

The Effects of Psychosocial Interventions on Anxiety and Depression in Siblings of Children with Cancer: A Systematic Review and Meta-Analysis

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[Abstract]

This systematic review and meta-analysis evaluated the effects of psychosocial interventions for siblings of children with cancer. A total of 538 studies were screened, and 14 were ultimately included. The pooled analysis of 12 studies addressing anxiety demonstrated a moderate reduction effect (SMD = -0.52, 95% CI: -0.68 to -0.35, $p < .001$; $I^2 = 0\%$), with significant benefits observed in educational and supportive programs, CBT-based interventions, camp programs, interventions delivered in 3-9 sessions, and those conducted in family- or group-based formats. In contrast, the pooled effect from seven studies addressing depression was not statistically significant (SMD = -0.74, $p = .08$; $I^2 = 93\%$), showing substantial heterogeneity across studies. These findings suggest that structured psychosocial interventions are effective in alleviating anxiety among siblings of children with cancer, whereas the effects on depression remain inconsistent. Further randomized controlled trials and studies examining long-term outcomes are warranted.

▶ **Key words:** Childhood Cancer, Siblings, Psychosocial intervention, Anxiety, Depression, Meta-analysis

[요 약]

본 체계적 고찰 및 메타분석은 소아암 환자의 형제자매를 대상으로 한 심리사회적 중재의 효과를 평가하였다. 총 538편의 문헌을 검토하여 최종 14편이 포함되었다. 불안에 대한 12편의 연구를 통합 분석한 결과, 불안 감소에 중간 정도의 효과(SMD = -0.52, 95% CI: -0.68 ~ -0.35, $p < .001$; $I^2 = 0\%$)가 확인되었으며, 교육·지지 프로그램, CBT 기반 중재, 캠프 프로그램, 3-9회기 중재, 가족 및 집단 기반 형식에서 유의한 효과가 나타났다. 반면, 우울에 대한 7편의 연구에서 통합 효과는 통계적으로 유의하지 않았으며(SMD = -0.74, $p = .08$; $I^2 = 93\%$), 연구 간 이질성이 높게 나타났다. 이는 구조화된 심리사회적 중재가 소아암 환자 형제자매의 불안 완화에는 효과적임을 시사하나, 우울에 대한 효과는 일관되지 않음을 보여준다. 향후 무작위대조군 연구와 장기적 효과를 검증하는 연구가 필요하다.

▶ **주제어:** 소아암, 형제자매, 심리사회적 중재, 불안, 우울, 메타분석

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I. Introduction

Globally, approximately 400,000 children are diagnosed with cancer each year[1], and in Korea, about 1,200 children were newly diagnosed with pediatric cancer in 2022 alone[2]. Childhood cancer is not only a life-threatening physical illness but also a profound psychosocial crisis that fundamentally alters the lives of patients and their families. Among family members, siblings of children with cancer (hereafter referred to as cancer siblings) are considered a high-risk group, as they experience complex psychosocial challenges in emotional, social, and developmental domains despite being physically healthy[3]. These siblings often face repeated situations in which parental attention is concentrated on the ill child, leaving them vulnerable to emotional neglect, informational deprivation, and role strain[4].

Previous studies have shown that cancer siblings exhibit higher levels of anxiety and depression compared to their healthy peers, and are more likely to experience post-traumatic stress symptoms, self-blame, guilt, jealousy, and feelings of isolation[5]. Such challenges extend beyond short-term emotional reactions and may negatively affect developmental processes and identity formation[6]. Furthermore, the reorganization of family roles due to illness often imposes caregiving responsibilities or inappropriate burdens on siblings, while simultaneously suppressing their own needs. This may hinder psychological stability and the fulfillment of developmental tasks during childhood[7]. These psychosocial burdens are not confined to family conflict but also extend to school adjustment, peer relationships, and the development of self-efficacy, thereby exerting adverse effects on major developmental milestones[8]. Without timely intervention, these emotional difficulties may persist into adolescence and adulthood, potentially leading to long-term psychological problems[9].

