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Effectiveness of psychosocial interventions for pediatric patients with scoliosis: a systematic review

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ABSTRACT

Background Pediatric patients affected by scoliosis have complex psychological and social care needs, and may benefit from psychosocial interventions. We therefore aimed to summarize evidence of the efficacy of psychosocial interventions for this patient population.

Methods Literature was identified by searching Medline, PsycINFO, Embase, EBSCO Cumulated Index to Nursing and Allied Health Literature (CINAHL), and Cochrane Central Register of Controlled Trials (CENTRAL) from database inception to 20 March 2022. Articles that evaluated the effectiveness of psychosocial interventions for pediatric patients diagnosed with scoliosis and reported at least one quantitative outcome were included. Article eligibility, data extraction, and quality assessment (using the Cochrane Collaboration's Risk of Bias Tool and Methodological Index for Non-Randomized Studies) were performed by two independent researchers. Findings are presented using narrative synthesis.

Results We identified ten studies, all of which focused on adolescent idiopathic scoliosis. Studies included a total of 1007 participants, most of whom were female. Three studies focused on patients undergoing bracing, six on patients undergoing spinal surgery, and one on patients broadly. Brace compliance monitoring and counseling were found to significantly improve brace compliance quality and quantity. Proactive mental healthcare delivery by nurses after spinal surgery was similarly found to improve outcomes. Several studies examined the efficacy of brief educational interventions; most did not report clear evidence of their efficacy. The methodological quality of studies was often unclear due to limitations in articles' reporting quality.

Conclusions Research on the efficacy of psychosocial interventions for pediatric patients with scoliosis is limited, with interventions involving frequent patient-provider interactions showing the most promise. Future clinical and research efforts should focus on developing and testing psychosocial interventions for this patient population, with emphasis on multidisciplinary teams delivering holistic care.

Trial registration number PROSPERO number CRD42022326957

WHAT IS ALREADY KNOWN ABOUT THIS TOPIC

⇒ Pediatric patients affected by scoliosis have complex psychosocial care needs and may benefit from psychosocial interventions, however a comprehensive overview of this evidence base is lacking.

WHAT THIS STUDY ADDS

⇒ We therefore conducted a systematic review of the efficacy of psychosocial interventions for pediatric patients with scoliosis.

⇒ We found interventions involving frequent patient-provider interactions improved pediatric patients' outcomes the most, with brace compliance monitoring and counselling significantly improving brace compliance quality and quantity, and proactive mental healthcare delivery by nurses following spinal surgery also improving mental and physical health outcomes.

⇒ Several studies examined the efficacy of less intensive, brief educational interventions; most did not report clear evidence of their effectiveness.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE, OR POLICY

⇒ Research on the efficacy of psychosocial interventions for pediatric patients with scoliosis remains limited; therefore, we propose that future clinical and research efforts be directed towards developing psychosocial interventions for this patient population, particularly those emphasizing multidisciplinary teams delivering holistic care.

INTRODUCTION

Scoliosis can dramatically alter a child or adolescent's daily life.[1 2] During and after diagnosis, affected patients and their caregivers report numerous physical, psychological, and social care needs.[1–4] Effective management of scoliosis therefore requires holistic care that addresses these complex needs—failing to do so can lead to poor physical and mental health outcomes.[1 3 5]

Several systematic reviews have been published on surgical, bracing, and exercise interventions to improve outcomes in pediatric patients with adolescent idiopathic scoliosis (AIS).[6–13] However, there are no reviews that have comprehensively summarized literatures on the effectiveness of psychosocial interventions for this patient population, with existing reviews focusing primarily on

describing pediatric patients' and caregivers' psychosocial well-being.[2 3 14] It is critical to have an overview of this evidence base because psychosocial interventions may offer a means of significantly improving biopsychosocial outcomes, as has been suggested by qualitative literature in the field.[1 15]

Therefore, this systematic review aims to summarize evidence of the efficacy of psychosocial interventions on patient and health service outcomes (such as psychological symptoms, treatment compliance, and healthcare utilization) among pediatric patients with scoliosis in any setting.

METHODS

Study design

This systematic review was conducted following Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.[16–18] Its protocol was prospectively registered and available on International Prospective Register of Systematic Reviews (PROSPERO).[19]

Search strategy

Relevant literature was identified by searching Medline, PsycINFO, Embase, EBSCO Cumulated Index to Nursing and Allied Health Literature (CINAHL), and Cochrane Central Register of Controlled Trials (CENTRAL) from database inception to March 2022. No language or publication date restrictions were applied. Searches were run for a combination of 'psychosocial intervention', 'pediatric', and 'scoliosis' using standardized subject and free-text terms, including synonyms and alternative spellings (online supplemental material 1). The search strategy was developed in collaboration with an information specialist (CW). Manual reference list searches of the articles included were conducted. We also searched for gray literature by (1) contacting authors of relevant conference abstracts or dissertations found through the electronic database search for associated publications and (2) screening ClinicalTrials.gov and WHO International Clinical Trials Registry Platform (ICTRP) for completed relevant trials.

Selection criteria

Articles were included if they met the following selection criteria: (1) the study aimed to evaluate the effectiveness of a psychosocial intervention (defined below); (2) participants were pediatric patients (aged ≤21 years, the highest threshold used for defining pediatric patients in research and clinical practice) diagnosed with scoliosis; (3) the study reported at least one quantitative patient outcome (eg, psychological symptoms, treatment compliance) or health service outcome (eg, healthcare utilization) at any follow-up timeframe; (4) the full text was available to allow for data extraction and quality appraisal; and (5) the article was a primary study (ie, not review, editorial). We included all randomized controlled trials (RCTs) examining the efficacy of psychosocial interventions, irrespective of the comparison group used. We did not anticipate finding a large number of RCTs and therefore broadened our selection to include non-randomized studies as well.

We defined psychosocial interventions as 'interpersonal or informational activities, techniques, or strategies that target biological, behavioral, cognitive, emotional, interpersonal, social, or environmental factors with the aim of improving health functioning and well-being'.[20] Our review included studies whose intervention included a core psychosocial component (such as counseling, psychoeducation, or coordination of care). We excluded studies concentrating primarily on comparing surgery, bracing, or exercises with usual care, as their findings were unlikely to elucidate the impact of psychosocial interventions.

Data collection

All articles identified through the database search were imported into Covidence, an electronic software platform for managing reviews. Two independent reviewers (MvN did all of them and AR and KT split their role) screened articles' titles and abstracts to determine if they met selection criteria and reviewed the full text of all articles deemed to be potentially relevant. Two reviewers (AR and MvN) independently (1) extracted the following data from eligible articles: study setting; study design; sample characteristics; intervention group and control group characteristics; all patient or healthcare outcome measure(s); and associated result(s) (eg, mean difference), and (2) conducted quality assessments of all randomized and non-randomized studies using the Cochrane Collaboration's Risk of Bias Tool and Methodological Index for Non-Randomized Studies, respectively.[21 22] Disagreements in article inclusion, data extraction, or quality assessment ratings were resolved through consensus discussion with a third independent reviewer (KT and JV).

Data analysis

The findings of the systematic review are presented using narrative synthesis and tables, highlighting the results of all outcome measures reported in eligible articles. Heterogeneity between psychosocial interventions included in the review (1) precluded pooling findings by meta-analyses and (2) made conducting formal analyses of causes of heterogeneity between studies unnecessary.

