form 36 health survey questionnaire; STAI, state–trait anxiety inventory.

[a]A crossover study, only data before crossover (before 8 weeks) was presented and extracted.

[b]A four-arm study, only the coping instruction (IG 2) and control groups were included.

et al. 2019; Kashikar-Zuck et al. 2005, 2012; LaMontagne et al. 2003; Stinson et al. 2020, 2010), while the remaining five studies exclusively engaged adolescents as the primary participants (Betz, Smith, and Macias 2010; Charette et al. 2015; Crawley et al. 2018; Li, Higgins, and Deeks 2023). The duration of intervention varied across the included studies, ranging from a single day (LaMontagne et al. 2003) to a maximum of 26 weeks (Chalder et al. 2010). Total number of intervention sessions ranged from one (LaMontagne et al. 2003) to 14 sessions (Connelly et al. 2019; Stinson et al. 2020, 2010), with 8–240 min per session. Two studies did not provide information on the specific duration of each session (Kashikar-Zuck et al. 2005; Xu 2007), and the latter study did not report the number of sessions. Three intervention delivery modes were found: face-to-face ($n = 7$, 58.3%; Betz, Smith, and Macias 2010; Chalder et al. 2010; Crawley et al. 2018; Kashikar-Zuck et al. 2005, 2012; Li, Higgins, and Deeks 2023; Xu 2007), online ($n = 3$, 25.0%; Connelly et al. 2019; Stinson et al. 2020, 2010), and pre-prepared videos ($n = 2$, 16.7%; Charette et al. 2015; LaMontagne et al. 2003). Individual-based interventions ($n = 8$, 66.7%; Chalder et al. 2010; Charette et al. 2015; Connelly et al. 2019; Kashikar-Zuck et al. 2005, 2012; LaMontagne et al. 2003; Stinson et al. 2020, 2010) were more common than group-based intervention ($n = 3$, 25.0%; Betz, Smith, and Macias 2010; Crawley et al. 2018; Li et al. 2023), while one study did not mention the format (Xu 2007). Qualifications of interventionists were reported in 10 studies, including trained research personnel ($n = 6$, 50.0%; Charette et al. 2015; Connelly et al. 2019; Crawley et al. 2018; Li et al. 2023; Stinson et al. 2020, 2010), psychotherapists ($n = 3$, 25.0%; Chalder et al. 2010; Kashikar-Zuck et al. 2005, 2012) and one child life specialist (LaMontagne et al. 2003).

3.2.3 | Characteristics of Controls

Five studies used inactive controls, including standard care ($n = 4$, 33.3%; Betz, Smith, and Macias 2010; Charette et al. 2015; LaMontagne et al. 2003; Xu 2007) and self-monitoring ($n = 1$, 8.4%; Kashikar-Zuck et al. 2005). Other used active controls, such as enhanced psychoeducation and disease care ($n = 4$, 33.3%; Chalder et al. 2010; Crawley et al. 2018; Kashikar-Zuck et al. 2012; Li et al. 2023) and online education with regular therapist contact ($n = 3$, 25.0%; Connelly et al. 2019; Stinson et al. 2020, 2010). The main characteristics of the intervention content of control groups can be found in Table S13.

3.2.4 | Outcome Measures

The outcome measures, as presented in Table 1, encompassed valid and reliable questionnaires utilised across the studies. Different time points were employed by the studies to collect their respective results. Additionally, one study conducted an assessment at the midpoint of the intervention (Charette et al. 2015). Most of the studies ($n = 9$, 75.0%) assessed the immediate postintervention effects, with three studies first reporting outcomes of interest at 3- (Betz, Smith, and Macias 2010), 4- (Crawley et al. 2018) and 6-month (Chalder et al. 2010) postintervention. Six studies employed multiple time points to evaluate follow-up effects, three of them assessed medium-term effects (Connelly et al. 2019; Crawley et al. 2018; Stinson et al. 2020), and all six cases conducted the final follow-up assessments at least 6 months after the intervention (Chalder et al. 2010; Connelly et al. 2019; Crawley et al. 2018; Kashikar-Zuck et al. 2012; Li et al. 2023; Stinson et al. 2020).