In response, increasing attention has been directed toward the need for psychosocial

interventions for siblings, and a variety of intervention programs have been developed and implemented. These include individual counseling, group therapy, art therapy, play therapy, and educational programs, with the primary goals of reducing anxiety and depression while enhancing coping skills and resilience[10]. Indeed, some studies have reported that such interventions improve siblings' psychological well-being and significantly reduce negative emotions[11,12].

However, most published research to date has been limited to case studies or small-scale experimental studies, with effect sizes varying considerably across studies[13]. Moreover, existing systematic reviews and meta-analyses have primarily focused on patients or parents[14], while quantitative syntheses specifically targeting siblings remain scarce. Yet, siblings exhibit distinctive psychological responses that differ from those of patients or parents, including identity confusion, ambivalent emotions, uncertainty and loss, and social isolation. Therefore, individualized approaches and assessments that acknowledge and support their unique experiences are warranted [15].

Therefore, the present study aims to systematically review psychosocial intervention studies targeting cancer siblings and to conduct a meta-analysis focusing on outcomes related to anxiety and depression. By integrating empirical evidence, this study seeks to provide a comprehensive evaluation of the effectiveness of such interventions, thereby offering a foundation for the development of more effective and standardized programs. Furthermore, the findings are expected to contribute to establishing policy and institutional support systems specifically designed for cancer siblings.

II. Preliminaries

Psychosocial interventions for cancer siblings are grounded in developmental psychology, crisis

theory, family systems theory, and cognitive-behavioral theory (CBT), aiming to provide an integrative approach that considers developmental stages and family dynamics[16]. These theoretical frameworks suggest that interventions should go beyond simple emotional support, incorporating information provision, role reinforcement, and identity restoration to facilitate adaptation.

Psychosocial interventions for cancer siblings are designed in diverse formats according to individual needs and family contexts, and can generally be categorized into individual, group, and family-based interventions. First, individual interventions are delivered on a one-to-one basis, tailored to the sibling's emotional state, personality traits, and developmental stage. These interventions are primarily applied to children and adolescents in psychologically vulnerable conditions, focusing on emotional expression and the enhancement of coping skills[17]. Common therapeutic techniques include play therapy, CBT, art therapy, and narrative therapy[18]. For instance, Mooney-Doyle et al.[19] reported in their systematic review that individual counseling significantly reduced anxiety among cancer siblings. Such approaches are effective in fostering children's ability to safely express and regulate emotions.

Second, group interventions involve structured programs in which cancer siblings with shared experiences participate together, offering opportunities for peer interaction, mutual support, and empathy[20]. Activities within group sessions typically include self-introduction, sharing of emotions, cooperative games, and creative tasks, culminating in training positive coping strategies and sharing a sense of accomplishment [21]. Guan et al.[22] demonstrated that cancer siblings who participated in group therapy showed reduced social withdrawal and improved self-esteem compared to pre-intervention levels. Sharing experiences with peers who have undergone similar challenges plays a critical role in alleviating

feelings of loneliness and isolation.

Finally, family-based interventions target the entire family unit, including cancer siblings, parents, and the child with cancer. This approach seeks to improve family communication, promote role reorganization, and restore family functioning through emotional sharing[23]. Intervention components often include parent education, family meetings, role-playing, and activities designed for emotional exchange, helping cancer siblings to be recognized as important members of the family rather than peripheral figures[24]. Koumariou et al.[25] found that family-based programs incorporating parent education and whole-family participation were effective in reducing cancer siblings' depressive symptoms. Such interventions are particularly beneficial in alleviating feelings of neglect, unfairness, and guilt.

Taken together, these intervention strategies reported in previous studies vary in their focal points and scope of application, and the choice of approach should depend on the sibling's age, psychological state, and family circumstances. An integrative application of multiple approaches may more effectively promote the psychosocial recovery of cancer siblings.