RESULTS

Overview

Totally, 6445 articles were identified through the electronic database and register searches. After removal of duplicates, 4238 titles and abstracts were screened, yielding 177 articles for full review. A total of 146 articles were excluded after reviewing the full paper, and 18 articles did not have full texts available for review. Ten studies

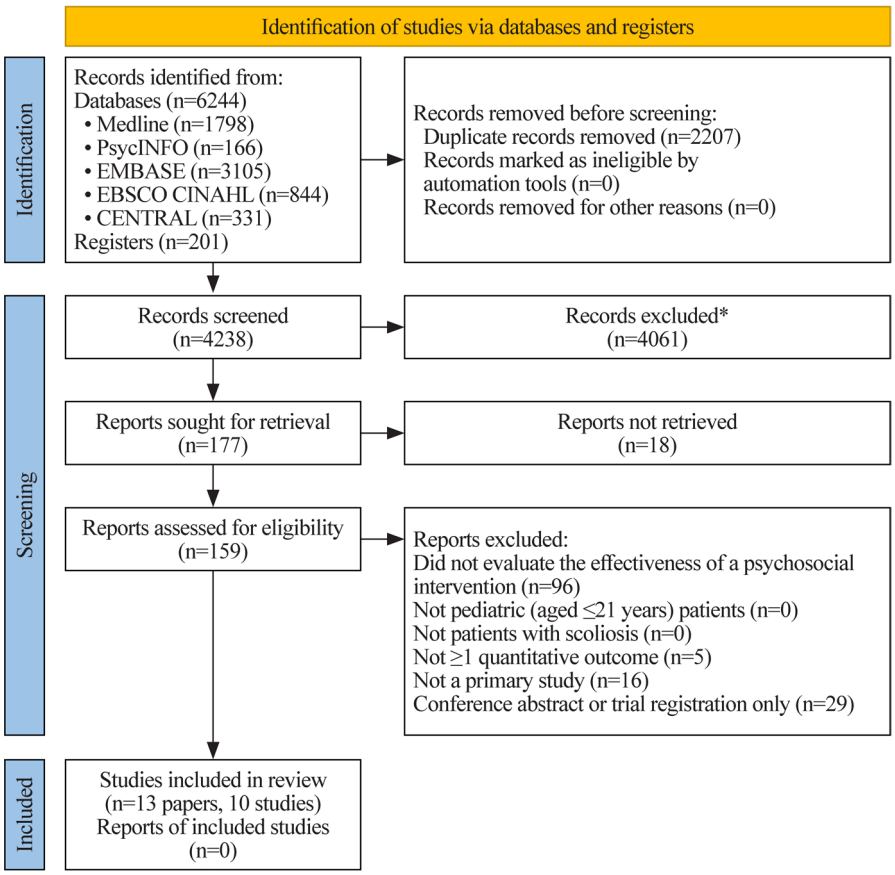

Figure 1 Systematic review flow chart (adapted from Page *et al*[18]). *Duplicates excluded via automation tool, Covidence. CENTRAL, Cochrane Central Register of Controlled Trial; EBSCO CINAHL, Cumulated Index to Nursing and Allied Health Literature.

(described in 13 papers) met the selection criteria, all of which focused on AIS (figure 1).[23–35]

We included six clinical trials,[23 28–34] three cohort studies,[24–27] and one cross-sectional study.[35] The included studies analyzed relatively small sample sizes (mean (range) of analyzed sample sizes: 101 (28–237)). Studies were primarily comprised of female adolescents (mean age range: 12–16 years; percentage of female range: 64%–100%). Five studies were conducted in the United States,[23 29–33 35] two in China,[25 26 34] one in Japan,[24] one in Malaysia,[27] and one in Canada.[28] Four studies were conducted in the past 5 years,[25–27 32 34] with publication dates ranging from 1985 to 2021.

Interventions for patients undergoing bracing

Three studies (described in four papers) focused on patients with AIS undergoing bracing treatment (online supplemental table 1).[23–26] The studies analyzed a total of 344 participants, with the vast majority of participants being female (82%–100%).[23–26] Participants who wore thoracic lumbar sacral orthosis (TSLO) braces were included in two studies,[23 24] Milwaukee braces in one study,[24] and Chêneau braces in one study.[25 26] Studies examined two main categories of interventions: (1) brace compliance monitoring and counseling[23 25 26] and (2) mental health-informed treatment planning.[24]

Brace compliance monitoring and counseling

Two studies investigated the use of brace compliance monitoring and counseling in improving brace compliance.[23 25 26] Both studies found evidence that this intervention significantly improved outcomes.[23 25 26] Karol *et al*[23] conducted an RCT and found that adolescents who received brace compliance reports and whose providers similarly received these reports and offered compliance counseling wore their TSLO braces significantly longer than those who did not. Zhu *et al*[25 26] incorporated a mobile phone application for providers to offer real-time compliance monitoring and counseling. They similarly found a significant increase in brace compliance quantity and quality over time following this interaction.[25 26] Almost all participants were very or somewhat satisfied with this form of monitoring.[25 26]

Mental health-informed treatment planning

Matsunaga *et al*[24] conducted a prospective cohort study examining the efficacy of reducing patients' emotional distress by tailoring bracing treatment plans based on

patients' mental well-being; for example, switching a patient from full-time bracing to part-time bracing if they demonstrated ongoing emotional distress. They found that, over time, there was a significant decrease in the percentage of individuals who were emotionally distressed.[24] While it is possible that tailoring patients' bracing therapy helped improve emotional outcomes, it could also be that patients' emotional distress decreased over time for other reasons, such as getting used to wearing their brace.

Key takeaways

In patients undergoing bracing, we found prospective and trial evidence demonstrating that brace compliance monitoring and counseling can help improve brace compliance, and prospective evidence that tailoring brace treatment plans based on mental health outcomes may reduce emotional distress.

Interventions for patients undergoing spinal surgery

Six studies (described in eight papers) focused on patients with AIS undergoing spinal surgery (online supplemental table 2).[27–34] The studies analyzed a total of 426 participants.[27–34] Most were RCTs,[28–34] and all but one study excluded patients with psychological, cognitive, and/or developmental conditions.[27–31 33 34] Studies examined two main categories of interventions: (1) brief educational interventions[28–30 32 33] and (2) intensive multidisciplinary care models.[27 34]

Brief educational interventions

Four of the six studies examined the efficacy of brief educational interventions for patients in managing post-spinal surgery pain and/or anxiety.[28–30 32 33] The interventions were heterogeneous, incorporating components such as guided imagery and relaxation training,[28–32] concrete medical information teaching,[29–31 33] and music therapy.[32] In general, most studies did not report convincing evidence of brief educational interventions being more efficacious than routine medical care in improving outcomes.

Interestingly, Charette *et al*[28] found that patients randomized to receive a short audiovisual intervention of guided imagery and relaxation exercises for postoperative pain management had significantly lower pain levels at discharge and 1 month postdischarge than those who received routine medical care. However, when LaMontagne *et al*[29 30] conducted a similar trial comparing audiovisual interventions of coping and/or concrete medical information training with routine medical care, they did not report significant between-group differences in anxiety or pain levels, except in subgroup analyses (eg, patients under 14 years and highly anxious patients).

Although most studies compared interventions with routine medical care, one RCT by Nelson, Adamek, and Kleiber did not.[32] In this trial, both study groups received postoperative music therapy, with one also receiving preoperative music-assisted relaxation training.[32] Researchers reported significant within-group, but not between-group, differences in anxiety and pain levels, highlighting the need for research comparing music therapy with routine care alone.[32]

Intensive multidisciplinary care models

Two of the six studies examined the efficacy of intensive multidisciplinary care models for adolescents with scoliosis after spinal surgery.[27 34] Both studies reported improvements in patient outcomes, with one focusing on mental health outcomes, pain levels, and satisfaction with care, and the other on length of hospital stay.[27 34]

The first study was an RCT conducted by Ying and Fu,[34] which compared routine nursing care with Rosenthal effect based nursing, where nurses offered proactive mental healthcare post spinal surgery and provided mental health training for family members to monitor patients' mental well-being.[34] Researchers reported that the intervention was significantly more efficacious than routine medical care in improving depressive and anxiety symptoms, quality of life, pain levels, and satisfaction with nursing.[34]

The second study was a prospective cohort study conducted by Chan *et al*,[27] which compared an accelerated recovery protocol for adolescents undergoing spinal fusion surgery (described further in online supplemental table 2) with an earlier audit of routine medical care, reporting reductions in length of hospital stay after implementation of the protocol.