3.3 | Methodological Quality of the Included Studies

Five of the 12 included RCTs (41.7%) were considered at 'high' risk of bias; the remaining seven studies were with 'some concerns'. Regarding the randomisation process, three studies (25.0%) raised concerns about potential bias due to insufficient information on allocation concealment and/or sequence generation. Furthermore, two studies (16.7%) exhibited biased aspects related to deviations from the intended interventions, while the remaining 10 studies were considered to have a 'low' risk of bias. Except for one study, which indicated that the higher missing values in the intervention group could be attributed to the longer duration of CBIs, other studies were deemed 'low' risk (91.7%). Eleven (91.7%) studies were found to have biased results concerning outcome measurements. This bias arose from the use of self-reported instruments and the absence of blinding. In terms of the selection of the reported results, four studies (33.3%) raised 'some concerns' due to insufficient information about prespecified plans/protocols. The summary of risk-of-bias for the 12 included studies is presented in Figure 2.

3.4 | Evidence Quality of Included Studies for Meta-Analysis

The certainty of evidence ranged from 'moderate' to 'low' (Table S14). The certainty of the effects of CBIs on depressive symptoms was downgraded by one level due to the risk of bias in the included studies. For the effects of CBIs on anxiety, stress and physical function, the evidence had a 'low' level of certainty. This was primarily due to the risk of bias, as well as either inconsistency (high heterogeneity) or imprecision (small sample sizes below 400).

3.5 | Effectiveness of Cognitive-Based Interventions

3.5.1 | Stress

Two RCTs involving 118 subjects investigated the impact of CBIs on post-intervention stress (Li et al. 2023; Stinson et al. 2010). Although participants receiving CBIs demonstrated improvements in stress, these enhancements were not statistically significant ($g = -0.15$, 95% CI [−0.52, 0.21], $I^2 = 0\%$; Figure 3). Only one study evaluated the long-term effects of a mindfulness-based intervention on stress, revealing non-significant improvements in stress symptoms 6-month postintervention ($g = 0.02$, 95% CI [−0.44, 0.49]; Li et al. 2023).

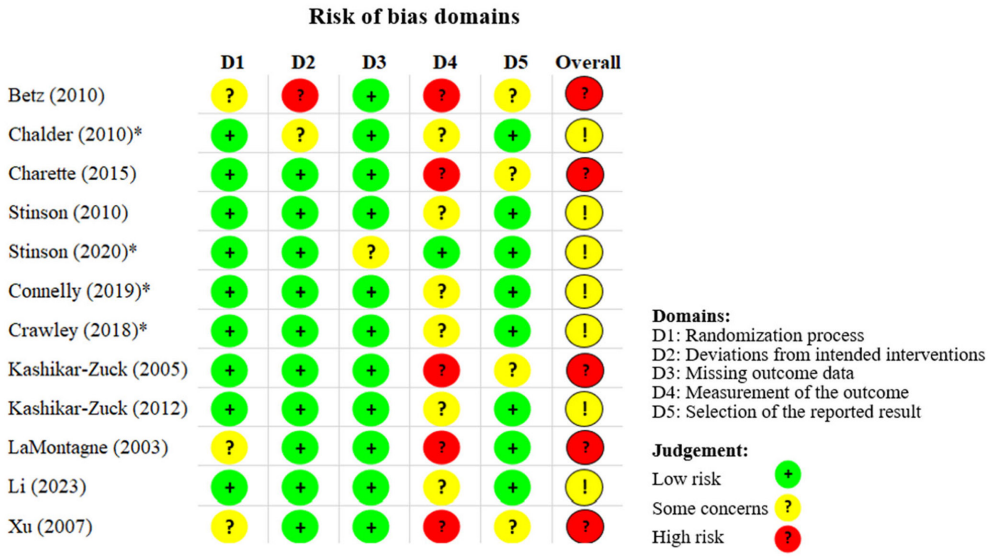

FIGURE 2 | Risk of bias summary by Cochrane risk-of-bias tool. *Consistent risk-of-bias judgements were observed across the multiple outcomes assessed in these four studies. Therefore, a unified presentation is provided in this risk-of-bias summary figure.