III. Research Methods

1. Eligibility Criteria

This study was conducted in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. The inclusion criteria were established using the PICO-SD framework (Participants, Intervention, Comparison, Outcome, Study Design). Participants were defined as cancer siblings, namely siblings under the age of 18 whose brother or sister had been diagnosed with cancer. Eligible interventions included non-pharmacological psychosocial interventions such as counseling, group therapy, play therapy, art therapy, and educational

programs, while pharmacological treatments were excluded. Comparisons were defined as groups that received no intervention or standard/usual care. The primary outcomes were anxiety and depression in cancer siblings, assessed by quantitative measures comparing pre- and post-intervention changes or differences between experimental and control groups.

In terms of study design, randomized controlled trials (RCTs) were prioritized. However, given the limited number of available studies, non-randomized controlled trials (non-RCTs) and single-group pre-post studies were also included to allow a more comprehensive analysis of intervention effects. Only peer-reviewed full-text articles published in English or Korean were considered. Exclusion criteria were as follows: (1) qualitative studies, (2) descriptive or exploratory surveys without intervention effects, (3) prior systematic reviews or meta-analyses, (4) longitudinal studies without intervention analysis, (5) single case studies, (6) conference abstracts without full text, (7) studies without accessible full text, and (8) studies lacking essential statistical data required to calculate effect sizes.

2. Literature Search and Data Extraction

A systematic search was conducted between June and July 2025, covering all studies published up to May 2025 without restrictions on publication year. The following international and domestic databases were searched: PubMed, CINAHL, Cochrane Library, Embase, RISS (Research Information Sharing Service), KISS (Korean studies Information Service System), and ScienceON. To enhance both sensitivity and specificity, search strategies were refined through preliminary searches that identified appropriate MeSH (Medical Subject Headings) and Emtree terms. Free-text terms were also applied to titles, abstracts, and keywords.

The final search strategy combined the following terms:

(child OR children OR adolescent OR adolescence OR teen OR teenager OR youth OR pediatric OR pediatry) AND (siblings OR brother* OR sister*) AND (neoplasm* OR neoplasia* OR tumor* OR cancer* OR carcinoma OR malignan* OR oncology OR leukemia) AND (psych* OR mental* OR anxiety OR depression OR emotional distress) AND (intervention OR program OR effect OR effectiveness OR treatment OR therapy OR camp OR support OR counseling OR psychoeducation).*

Data extraction was guided by a standardized template developed to ensure reliability and consistency. Extracted data included: author and year of publication, country, study design, participant characteristics (age, sex, sample size), type and format of intervention, intervention duration, frequency and number of sessions, session length, outcome variables, and measurement instruments.

3. Data Analysis

Statistical analyses were conducted using RevMan 5.3 software (Cochrane Collaboration). Standardized Mean Differences (SMDs) were calculated to compare the effects of interventions on anxiety and depression across studies. For studies reporting more than one effect size (e.g., across multiple subscales), the principal outcome selection method was adopted to prevent non-independence of data. The representative effect size was determined based on either the primary outcome specified by the study or the variable deemed most clinically pertinent. Statistical heterogeneity was assessed using Higgins' I^2 statistic. A fixed-effects model was applied when heterogeneity was low, while a random-effects model was used in cases of high heterogeneity. Subgroup analyses were performed to identify potential moderators of intervention effects. Subgroups were pre-defined according to type of intervention (e.g., educational/supportive program, CBT, camp program), number of sessions,

and delivery format (individual, group, family-based). Statistical significance was determined using overall effect tests and 95% confidence intervals (CIs), with $p < .05$ considered significant. Effect sizes were interpreted based on Cohen's criteria[26], where SMD values of 0.20-0.49 indicated a small effect, 0.50-0.80 a medium effect, and >0.80 a large effect. Publication bias was visually examined using funnel plots.