Key takeaways

In patients undergoing spinal surgery, we found inconsistent trial evidence of the efficacy of brief educational interventions on reducing postsurgical anxiety or pain, but improvements in these outcomes (as well as depressive symptoms, quality of life, and satisfaction with care) via proactive mental healthcare delivery by nurses following spinal surgery. This shows the importance of intensive multidisciplinary care.

General interventions

Only one study included in this review broadly focused on patients with scoliosis (ie, not specifically bracing or spinal surgery) (online supplemental table 3).[35] Hinrichsen, Revenson, and Shinn[35] performed a cross-sectional study in 1985 comparing the psychological well-being of adolescents who attended a scoliosis self-help group with those who sought information about the group but did not yet attend. They found no significant between-group differences for most outcomes, including psychosomatic symptoms.[35]

Quality assessments

We summarize the results of our quality assessments in online supplemental tables 4 and 5.[21 22] It was difficult to conduct quality assessments for many of the included studies due to limitations in their reporting quality, consequently also resulting in relatively low certainty in

the body of evidence. For example, most RCTs did not clearly report their allocation concealment or outcome assessor blinding procedures, or lack thereof. Many non-randomized studies also did not clearly describe their sampling procedures, outcome assessor blinding procedures, or sample size calculations. Notably, several RCTs were deemed to have a high risk of bias for participant and clinician unblinding, incomplete outcome data, and selective outcome reporting.

Although not assessed by the quality assessment tools, it should be noted that a number of the studies were conducted more than 5 years ago, with one conducted in 1985 and several in the early 2000s.[24 29–31 35] This may reduce their relevance and applicability to current clinical practice.[24 29–31 35]

DISCUSSION

Main findings

This systematic review aimed to summarize evidence of the efficacy of psychosocial interventions on patient and health service outcomes (such as psychological symptoms, treatment compliance, healthcare utilization) among pediatric patients with scoliosis in any setting. Ten eligible studies (described in 13 articles) were identified, all focusing on patients with AIS. More specifically, three focused on those undergoing bracing, six on those undergoing spinal surgery, and one on patients broadly. Brace compliance monitoring and counseling were found to significantly improve brace compliance quality and quantity in adolescents with scoliosis. Proactive mental healthcare delivery by nurses after spinal surgery was also found to significantly improve mental and physical health outcomes for these patients. Several studies examined the efficacy of brief educational interventions on postsurgical anxiety and/or pain; most did not report clear evidence of interventions being more efficacious than comparator interventions.

Discussion of main findings

Bracing

Given the large body of literature highlighting poor brace compliance among pediatric patients with scoliosis and the importance of compliance for effective treatment outcomes, it is crucial that we find clinically effective and cost-effective mechanisms to improve brace compliance.[5] Proactive brace compliance monitoring and counseling could be one such intervention,[23 25 26] as it allows patients to receive timely, frequent, and individualized advice from providers, preventing them from 'falling through the cracks'. Implementing this intervention via mobile apps may be particularly feasible because it would overcome barriers associated with inperson visits.[25]

Spinal surgery

Anxiety and pain management are key concerns for patients with scoliosis undergoing surgery.[29] We found some evidence to support using brief audiovisual interventions to help manage pain in these patients.[28] We also found that interventions should be tailored to specific patient populations; for example, teaching coping techniques may be particularly helpful for young adolescents.[29 30] Given that these interventions are brief, they may offer a relatively easy way for surgical services to equip their patients with techniques to manage their anxiety and pain.[29] That being said, intensive multidisciplinary interventions which are more resource-intensive are likely the most effective way of improving outcomes for these patients (eg, training providers to provide proactive preoperative and postoperative mental healthcare).[34]

Other relevant literature

To our knowledge, this is the first systematic review to examine the effectiveness of psychosocial interventions for pediatric patients with scoliosis. However, there are a number of additional relevant reviews worth noting.

Our review only included studies that reported quantitative data, as another recent review by Essex *et al*[1] summarized relevant qualitative data. They highlighted the complex biopsychosocial needs of adolescents with scoliosis, including body image concerns and limitations in everyday activities.[1] They also described several encouraging 'simple' interventions, including poetry writing and co-designing scoliosis braces, that may improve patient outcomes.[1] However, reviewers also found that patients were often not adequately supported by providers, noting a need for improved information provision, ongoing emotional support (particularly to overcome barriers to brace compliance), and greater general attentiveness of clinical staff.[1]

Furthermore, our review only focused on pediatric patients with scoliosis because another review by Motyer *et al*[3] summarized evidence on the experiences of parents of children with scoliosis, highlighting their information needs, treatment concerns, and psychological well-being. They found that parents often lacked treatment knowledge and consequently turned to the internet for information, which resulted in more confusion and distress.[3] Therefore, they highlighted the importance of evidence-based resources for parents.[3] Parents were also found to experience high levels of psychological distress and concern about their child's treatments.[3] Researchers have emphasized the important role that providers have in consistently supporting parents.[3]

Recommendations for future research and clinical practice

On completion of our review, we organized a consultation meeting, where we presented the review findings to a diverse group of scoliosis experts at our institution, including pediatric orthopedic surgeons, nurses, physical therapists, social workers, psychologists, researchers, and people with lived experience. After providing detailed descriptions of the included studies in the review, as well as the overall review results, we asked them to share their perceptions of integrating the interventions into clinical

practice. Overall, group members were supportive of the proactive brace compliance monitoring and counseling intervention, but simultaneously cautioned against making patients feel 'guilty' when implementing this intervention. Group members also saw the value of intensive multidisciplinary interventions, such as training a provider to proactively deliver mental healthcare, as depicted in the study on Rosenthal effect-based nursing. Based on their clinical expertise, group members also recommended implementing structured support groups and one-on-one peer mentorship programs for patients and their caregivers, as well as developing evidence-based resources with practical information on living with scoliosis; these suggestions mirror those made in the two systematic reviews previously described.[1 3] However, it should be noted that while peer support interventions have been shown to have potential value, limitations in the quality of the literature have prevented strong conclusions regarding their efficacy.[36 37]

We recommend that future clinical and research efforts be directed towards developing and implementing innovative models of care that integrate multiple interventions shown to have the most promise in the literature and clinical practice. One such model of care recommended by the World Health Organization (WHO) is case management (CM).[38] CM often involves adding a new member to the care team, a case manager, to improve the coordination and delivery of holistic care.[39] When appropriately implemented, CM has been found to have the potential to improve high-quality care for populations with diverse conditions.[40] However, the efficacy of these types of complex, multidisciplinary models of care requires further investigation in pediatric patients with scoliosis. In addition, future research efforts should focus on other patient populations with scoliosis, such as those with neuromuscular scoliosis.

Strengths and limitations

This systematic review has several strengths which include: (1) using a comprehensive search strategy developed with an information specialist to find all relevant published literature; (2) not applying language or publication date restrictions; (3) minimizing selection bias by preregistering our protocol and using two independent reviewers for study selection; (4) minimizing reporting bias by using two independent reviewers for data extraction and quality assessments; (5) conducting rigorous quality assessments of all included studies; and (6) searching for gray literature.