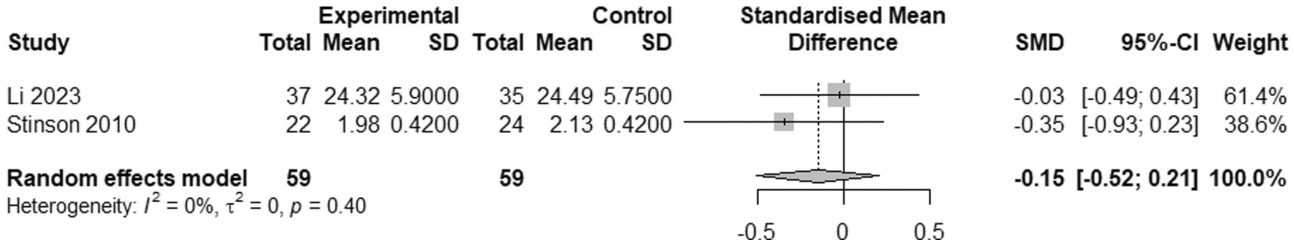

FIGURE 3 | The effects of CBIs on stress at postintervention.

3.5.2 | Distress

Two studies reported non-significant results on improving distress at 3-month postintervention ($g = -0.35$, 95% CI [−0.84, 0.14]; Betz, Smith, and Macias 2010) and 6-month postintervention ($g = -0.05$, 95% CI [−0.59, 0.49]; Chalder et al. 2010), respectively. Due to the different measurement time periods, no meta-analysis was conducted.

3.5.3 | Anxiety

3.5.3.1 | Meta-Analysis Results of Anxiety at Postintervention. Five trials with 551 participants were included to assess the effectiveness of CBIs on anxiety at postintervention (Charette et al. 2015; Connelly et al. 2019; LaMontagne et al. 2003; Stinson et al. 2020; Xu 2007). The pooled results did not demonstrate significant improvements ($g = -0.43$, 95% CI [−0.93, 0.07], $I^2 = 81\%$; Figure 4). Upon conducting sensitivity analyses, it was observed that the potential benefits of CBIs emerged after the removal of an outlier ($g = -0.59$, 95% CI [−1.14, −0.05]; Figure S1; Connelly et al. 2019). Nevertheless, persistent heterogeneity was observed after sensitivity analyses ($I^2 = 58\%$–83%), prescribed subgroup analyses were therefore performed (shown in Table S15). The findings indicate that child-only CBIs were more effective in reducing anxiety ($g = -0.72$, 95% CI [−1.37, −0.07], $n = 1$) compared to parent–child dyad CBIs ($g = -0.04$, 95% CI [−0.27, 0.20], $n = 3$). Interventions conducted within 1–8 weeks ($g = -0.80$, 95% CI [−1.38, −0.22], $n = 3$) showed greater improvements in anxiety compared to interventions lasting over 8 weeks ($g = 0.03$, 95% CI [−0.17, 0.24], $n = 2$). Face-to-face ($g = -1.39$, 95% CI [−2.06, −0.71], $n = 1$) and video-based delivery modes ($g = -0.52$, 95% CI [−0.94, −0.10], $n = 2$) were more beneficial in improving anxiety.

3.5.3.2 | Meta-Analysis Results of Anxiety at Follow-Up. When exploring the lasting effects of CBIs on anxiety, three RCTs with 443 subjects in the medium term and three RCTs with 441 subjects in the long term were included (Connelly et al. 2019; Crawley et al. 2018; Stinson et al. 2020). The impact of CBIs on anxiety symptoms was not significant in both the medium term ($g = -0.14$, 95% CI [−0.63, 0.34], $I^2 = 77\%$; Figure S2) and long term ($g = -0.37$, 95% CI [−0.85, 0.11], $I^2 = 75\%$; Figure S3). The sensitivity analyses proved the robustness of the findings (Figures S4 and S5). We did not perform a subgroup analysis for the follow-up anxiety outcome due to the limited number of studies (only three) that provided data.