4. Risk of Bias Assessment

Given the inclusion of diverse study designs, risk of bias was evaluated using the Risk of Bias Assessment Tool for Non-randomized Studies 2.0 (RoBANS 2.0)[27]. RoBANS 2.0 comprises eight domains: (1) comparison possibility of participants, (2) selection of participants, (3) confounding variables, (4) measurement of exposure, (5) blinding of outcome assessment, (6) outcome evaluation, (7) incomplete outcome data, and (8) selective outcome reporting. Each domain was rated as "low," "high," or "unclear" risk of bias.

IV. Results

1. Literature selection

Figure 1 illustrates the study selection process. A total of 538 records (no limit-May 2025) were initially identified through database searches. After removing 261 duplicates, 277 studies were screened for eligibility. Based on title and abstract screening, 96 articles were retained for full-text review. After applying the inclusion and exclusion criteria, 14 studies were ultimately included in the meta-analysis.

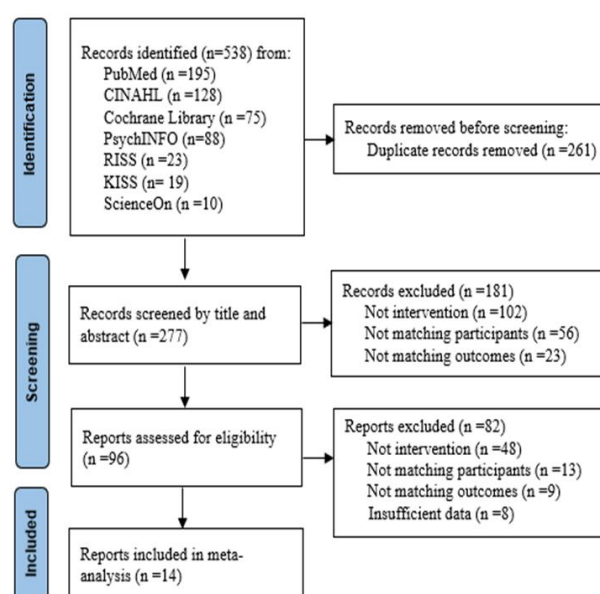


Fig. 1. Flow Diagram of Study Selection

2. Characteristics of the included studies

Table 1 summarizes the characteristics of the 14 studies conducted across seven countries. Study designs included 4 randomized controlled trials (RCTs, 28.6%) and 10 single-group pre-post studies (71.4%). Participants' ages ranged from 6 to 18 years, with an average male proportion of 50.6%, and a total sample size of 438 cancer siblings.

Regarding intervention types, 5 studies (35.7%) applied CBT-based therapy, 3 (21.4%) used camp programs, and 2 (14.3%) employed art therapy or supportive programs, respectively. In terms of delivery format, 10 studies (71.4%) adopted group interventions, 3 (21.4%) used family-based interventions, and 1 (7.1%) applied individual intervention. Intervention duration ranged from 4 days to 6 months, with the number of sessions varying from 3 to more than 12. Session length ranged between 30-45 minutes and 120 minutes.

For outcome measurement, anxiety was most frequently assessed using the State-Trait Anxiety Inventory for Children (STAIC, 7 studies, 50.0%), while depression was most often measured with the Children's Depression Inventory (CDI, 5 studies, 35.7%). Additionally, 4 studies (28.6%) conducted follow-up assessments between 3 and 6 months after the intervention.