This systematic review also has limitations which include the inclusion of: (1) a small number of studies, often with poor reporting quality; (2) non-randomized studies; (3) studies conducted more than five years ago, including one from 1985 and several from the early 2000s; (4) studies that almost exclusively focused on female adolescents with scoliosis, with little to no consideration for other populations, such as those with neuromuscular scoliosis; (5) studies that typically developed and tested brief one-off interventions, rather than intensive interventions or models of care likely to change overall care offered to those with scoliosis; and (6) studies that provided scant evidence of the efficacy of psychosocial interventions on physical health outcomes or long-term health outcomes. Other limitations of our review include: (1) our inability to conduct statistical analyses due to psychosocial intervention heterogeneity and (2) our gray literature search not retrieving any additional published literature for inclusion. However, we were encouraged to discover that a number of trials in this field are underway or have recently been completed, which will provide further insight into the effectiveness and potential of certain interventions.

CONCLUSIONS

Research on the efficacy of psychosocial interventions for pediatric patients with scoliosis is limited, with interventions involving frequent patient-provider interactions showing the most promise. Examples of such interventions include brace compliance monitoring and counseling, as well as proactive mental healthcare delivery by nurses after spinal surgery. Future clinical and research efforts should focus on developing and testing psychosocial interventions for this patient population, with emphasis on multidisciplinary teams delivering holistic care. Efforts should also be devoted to focusing on other patient populations with scoliosis aside from AIS, such as those with neuromuscular scoliosis.

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39 Mwandala T. Roles, training, and qualifications of a case manager in the Canadian health care industry: a narrative review. *Prof Case Manag* 2021;26:27–33.
40 Buja A, Francesconi P, Bellini I, *et al*. Health and health service usage outcomes of case management for patients with long-term conditions: a review of reviews. *Prim Health Care Res Dev* 2020;21:e26.

SUPPLEMENTARY MATERIAL

Supplementary material for: Effectiveness of psychosocial interventions for pediatric patients with scoliosis: A systematic review

SEARCH STRATEGY

Searches were run from database inception to March 20, 2022.

Database 1: Medline (1946 to March 20, 2022)

1 Psychotherapy/
2 Psychosocial intervention/
3 Patient Education as Topic/
4 Self Care/
5 Professional-patient relations/
6 Psych*.ti,ab.
7 Biopsychosocial.ti,ab.
8 Bio psychosocial.ti,ab.
9 Bio psycho social.ti,ab.
10 Biopsycho social.ti,ab.
11 Integrated care.ti,ab.
12 Collaborative care.ti,ab.
13 Case manage*.ti,ab.
14 Social work*.ti,ab.
15 Monitor*.ti,ab.
16 Patient center*.ti,ab.
17 Patient centre*.ti,ab.
18 Mental health.ti,ab.
19 Counsel*.ti,ab.
20 ((behav* or cognitive or relaxation or acceptance or commitment) adj3 (therap* or treatment*)).ti,ab.
21 CBT.ti,ab.
22 Mindful*.ti,ab.
23 ((Patient* or health) adj3 (educat* or learn* or teach* or train*)).ti,ab.
24 Self care.ti,ab.
25 Self manag*.ti,ab.
26 Self help.ti,ab.
27 Complian*.ti,ab.
28 Behaviour therap*.ti,ab.
29 Relaxation.ti,ab.
30 Child/
31 Adolescent/
32 Child*.ti,ab.
33 Adolescen*.ti,ab.
34 Youth*.ti,ab.
35 Young*.ti,ab.
36 Teen*.ti,ab.
37 Juvenile*.ti,ab.
38 Junior*.ti,ab.
39 Pediatric*.ti,ab,jw.
40 Paediatric*.ti,ab,jw.
41 Scoliosis/
42 Scoliosis.ti,ab,kw.
43 AIS.ti,ab,kw.
44 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29
45 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40
46 41 or 42 or 43
47 44 and 45 and 46
48 47 not (editorial or comment or guideline or letter or protocol).ti,ab.

Database 2: PsycINFO (1806 to March 20, 2022)

1 Psychotherapy/
2 Psychotherapeutic Techniques/
3 Self Care/
4 Psych*.ti,ab.
5 Biopsychosocial.ti,ab.
6 Bio psychosocial.ti,ab.
7 Bio psycho social.ti,ab.
8 Biopsycho social.ti,ab.
9 Integrated care.ti,ab.
10 Collaborative care.ti,ab.
11 Case manage*.ti,ab.
12 Social work*.ti,ab.
13 Monitor*.ti,ab.
14 Patient center*.ti,ab.
15 Patient centre*.ti,ab.
16 Mental health.ti,ab.
17 Counsel*.ti,ab.
18 ((behav* or cognitive or relaxation or acceptance or commitment) adj3 (therap* or treatment*)).ti,ab.
19 CBT.ti,ab.
20 Mindful*.ti,ab.
21 ((Patient* or health) adj3 (educat* or learn* or teach* or train*)).ti,ab.
22 Self care.ti,ab.
23 Self manag*.ti,ab.
24 Self help.ti,ab.
25 Complian*.ti,ab.
26 Behaviour therap*.ti,ab.
27 Relaxation.ti,ab.
28 Childhood Development/
29 Adolescent Development/
30 Child*.ti,ab.
31 Adolescen*.ti,ab.
32 Youth*.ti,ab.
33 Young*.ti,ab.
34 Teen*.ti,ab.
35 Juvenile*.ti,ab.
36 Junior*.ti,ab.
37 Pediatric*.ti,ab,jw.
38 Paediatric*.ti,ab,jw.
39 Scoliosis.ti,ab.
40 AIS.ti,ab.
41 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27
42 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38
43 39 or 40
44 41 and 42 and 43
45 44 not (editorial or comment or guideline or letter or protocol).ti,ab.

Database 3: Embase (1974 to March 20, 2022)

1 Psychotherapy/
2 Psychosocial intervention/
3 Patient Education as Topic/
4 Self Care/
5 Professional-patient relations/
6 Psych*.ti,ab.
7 Biopsychosocial.ti,ab.
8 Bio psychosocial.ti,ab.
9 Bio psycho social.ti,ab.
10 Biopsycho social.ti,ab.
11 Integrated care.ti,ab.
12 Collaborative care.ti,ab.
13 Case manage*.ti,ab.
14 Social work*.ti,ab.
15 Monitor*.ti,ab.
16 Patient center*.ti,ab.
17 Patient centre*.ti,ab.
18 Mental health.ti,ab.
19 Counsel*.ti,ab.
20 ((behav* or cognitive or relaxation or acceptance or commitment) adj3 (therap* or treatment*)).ti,ab.
21 CBT.ti,ab.
22 Mindful*.ti,ab.
23 ((Patient* or health) adj3 (educat* or learn* or teach* or train*)).ti,ab.
24 Self care.ti,ab.
25 Self manag*.ti,ab.
26 Self help.ti,ab.
27 Complian*.ti,ab.
28 Behaviour therap*.ti,ab.
29 Relaxation.ti,ab.
30 Child/
31 Adolescent/
32 Child*.ti,ab.
33 Adolescen*.ti,ab.
34 Youth*.ti,ab.
35 Young*.ti,ab.
36 Teen*.ti,ab.
37 Juvenile*.ti,ab.
38 Junior*.ti,ab.
39 Pediatric*.ti,ab,jw.
40 Paediatric*.ti,ab,jw.
41 Scoliosis/
42 Scoliosis.ti,ab,kw.
43 AIS.ti,ab,kw.
44 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29
45 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40
46 41 or 42 or 43
47 44 and 45 and 46
48 47 not (editorial or comment or guideline or letter or protocol).ti,ab.