3.5.4 | Depressive Symptoms

3.5.4.1 | Meta-Analysis Results of Depressive Symptoms at Postintervention. Four RCTs assessed depressive symptoms

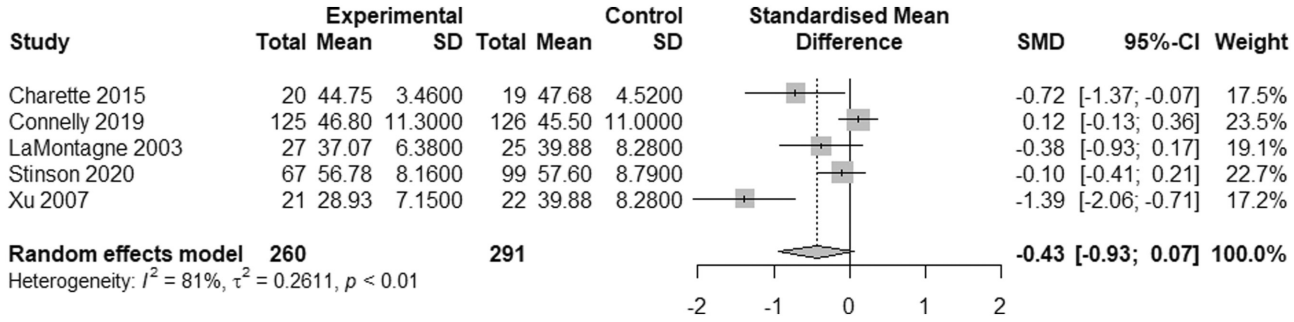

FIGURE 4 | The effects of CBIs on anxiety at postintervention.

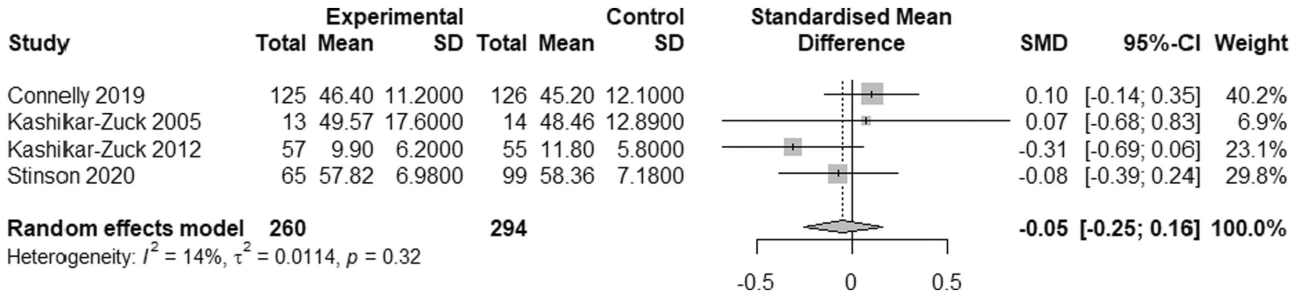

FIGURE 5 | The effects of CBIs on depressive symptoms at postintervention.

at postintervention and were included in the meta-analysis pooling 554 participants (Connelly et al. 2019; Kashikar-Zuck et al. 2005, 2012; Stinson et al. 2020). The pooled analysis yielded non-significant results ($g = -0.05$, 95% CI [−0.25, 0.16], $I^2 = 14\%$; Figure 5) and sensitivity analyses provided further support for the reliability of these findings (Figure S6). Subgroup analyses were performed for different intervention durations and delivery modes, revealing no statistically significant reduction in depressive symptoms (Table S15).