Database 4: EBSCO CINAHL (1937 to March 20, 2022)

S1	(MH "Psychotherapy") OR (MH "Patient Education") OR (MH "Self Care") OR (MH "Psychiatric Care") OR (MH "Orthopedic Care") OR (MH "Holistic Care") OR (MH "Professional-Patient Relations")
S2	TI (psych* OR biopsychosocial OR "bio psychosocial" OR "Bio psycho social" OR "Biopsycho social" OR "Integrated care" OR "Collaborative care" OR "Case manage*" OR "Social work*" OR Monitor* OR "Patient center*" OR "Patient centre*" OR "Mental health" OR Counsel* OR CBT OR Mindful* OR "Self care" OR "Self manag*" OR "Self help" OR Complian* OR "Behaviour therap*" OR Relaxation) OR AB (psych* OR biopsychosocial OR "bio psychosocial" OR "Bio psycho social" OR "Biopsycho social" OR "Integrated care" OR "Collaborative care" OR "Case manage*" OR "Social work*" OR Monitor* OR "Patient center*" OR "Patient centre*" OR "Mental health" OR Counsel* OR CBT OR Mindful* OR "Self care" OR "Self manag*" OR "Self help" OR Complian* OR "Behaviour therap*" OR Relaxation) OR TI ((behav* n3 therap*) OR (cognitive n3 therap*) OR (relaxation n3 therap*) OR (acceptance n3 therap*) OR (commitment n3 therap*) OR (behav* n3 treatment*) OR (cognitive n3 treatment*) OR (relaxation n3 treatment*) OR (acceptance n3 treatment*) OR (commitment n3 treatment*)) OR AB ((behav* n3 therap*) OR (cognitive n3 therap*) OR (relaxation n3 therap*) OR (acceptance n3 therap*) OR (commitment n3 therap*) OR (behav* n3 treatment*) OR (cognitive n3 treatment*) OR (relaxation n3 treatment*) OR (acceptance n3 treatment*) OR (commitment n3 treatment*)) OR TI ((Patient* n3 educat*) OR (Health n3 educat*) OR (Patient* n3 learn*) OR (Health n3 learn*) OR (Patient* n3 teach*) OR (Health n3 teach*) OR (Patient* n3 train*) OR (Health n3 train*)) OR AB ((Patient* n3 educat*) OR (Health n3 educat*) OR (Patient* n3 learn*) OR (Health n3 learn*) OR (Patient* n3 teach*) OR (Health n3 teach*) OR (Patient* n3 train*) OR (Health n3 train*))
S3	(MH "Child Health") OR (MH "Child Psychiatry") OR (MH "Adolescent Health") OR (MH "Adolescent Psychiatry")
S4	TI (Child* OR Adolescen* OR Youth* OR Young* OR Teen* OR Juvenile* OR Junior* OR Pediatric* OR Paediatric*) OR AB (Child* OR Adolescen* OR Youth* OR Young* OR Teen* OR Juvenile* OR Junior* OR Pediatric* OR Paediatric*)
S5	(MH "Scoliosis")
S6	TI (Scoliosis OR AIS) OR AB (Scoliosis OR AIS)
S7	S1 or S2
S8	S3 or S4
S9	S5 or S6
S10	S7 AND S8 AND S9

Database 5: Cochrane Central Register of Controlled Trials (CENTRAL) (1992 to March 20, 2022)

#1	MeSH descriptor: [Psychotherapy] explode all trees
#2	MeSH descriptor: [Patient Education as Topic] explode all trees
#3	MeSH descriptor: [Self Care] explode all trees
#4	MeSH descriptor: [Professional-Patient Relations] explode all trees
#5	(Psych*):ti,ab,kw
#6	(Biopsychosocial):ti,ab,kw
#7	(Bio psychosocial):ti,ab,kw
#8	(Bio psycho social):ti,ab,kw
#9	(Biopsycho social):ti,ab,kw
#10	(Integrated care):ti,ab,kw
#11	(Collaborative care):ti,ab,kw
#12	(Case manage*):ti,ab,kw
#13	(Social work*):ti,ab,kw
#14	(Monitor*):ti,ab,kw
#15	(Patient center*):ti,ab,kw
#16	(Patient centre*):ti,ab,kw
#17	(Mental health):ti,ab,kw
#18	(Counsel*):ti,ab,kw
#19	(behav* n3 therap*):ti,ab,kw
#20	(cognitive n3 therap*):ti,ab,kw
#21	(relaxation n3 therap*):ti,ab,kw
#22	(acceptance n3 therap*):ti,ab,kw
#23	(commitment n3 therap*):ti,ab,kw
#24	(behav* n3 treatment*):ti,ab,kw
#25	(cognitive n3 treatment*):ti,ab,kw
#26	(relaxation n3 treatment*):ti,ab,kw
#27	(acceptance n3 treatment*):ti,ab,kw
#28	(commitment n3 treatment*):ti,ab,kw
#29	(Patient* n3 educat*):ti,ab,kw
#30	(Health n3 educat*):ti,ab,kw
#31	(Patient* n3 learn*):ti,ab,kw
#32	(Health n3 learn*):ti,ab,kw
#33	(Patient* n3 teach*):ti,ab,kw
#34	(Health n3 teach*):ti,ab,kw
#35	(Patient* n3 train*):ti,ab,kw
#36	(Health n3 train*):ti,ab,kw
#37	(CBT):ti,ab,kw
#38	(Mindful*):ti,ab,kw
#39	(Self care):ti,ab,kw
#40	(Self manag*):ti,ab,kw
#41	(Self help):ti,ab,kw
#42	(Complian*):ti,ab,kw
#43	(Behaviour therap*):ti,ab,kw
#44	(Relaxation):ti,ab,kw
#45	MeSH descriptor: [Child] explode all trees
#46	MeSH descriptor: [Adolescent] explode all trees
#47	(Child*):ti,ab,kw
#48	(Adolescen*):ti,ab,kw
#49	(Youth*):ti,ab,kw
#50	(Young*):ti,ab,kw
#51	(Teen*):ti,ab,kw
#52	(Juvenile*):ti,ab,kw
#53	(Junior*):ti,ab,kw
#54	(Pediatric*):ti,ab,kw
#55	(Paediatric*):ti,ab,kw
#56	MeSH descriptor: [Scoliosis] explode all trees

#57 (Scoliosis):ti,ab,kw
#58 (AIS):ti,ab,kw
#59 59 and 60 and 61
#60 #1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9 or #10 or #11 or #12 or #13 or #14 or #15 or #16 or #17 or #18 or #19 or #20 or #21 or #22 or #23 or #24 or #25 or #26 or #27 or #28 or #29 or #30 or #31 or #32 or #33 or #34 or #35 or #36 or #37 or #38 or #39 or #40 or #41 or #42 or #43 or #44
#61 #45 or #46 or #47 or #48 or #49 or #50 or #51 or #52 or #53 or #54 or #55
#62 #56 or #57 or #58
#63 #60 and #61 and #62

Grey Literature

Database 1: ClinicalTrials.Gov
Search term: “Scoliosis”
Restrictions: “Completed”

Database 2: International Clinical Trials Registry Platform (ICTRP)
Search term: “Scoliosis”

Supplementary Table 1. Effectiveness of psychosocial interventions in pediatric patients with scoliosis undergoing **bracing**

General		Sample Characteristics		Study Groups		Outcomes	
Study (Country)	**Study Design & Dates**	**Selection Criteria**	**Sample Size, Age, % Female, Curve Size**	**Intervention Group**	**Comparison Group**	**Outcome Measure(s)**	**Result(s) & Key Takeaway**
Karol et al 2016 [23] (USA)	2-arm, cluster randomized trial (cluster = treating physician) 2008 to 2013	Adolescent with idiopathic scoliosis; spinal curvature 25° to 45°; Risser stage 0 to 2; if female, < 1 year post-menarche.	**Total** N = 171 analyzed (222 randomized) Mean (SD) age = NR % female = 90%* Brace = TLSO brace **Intervention group** N = 93 analyzed Mean (SD) age = NR Mean (SD) curve size = 33.2° (NR) % female = 88% **Control group** N = 78 analyzed Mean (SD) age = NR Mean (SD) curve size = 33.9° (NR) % female = 92%	**Brace prescription + brace compliance monitoring and counselling:** patients prescribed brace with temperature sensor and **informed** compliance was being monitored; orthopedist and orthopedic surgeon aware of compliance data; orthopedist and orthopedic surgeon offered counselling using compliance data ≥ 1 every 3 months.	**Brace prescription + usual compliance advice:** patients prescribed brace with temperature sensor and **not informed** compliance was being monitored; orthopedist, orthopedic surgeon, and patient did not have access to compliance data; patients received usual advice regarding compliance (i.e., not informed by data from sensors).	**Primary** Brace compliance (number of hrs. of daily brace wear via temperature sensor) throughout course of treatment. **Secondary** Curve progression (measured using radiograph) at brace termination.	**Primary** (intervention vs. control) ***Average hours of daily brace wear at 180 days: 15.0 hrs. vs. 12.5 hrs. (p=0.0095)***. ***Average hours of daily brace wear throughout course of brace treatment: 13.8 hrs. vs. 10.8 hrs. (p= 0.002).*** **Secondary** Curve progression < 6°, ≥ 6°, or ≥50° (magnitude needing surgery): no significant between-group differences in proportions. **Key Takeaway** Knowledge of brace compliance monitoring and counselling can improve brace compliance in patients with AIS.
Matsunaga et al 2005 [24] (Japan)	Prospective cohort study Study dates NR	Female adolescent with idiopathic scoliosis; brace therapy alone.	**Total** N = 145 analyzed Mean (range) age = 12.4 (11 to 16) years % female = 100% Brace = Milwaukee (24%*) & TSLO (76%*)	**Brace prescription based on psychologic testing (Maudsley Personality Inventory):** *Before brace therapy*: patients completed psychological test and received introversion/extraversion score (E) and neuroticism score (N); patients rated as: **1 = Normal** **2 = Abnormal** *2a* = E(-)N(-): introverted *2b* = E(-)N(+): highly anxious *2c* = E(+)N(-): passionate *2d* = E(+)N(+): passionate	**No comparison group.**	**Primary** Emotional distress (Maudsley Personality Inventory) measured at 1- and 2-months post-brace therapy.	**Primary** **Emotional Distress** Before brace therapy (baseline) Normal: 92%* Abnormal: 8%* 1 month post-brace therapy ***Significant decrease in percent rated as normal compared to baseline (p<0.001)*** Normal: 18%* Abnormal: 82%* 2 months post-brace therapy

				If rated (1) or (2c), patients completed brace therapy without modification. If rated (2a) or (2b), patients received additional relaxation training. If rated (2d), patients' teachers received advice on improving school environment for patient. *1 month post-brace therapy*: Patients re-tested. If rated (1) or (2c), treatment did not change. If rated (2a), (2b), or (2d), treatment changed from full-time to part-time brace therapy. *2 months post-brace therapy*: Patients re-assessed.			***Significant increase in percent rated as normal after modifications made at 1 month (p<0.001)*** Normal: 68%* Abnormal: 32% **Key Takeaway** In patients with AIS, tailoring their brace therapy based on their personality pattern may improve emotional outcomes.
Zhu et al 2021a, 2021b [25, 26] (China) *Data were only extracted from 2021a because it has a larger sample size than 2021b*	Prospective cohort study Study dates NR	Aged ≥ 10 years at time of brace treatment; spinal curvature 25° to 40°; Risser stage 0 to 2; no prior treatment.	**Total** N = 28 analyzed (30 enrolled) Mean (SD) age = 12.4 (1.5) years % female = 82%* Brace = Chêneau brace	**Brace prescription + real-time brace compliance monitoring + counselling:** patients prescribed brace (23 hrs. per day) with force sensor; patients uploaded their compliance ≥ 1 daily to a mobile *WeChat Mini Program* that showed compliance data and had an interface to communicate with providers; compliance data linked to a cloud-based storage system and website for providers to review compliance data; providers offered recommendations and counselling to patients (patients could communicate as needed via *WeChat Mini Program*; if no contact, provider followed up at least every 3 months).	**No comparison group.**	**Primary** Quantity of brace compliance (measured time/prescribed time [23 hrs] via force sensor) at 3 and 6 months. Quality of brace compliance (measured force/ baseline force via force sensor) at 3 and 6 months. **Secondary** Satisfaction with monitoring system (very satisfied, somewhat satisfied, somewhat dissatisfied, or very dissatisfied) at 6 months.	**Primary** (6 months vs. 3 months) **Quantity of compliance** ***Proportion (SD) compliant: 70.3% (6.4%) vs. 52.3% (10.8%) (p=0.000).*** ***Mean (SD) daily wear: 16.1 (1.4) vs. 12.0 (2.4) (p=0.000).*** **Quality of compliance** ***Proportion (SD) compliant: 80.5% (19.6%) vs. 49.1% (10.4%) (p=0.000).*** **Secondary** 96.4% very or somewhat satisfied with monitoring system. **Key Takeaway** Real-time compliance monitoring and counselling

							may improve quantity *and* quality of brace compliance over time in patients with AIS.

*Calculated using data from paper.

AIS = Adolescent Idiopathic Scoliosis; Hrs. = Hours; NR = Not Reported; SD = Standard Deviation; TSLO = Thoracic Lumbar Sacral Orthosis; USA = United States of America.

Supplementary Table 2. Effectiveness of psychosocial interventions in pediatric patients with scoliosis undergoing **spinal surgery**

General		Sample Characteristics		Study Groups		Outcomes	
Study (Country)	**Study Design & Dates**	**Selection Criteria**	**Sample Size, Age, % Female**	**Intervention Group**	**Comparison Group**	**Outcome Measure(s)**	**Result(s) & Key Takeaway**
Chan et al 2017 [27] (Malaysia)	Prospective cohort study September 2015 to June 2016	Diagnosis of AIS; undergoing posterior spinal fusion; no psychological disorders, non-idiopathic scoliosis, metabolic bone disease, or undergoing revision surgery.	**Total** N = 107 analyzed Mean (SD) age = NR % female = NR Mean (SD) curve size = NR **Intervention group** N = 74 recruited & analyzed Mean (SD) age = 15.8 (4.6) years % female = 88%* Mean (SD) curve size = 65.5° (15.9°) **Control group (2010 audit)** N = 33 analyzed Mean (SD) age = NR % female = NR Mean (SD) curve size = NR	**Accelerated recovery protocol:** patients received pre-operative regime (e.g., scoliosis support group; aerobic exercise regime); pre-operative day of surgery counseling (e.g., counseling on post-op pain management); intra-operative strategies to shorten surgical time (e.g., dual attending surgeon); accelerated post-operative rehabilitation; and pain management regime.	**2010 Audit:** patients who received traditional care pathway before accelerated recovery protocol was implemented (e.g., single surgeon, pain management via patient-controlled analgesia or morphine).	**Primary** Length of stay (LOS)	**Primary** (study vs. audit) Mean (SD) LOS: 70.8 (10.3) hrs. vs. 125.4 (58.4) hrs. Found protocol was feasible without increasing complication or readmission rates **Key Finding** An accelerated recovery protocol can be successfully implemented and has the potential to reduce length of hospital stay for patients with AIS.
Charette et al 2015 [28] (Canada)	2-arm, parallel-group randomized trial March 2010 to June 2011	Aged 11 to 20 years; undergoing spinal fusion for idiopathic scoliosis; understood/spoke French; had computer or DVD player at home; no moderate to severe cognitive deficit.	**Total** N = 40 randomized & analyzed Mean (SD) age = 15 (2.15) years % female = 82.5%* **Intervention group** N = 20 randomized & analyzed Mean (SD) age = 15.50 (2.07) years % female = 90%* **Control group** N = 20 randomized & analyzed Mean (SD) age = 14.50 (2.16) years	**Guided imagery, relaxation, and education intervention + usual care:** patients were given DVD on post-operative pain management with demonstrations of guided imagery and relaxation exercises (nurse showed DVD 1-day pre-operatively and at discharge; nurse followed up 2 weeks post-discharge to reinforce technique); patients instructed to practice exercises ≥ 3 times per week for ≥ 2 weeks.	**Usual care:** patients received standard care (including analgesics, regular physiotherapy care, and 1-month follow-up outpatient visit).	**Primary** Pain intensity (French-BPI) at discharge, 2 weeks post-discharge, and 1-month post-discharge. **Secondary** Anxiety (French-STAI-Y), pain-related coping strategies (French-PPCI), and resumption of regular daily activities (French-BPI) at discharge	**Primary** (intervention vs. comparison) ***Significantly lower average pain at all timepoints (moderate to large effect sizes: discharge, d = 0.22, p=0.004; 2-weeks post-operative, d = 0.51, p=0.001; 1-month post-operative, 0.42, p=0.007).*** **Secondary** No significant between-group differences on most outcomes before or after adjustment; *some significant improvements*