3.5.4.2 | Meta-Analysis Results of Depressive Symptoms at Follow-Up. Three RCTs with 443 subjects in medium term showed no significant improvement in depressive symptoms ($g = -0.02$, 95% CI [−0.21, 0.17], $I^2 = 8\%$), which was confirmed by sensitivity analysis (Figures S7 and S8; Connelly et al. 2019; Crawley et al. 2018; Stinson et al. 2020). In the long-term analysis involving four RCTs with 555 subjects (Connelly et al. 2019; Crawley et al. 2018; Kashikar-Zuck et al. 2012; Stinson et al. 2020), Connelly's study significantly contributed to the heterogeneity in the meta-analysis of depressive symptoms (Connelly et al. 2019). This resulted in a change in the effect size estimate from −0.15 (95% CI [−0.36, 0.06], $I^2 = 34\%$; Figure S9) to −0.24 (95% CI [−0.46, −0.03], $I^2 = 0\%$; Figure S10). The subgroup analysis results showed that the child-only target CBIs were more beneficial in improving long-term depressive symptoms ($g = -0.54$, 95% CI [−1.06, −0.02], $n = 1$; Table S15). Subgroup differences in different durations and delivery modes were not significant.

3.5.5 | Physical Function

Two RCTs ($n_{\text{participant}} = 424$) assessed postintervention effects (Connelly et al. 2019; Stinson et al. 2020), three RCTs ($n_{\text{participant}} = 467$) evaluated medium-term effects (Connelly et al. 2019; Crawley et al. 2018; Stinson et al. 2020) and four RCTs ($n_{\text{participant}} = 519$) examined long-term effects of CBIs on physical function (Chalder et al. 2010; Connelly et al. 2019; Crawley et al. 2018; Stinson et al. 2020). No significant improvements were found postintervention ($g = -0.05$, 95% CI [−0.42, 0.33], $I^2 = 72\%$; Figure S11) and at the medium term ($g = 0.18$, 95% CI [−0.25, 0.61], $I^2 = 79\%$; Figure S12). Sensitivity analysis supported the findings (Figure S13). In the long-term analyses, Connelly's study significantly contributed to the heterogeneity in the meta-analysis of physical function, resulting in a change in effect size from 0.31 (95% CI [0.01, 0.61], $I^2 = 60\%$; Figure S14) to 0.43 (95% CI [0.13, 0.73], $I^2 = 27\%$; Figure S15; Connelly et al. 2019).

4 | Discussion

To the best of our knowledge, this is the first comprehensive systematic review and meta-analysis conducted in the research field of CBIs targeting psychological distress among adolescents with physical disabilities. Despite an extensive search and thorough examination of over 3500 papers, only 12 studies met the relatively broad inclusion criteria, suggesting that the field of research on this topic is still in its early stages. The included studies encompassed five distinct psychological conditions, with anxiety ($n = 6$, 50.0%) and depressive symptoms ($n = 5$, 41.7%) representing the most frequently reported concerns in this review.

4.1 | Psychological Distress

CBIs did not show significant effectiveness in improving stress levels compared to active controls, whereas Dunning

et al. reported small but significant benefits in reducing stress among children and adolescents (Dunning et al. 2019). A possible reason may be that our synthesis included only two studies (Li, Higgins, and Deeks 2023; Stinson et al. 2010), whereas the latter study encompassed 20 studies that focused primarily on typically developing youth. The small sample size in the synthesis may have hindered our ability to detect small effects favouring CBIs in the context of physical disabilities. In terms of distress, two studies yielded non-significant results, precluding a meta-analysis due to methodological heterogeneity. Moreover, the low certainty of evidence for stress outcomes and the high risk of bias in the study examining distress (Betz, Smith, and Macias 2010) underscore the need for further RCTs with robust designs in this field.

In contrast to the findings on cognitive behavioural therapy for children and adolescents (Vigerland et al. 2016), CBIs did not yield overall significant improvements in anxiety and depressive symptoms over time among adolescents with physical disabilities. This difference may be attributed to differences in eligibility criteria, as most participants in our analysis may not have had mood symptoms at the time of recruitment, whereas Vigerland et al.'s review specifically targeted reducing symptoms of established psychological conditions. Additionally, the limited effects could be attributed to only three studies focusing on psychological distress as a primary outcome (Kashikar-Zuck et al. 2005; LaMontagne et al. 2003; Xu 2007), suggesting that CBIs may indirectly impact these outcomes. Future research should target psychological issues in adolescents with physical disabilities and consider recruiting individuals with psychological symptoms for a more precise depiction of the effectiveness of CBIs.