			% female = 75%*			and 1-month post-discharge (BPI also administered at 2 weeks post-discharge).	*in resumption of daily activities (e.g. sleeping, eating, walking) at 2-weeks post-discharge.* **Key Takeaway** Guided imagery and relaxation exercises can improve post-spinal fusion pain in patients with AIS.
LaMontagne et al 2003a, 2003b [29,30] (USA) *Data were only extracted from 2003a because 2003b is a re-analysis of this study*	4-arm, parallel-group randomized trial Study dates NR	Aged 11 to 18 years; scheduled for major spinal surgery for idiopathic scoliosis; no previous spinal surgery; no learning or developmental problems; English-speaking (adolescent and parent).	**Total** N = 109 analyzed for anxiety & 89 for pain (113 randomized) Mean (range) age = 13.9 (11 to 18) years % female = 81% **Intervention group 1** N = 27 analyzed for anxiety & 22 for pain Mean (SD) age = 13.89 (1.89) % female = NR **Intervention group 2** N = 27 analyzed for anxiety & 24 for pain Mean (SD) age = 13.93 (1.77) % female = NR **Intervention group 3** N = 30 analyzed for anxiety & 24 for pain Mean (SD) age = 14.10 (1.73) % female = NR **Control group** N = 25 analyzed for anxiety & 19 for pain Mean (SD) age = 13.56 (1.76) years % female = NR	**Group 1: Coping training:** patients watched short videotape teaching coping strategies for managing post-operative pain (e.g., deep breathing, imagery, positive-self-talk) day before surgery; patients practiced coping skills with researcher after videotape. **Group 2: Concrete-objective information teaching:** patients watched short videotape teaching objective information about procedural and sensory information related to the spinal surgery (e.g., ambulation, bone graft discomfort, IV fluids). **Group 3: Coping training + concrete-objective information teaching:** patients received interventions outlined for Groups 1 and 2.	**Usual care, including standard information about surgery** (e.g., length of surgery, post-operative routines, hospital environment).	**Primary** Anxiety (STAI-child/adolescent version) at 2 days post-operatively. Pain intensity (VAS) at 2 and 4 days post-operatively.	**Primary** **Anxiety** No significant between-group differences. **Pain** Significant *within-group* reductions in pain from 2 to 4 days post-operatively in Groups 2, 3, and control. Subgroup analyses showed (1) coping training & concrete-objective information were significantly more effective in reducing post-operative anxiety in highly anxious pre-operative patients and (2) interventions including coping intervention were significantly more effective in reducing post-operative anxiety and pain in patients under 14 years. **Key Takeaway** Cognitive-behavioral interventions to reduce anxiety and pain in post-spinal surgery for AIS should be tailored to their age and pre-operative anxiety; interventions with

							coping training may be particularly helpful for younger adolescents & interventions with coping and information training may be helpful for those with high pre-operative anxiety.
LaMontagne et al 2004 [31] (USA)	Continuation of above RCT		**Total** N = 88 analyzed (113 randomized) Mean (SD) age = 13.9 (1.79) years % female = 78% **Intervention group 1** N = 25 analyzed Mean (SD) age = NR % female = NR **Intervention group 2** N = 23 analyzed Mean (SD) age = NR % female = NR **Intervention group 3** N = 21 analyzed Mean (SD) age = NR % female = NR **Control group** N = 19 analyzed Mean (SD) age = NR % female = NR	*Above interventions + post-surgery booster videos at 3 and 6 months post-surgery* **Group 1: Coping training:** patients watched short booster videotape teaching coping strategies (e.g., problem solving, contact with friends). **Group 2: Concrete-objective information teaching:** patients watched short booster videotape teaching objective information about post-procedural information (e.g., body mechanics, incisional discomfort, stretching exercises, wound healing). **Group 3: Coping training + concrete-objective information teaching:** patients received interventions outlined for Groups 1 and 2.	**Usual care, including standard information about post-surgery** (e.g., post-operative activity restrictions, clinical visits, radiographs).	**Primary** Usual activities (YRS scale – Activities, Social Activities, Academic Performance Scales) at 1, 3, 6, and 9 months post-surgery.	**Primary** *Activities:* general trend of reduced usual activities post-discharge, with gradual resumption of activities in all groups; concrete objective information was most effective for helping patients return to usual activities from 3 to 6 months; no age effects. *Social activities:* same general trend as above; scores at 9 months remained below pre-operative levels; significantly higher social scores over post-operative period in Group 3 & control for patients aged 11 to 14 years. *Academic performance:* not influenced by intervention. **Key Takeaway** Concrete objective information may be particularly helpful in helping patients with AIS resume normal activities in the medium term (3 to 6 months).

Nelson, Adamek & Kleiber 2017 [32] (USA)	2-arm, parallel-group randomized trial Study dates NR	Diagnosis of AIS; aged 10 to 19 years; scheduled for spinal fusion surgery; spoke English; no hearing deficit.	**Total** N = 41 analyzed (44 randomized) Mean (SD) age = NR % female = 90%* **Intervention group** N = 19 analyzed (20 randomized) Median (range) age = 14 (10 to 19) years % female = 95%* **Control group** N = 22 analyzed (24 randomized) Median (range) age = 14 (11 to 15) years % female = 86%*	**Pre-operative music-assisted relaxation training + post-operative music therapy:** patients viewed a short video explaining and demonstrating music-assisted relaxation during pre-operative visit and received 1 music therapy session on day 2 post-operatively with music therapist; parents received educational video on typical post-surgical behaviour and ways to help their child.	**Post-operative music therapy only:** patients did not view music-assisted relaxation video; received 1 music therapy session on day 2 post-operatively with music therapist.	**Primary** Self-reported pain and anxiety (rating scale from 0 to 10, higher scores indicate greater pain or anxiety) before and after music therapy session. **Secondary** Observed "relaxed" or "distressed" behaviors during music therapy session.	**Primary** **Pain and anxiety** No significant between-group differences (p=0.521 and p=0.855 respectively); significant within-group improvements. **Secondary** No significant between-group differences. **Key Takeaway** Music therapy might offer a means of improving pain and anxiety post-spinal fusion in patients with AIS; further studies are needed to come its effectiveness with usual care.
Rhodes et al 2015 [33] (USA)	2-arm, parallel-group randomized trial May 2010 to November 2011	Diagnosis of AIS; aged 11 to 21 years; planned for posterior spinal fusion; spoke English; no developmental delays or neurological conditions.	**Total** N = 65 randomized & analyzed Mean (range) age = 14.2 (10.8 to 19.6) years % female = 65%* **Intervention group** N = 26 analyzed (30 randomized, as treated analysis) Mean (SD) age = 14.27 (2.34) years % female = 73% **Control group** N = 39 analyzed (35 randomized, as treated analysis) Mean (SD) age = 14.23 (1.88) years % female = 59%	**Pre-operative Education and Orientation for Scoliosis Surgery (PEOSS) intervention + usual care:** patients received structured education and orientation program, including tour of relevant locations in hospital and explanation of the care that they would receive.	**Usual care:** (e.g., patients attended pre-operative visit to discuss risks, benefits, and alternatives to posterior spinal fusion).	**Primary** Anxiety (STAI-children) 2 days post-operatively and at discharge. **Secondary** Caregiver anxiety (STAI), length of stay, morphine equivalent use, and patient and caregiver satisfaction (scale 0 to 4, higher scores indicate greater satisfaction).	**Primary** (intervention vs. comparison) Significantly higher state anxiety in post-operative period (p=0.024); no other significant between-group differences. **Secondary** ***Significantly higher patient satisfaction (mean 3.75 vs. 3.51, p=0.0005).*** Caregiver anxiety, length of stay, morphine equivalent use, caregiver satisfaction: no significant between-group differences. **Key Takeaway** Pre-operative education (e.g., hospital tour and explanation of care

							provided) may increase satisfaction after post-spinal fusion in patients with AIS, but might increase anxiety in the short-term.
Ying & Fu 2020 [34] (China)	2-arm, parallel-group trial August 2017 to July 2019	Diagnosis of AIS; admitted for scoliosis surgical correction; able to tolerate surgery; able to cooperate with treatment and nursing; no additional compromising diseases; no allergies to drugs; no poor treatment compliance; not transferred for First People's Hospital in Wenling.	**Total** N = 64 randomized & analyzed Mean (SD) age = NR % female = 64.06%* **Intervention group** Total = 34 randomized & analyzed Mean (SD) age = 12.62 (5.65) years % female = 64.71% **Control group** Total = 30 randomized & analyzed Mean (SD) age = 13.27 (5.72) years % female = 63.33%	**Rosenthal effect-based nursing:** nurses trained to evaluate patients' mental wellbeing; nurses provided health education training to patients' family members and collaborated with family members to offer patient care; nurses instructed families to monitor patients' mental wellbeing; nurses encouraged patients through rehabilitation program; nurses placed funny pictures and posters on wards to improve patients' wellbeing.	**Routine nursing care:** (e.g., nurses monitored vital signs, offered simple health education, assisted with rehabilitation).	**Primary** Depression (HAM-D), anxiety (HAM-A) at discharge. Pain (VAS) 1, 3, and 7 days post-operatively. Satisfaction with nursing (nursing satisfaction questionnaire) at discharge. Quality of life (100-point system) 3 months post-discharge.	**Primary** (intervention vs. control) ***Significantly lower depression and anxiety & pain (3 and 7 days post-operatively only) (p<0.01).*** ***Significantly higher nursing satisfaction and quality of life (p<0.05).*** **Key Takeaway** Rosenthal effect-based nursing can improve mental health outcomes and pain in patients with AIS.

*Calculated using data from paper.
AIS = Adolescent Idiopathic Scoliosis; BPI = Brief Pain Inventory; HAM-A = Hamilton Anxiety Rating Scale; HAM-D = Hamilton Depression Rating Scale; IV = intravenous; NR = Not Reported; PPCI = Pediatric Pain Coping Inventory; RCT = Randomized Controlled Trial; SD = Standard Deviation; STAI = State-Trait Anxiety Inventory; USA = United States of America; VAS = Visual Analog Scale; YSR = Competence Scale of the Youth Self-Report and Profile.

Supplementary Table 3. Effectiveness of psychosocial interventions for pediatric patients with scoliosis **(general)**

General		Sample Characteristics		Study Groups		Outcomes	
Study (Country)	**Study Design & Dates**	**Selection Criteria**	**Sample Size, Age, % Female**	**Intervention Group**	**Comparison Group**	**Outcome Measure(s)**	**Result(s) & Key Takeaway**
Hinrichsen, Revenson & Shinn 1985 [35] (USA)	Cross-sectional study 1980	Intervention group: former or current dues-paying member of self-help clubs of Scoliosis Association, Inc.; completed survey (adolescent subgroup). Control: sought information about scoliosis self-hep groups to Scoliosis Association, Inc.; completed survey (adolescent subgroup).	**Total** N = 237 analyzed (283 enrolled) Mean (SD) age = NR % female = NR **Intervention group** Total = 140 enrolled (number analyzed 94) Mean (SD) age = 15.3 (NR) years % female = 91.5% **Control group** Total = 143 enrolled (number analyzed 143) Mean (SD) age = 14.6 (NR) years % female = 83.2%	**Self-help group:** members of self-help organization (Scoliosis Association) who attended ≥ 1 scoliosis club meeting aimed to reduce emotional upset, enhance physical and personal self-esteem, and improve communication with parents.	**Control:** individuals who sought information about scoliosis self-help clubs in response to a magazine article.	**Primary** Psychosocial adjustment outcomes (25-item, 4-point response scale) and satisfaction with club.	**Primary** **Psychosocial adjustment** No significant between-group differences for most outcomes (e.g., psychosomatic symptoms, self-esteem); control group had significantly more positive family environments ($p<0.05$). **Satisfaction with club** 61% reported being satisfied or very satisfied with the self-help groups. 40% reported enjoying club meetings a lot of very much. **Key Takeaway** The majority of patients with AIS appear to be satisfied with attending self-help groups, however the psychosocial benefit of these self-help groups was not evident in this study.

AIS = Adolescent Idiopathic Scoliosis; NR = Not Reported; SD = Standard Deviation; USA = United States of America.

Supplementary Table 4. Quality Assessments of Randomized Controlled Trials using Cochrane Risk of Bias Tool

Study	Selection Bias		Performance Bias	Detection Bias	Attrition Bias	Reporting Bias	Level of Evidence*
	Random sequence generation	Allocation concealment	Participant and clinician blinding	Outcome assessor blinding	Incomplete outcome data	Selective outcome reporting	
Charette et al 2016 [28]	low	low	high	high	low	low	Level 2
Karol et al 2016 [23]	unclear	unclear	high	unclear	some	some	Level 2
LaMontagne et al 2003a, 2003b, 2004 [29,30,31]	low	unclear	high	high	high	high	Level 2
Nelson, Adamek & Kleiber 2017 [32]	unclear	unclear	high	high	some	low	Level 2
Rhodes et al 2015 [33]	low	unclear	some	low	high	high	Level 2
Ying & Fu 2020 [34]	unclear	unclear	high	high	low	high	Level 2

*Column from the Centre for Evidence-Based Medicine: http://www.cebm.net.
Ratings: Level I = high-quality RCT; Level 2 = lesser-quality RCT (rated as lesser-quality due to methodological and/or reporting limitations depicted in Table).

Supplementary Table 5. Quality Assessments of Non-Randomized Studies using MINORS

	Chan et al 2017 [27]	**Hinrichsen, Revenson & Shinn 1985 [35]**	**Matsunaga et al 2005 [24]**	**Zhu et al 2021a, 2021b [25,26]**
Clearly stated aim	yes	yes	yes	yes
Inclusion of consecutive patients	unclear	yes for intervention group, no for comparison group	unclear	unclear
Prospective data collection	yes	not applicable	yes	yes
Appropriate endpoints for aim of study	yes	yes	yes	yes
Unbiased assessment of study endpoint	unclear	unclear	unclear	yes
< 5% loss to follow up	yes	no**	unclear	no
Prospective calculation of sample size	yes	unclear	unclear	unclear
Level of evidence*	Level 2	Level 3	Level 2	Level 2

* Column from the Centre for Evidence-Based Medicine: http://www.cebm.net.
Ratings: Level I = high-quality RCT; Level 2 = lesser-quality RCT or prospective comparative study; Level 3 = retrospective comparative study.
** Due to low response rate.
MINORS = Methodological Index for Non-Randomized Studies.