Notably, it was observed that CBIs had small to medium effects on postintervention anxiety and long-term depressive symptoms after excluding one study (Connelly et al. 2019). The variation in controls among the included studies, with Connelly et al.'s study and its multisite trial (Stinson et al. 2020) employing a more active control combining guided disease education and regular therapist contact, contributed to the inconsistent findings. Thus, the exclusion of Connelly et al.'s study, which had the largest weight but showed non-significant effects on anxiety and depressive symptoms, had a considerable impact on the overall results. Nevertheless, the evidence supporting anxiety and depression outcomes is of low to moderate quality, primarily due to potential internal biases and heterogeneity, indicating that future studies have the potential to alter the conclusions or enhance our confidence in them.

4.2 | Physical Function

CBIs did not elicit notable immediate or medium term changes in physical function, but a small positive effect was observed in the long term. These results concur with a large multicenter RCT of cognitive behavioural therapy for paediatric chronic pain, which indicated non-significant between-group differences in daily activity limitations immediately after treatment but significant differences at the 6-month follow-up (Palermo et al. 2016). Specifically, the enhancements in physical function may be attributed to improved self-management skills and behavioural changes. Drawing upon the generic cognitive model, the generation of beneficial behaviours stems from the adjustment of dysfunctional thoughts and emotional states (Beck and Haigh 2014). Consequently, alterations in physical function follow a progressive trajectory, potentially necessitating a duration to manifest notable effects.

4.3 | Promising Intervention Components Affecting the Effectiveness of CBIs

The interventions in the included studies exhibited variations in characteristics, highlighting a potential knowledge gap in the optimal application of CBIs for adolescents with physical disabilities. Regarding parent involvement, our subgroup analyses indicated that CBIs targeting adolescents only were more effective in reducing anxiety and depression. This effectiveness may be attributed to adolescents' high value for autonomy and control over their experiences (National Academies of Sciences, Engineering and Medicine 2019), where providing opportunities for independence positively impacts their engagement. However, substantial evidence supports the importance and effectiveness of involving parents in adolescent mental health interventions (Dardas, van de Water, and Simmons 2018; Grist et al. 2019), which challenges this speculation. The controversy may stem from age differences among the studied adolescents and variations in parental involvement. Nonetheless, more quantitative or qualitative evidence is necessary to confirm the effectiveness of CBIs in different recipient groups due to the limited number of studies available within each subgroup.

In terms of intervention durations, the review results suggested that CBIs of 1–8 weeks had a better effect in reducing postintervention anxiety, which is further supported by higher attrition rates observed in studies with longer-term interventions (3 months; Connelly et al. 2019; Stinson et al. 2020). One plausible reason is that short-term interventions are more likely to capture the attention and engagement of adolescents who juggle various school, family and social activities. Importantly, research has shown that 8 weeks of mindfulness-based training can induce similar alterations in brain function and emotion regulation as extended periods of traditional mental practices (Gotink et al. 2016). Therefore, research focusing on shorter-term CBIs for adolescents holds considerable promise for further exploration.

Face-to-face and video modes of delivery were found to be beneficial in reducing post-intervention anxiety, while online self-guided interventions with limited healthcare provider contact showed no significant effects on psychological symptoms (Connelly et al. 2019; Stinson et al. 2020). With the characteristic of real-time conversational interaction, chatbots embedded with mental health promotion techniques have demonstrated the potential to improve stress, distress and depression (Abd-Alrazaq et al. 2020). Given the demands of physically disabled adolescents for telemedicine services that transcend time and distance constraints, real-time virtual interventions (e.g. chatbots) that provide accessible spoken, written and visual language via electronic devices warrant further investigation.

Certain content elements have been identified as potentially crucial for successful CBIs. Cognitive components, such as guided imagery, challenging negative thoughts and building confidence in disease management, were found to be significant. Behavioural

strategies, including relaxation exercises, goal setting and coping skills training for disease and emotional symptoms, were also commonly incorporated into successful interventions. These findings align with a systematic review of psychological interventions for young people with chronic illnesses, emphasising the benefits of learning techniques to identify and modify maladaptive thought and behaviour patterns (Sansom-Daly et al. 2012).

4.4 | Strengths and Limitations

This review contributes to current knowledge by summarising the effectiveness of CBIs in improving psychological outcomes among adolescents with physical disabilities. A comprehensive search across multiple databases in both English and Chinese languages was conducted to minimise selection bias. Additionally, the synthesis of outcomes at different time points aimed to enhance the comprehensiveness of understanding the durability effects of CBIs. However, some limitations in this review warrant caution. First, the heterogeneity regarding participants' specific diseases and intervention characteristics in the included studies can potentially impact the reliability of the pooled results. Second, the inclusion of studies with biases and the limited certainty of evidence may affect the validity of the findings. Third, the observational nature along with the small number of included studies limited confidence in the subgroup analyses. Finally, the insufficient number of related studies prevented subgroup analyses on other important potential moderators (e.g. CBIs with different theoretical models), thereby limiting the generalisability of the findings.

5 | Conclusion

This systematic review and meta-analysis found limited effectiveness of CBIs in reducing psychological distress over time among adolescents with physical disabilities. However, significant long-term improvements in physical function were observed. Due to the predominantly low methodological quality of included studies and insufficient studies available for each outcome, the pooled results on the effectiveness of CBIs should be interpreted cautiously. The efficacy of CBIs may be influenced by factors such as recipients, durations and delivery modes, which require further investigation prior to clinical implementation. To draw definitive conclusions about the effects of CBIs and identify the optimal intervention components, future high-quality randomised controlled trials in this field are necessary.

6 | Relevance for Clinical Practice

Further exploration is warranted to improve the understanding of the effectiveness of different types of CBIs (e.g. mindfulness-based and acceptance and commitment therapies) for adolescents with physical disabilities. Future studies in this field should prioritise enhancing methodological quality by implementing techniques to achieve blinding or minimise the Hawthorne effect, conducting intention-to-treat analyses and pre-registering research proposals. CBIs exclusively targeting adolescents hold promise in promoting autonomy and treatment engagement, but it is important to consider the age groups and cognitive abilities of participants when tailoring these interventions. It is recommended to limit the duration of interventions to a 2-month timeframe to maximise beneficial effects. Considering the challenges faced by adolescents with physical disabilities in attending face-to-face programs, the utilisation of real-time telemedicine services can bridge treatment gaps and deliver interventions remotely, catering to the convenience of this population. Prior to clinical implementation, therapeutic components encompassing various aspects of adaptive cognition change and beneficial behaviour building should be considered and subjected to further testing. Finally, to obtain a more comprehensive understanding of psychological distress, future research should consider incorporating objective measures (e.g. electroencephalography) to supplement existing self-report assessments (de Aguiar Neto and Rosa 2019).

Author Contributions

All authors listed in this study meet the authorship criteria outlined in the latest guidelines of the International Committee of Medical Journal Editors. **Jiaying Li:** conceptualisation, methodology, formal analysis, Investigation, Writing–original draft. **Yan Li:** conceptualisation, methodology, supervision, data curation, writing–review and Editing. **Xiaoxiao Mei:** methodology, investigation, writing–review and editing. **Honggu He:** conceptualisation, writing–review and editing. **Lu Yu:** conceptualisation, writing–review and editing. **Grace Wing Ka Ho:** conceptualisation, writing–review and editing. **Engle Angela Chan:** supervision, writing–review and editing. All authors have reviewed and agreed with the final version of the manuscript prior to submission.

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The authors have nothing to report.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that supports the findings of this study are available in the supplementary material of this article.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section.