Table 1. Characteristics of Included Studies

First author and year	Country	Study Design	Participants			Intervention				Outcomes	Measures	Follow-up
			Age	Male (%)	No.	Name	Format	Total duration, session, Min,	Setting			
Alparslan 2012[28]	Turkey	Single group	9-18	40	45	Support program	Family-based	30D, 3S	Hospital	Anxiety	STAIC	-
Atherton 1984[29]	United States	RCT	8-13	44.4	18	Educational Intervention	Individual	2wk, 4S, 30-45	Hospital	Anxiety	STAIC	-
Barrera 2002[30]	Canada	Single group	6-18	64.7	17	CBT-Based Therapy	Group	8wk, 8S, 120	Hospital	Anxiety, depression,	STAIC, CDI	-
Barrera 2004[31]	Canada	Single group	6-14	40.5	42	CBT-Based Therapy	Group	8wk, 8S, 120	Hospital	Anxiety, depression,	STAIC, CDI	6M
Barrera 2018[32]	Canada	RCT	7-16	54.7	75	CBT-Based Therapy	Group	8wk, 8S, 120	Hospital	Depression	CDI	3-4M
Barrera 2020[33]	Canada	RCT	8-16	61.1	11	Web-based intervention	Family-based	6M	Hospital, home	Anxiety, depression	PI-ED	-
Fink 2014[34]	United States	Single group	7-11	70.0	10	Art therapy	Group	9wk, 9S, 60-75	hospital	anxiety	STAIC	-
Gregory 2022[35]	United States	Single group	7-16	40.6	32	Camp program	Group	7D, 7S	Camp	Anxiety	RCMAS	3M
Houtzager 2001[36]	Netherlands	Single group	7-18	37.5	24	Support program	Group	5wk, 5S	University	Anxiety	STAIC	-
Jo 2018[37]	Korea	Single group	7-10	52.9	17	Art therapy	Group	12wk, 12S, 60	Hospital	Anxiety, depression,	RCMAS, DAS	-
Prchal 2012[18]	Switzerland	RCT	6-17	60.0	29	CBT-Based Therapy	Group	6wk, 6S, 90	Hospital	Anxiety	SCAS	3M
Salavati 2014[38]	Canada	Single group	8-17	NM	57	CBT-Based Therapy	Group	8wk, 8S, 120	Hospital	Anxiety, depression,	STAIC, CDI	-
Sidhu 2006[39]	Australia	Single group	8-13	48	26	Camp program	Group	4D, 4S	Camp	Anxiety	BASC-SRP	-
Wellisch 2006[40]	United States	Single group	7-17	43	35	Camp program	Family-based	1wk, 7S	Camp	Depression	CDI	-

BASC-SRP = Behavior assessment system for children-self-report of personality, CBT = Cognitive behavioral therapy, CDI = Children's depression inventory, D = Day, M = Month, PI-ED = Pediatric index of emotional distress, RCMAS = Revised children's manifest anxiety scale, RCT = Randomized controlled trials, S = Session, SCAS = Spence children's anxiety scale, STAIC = State-trait anxiety inventory for the children, wk = Week

3. Effects of psychosocial intervention

Pooled effect sizes are presented in Figure 2, with subgroup analyses shown in Table 2. A total of 12 studies examined the effects of interventions on anxiety, yielding a pooled effect size of SMD = -0.52 (95% CI: -0.68 to -0.35, $p < .001$), which corresponds to a medium effect according to Cohen's criteria [25]. These findings indicate that psychosocial interventions exert clinically meaningful benefits in reducing anxiety among cancer siblings. No heterogeneity was detected ($I^2 = 0\%$).

Subgroup analyses revealed significant intervention effects across categories. By intervention type, educational or supportive programs (SMD = -0.65, 95% CI: -0.98 to -0.33),

camp programs (SMD = -0.42, 95% CI: -0.79 to -0.05), and CBT-based therapy (SMD = -0.40, 95% CI: -0.94 to 0.14) showed substantial reductions in anxiety. By number of sessions, both 3-5 sessions (SMD = -0.52, 95% CI: -0.80 to -0.24) and 6-9 sessions (SMD = -0.52, 95% CI: -0.74 to -0.31) were associated with significant improvements.

By format, family-based interventions (SMD = -0.56, 95% CI: -0.93 to -0.18) and group interventions (SMD = -0.51, 95% CI: -0.69 to -0.32) demonstrated statistically significant effects. Funnel plot analyses indicated minimal risk of publication bias.

In contrast, 7 studies assessed the effects of interventions on depression. The pooled effect size

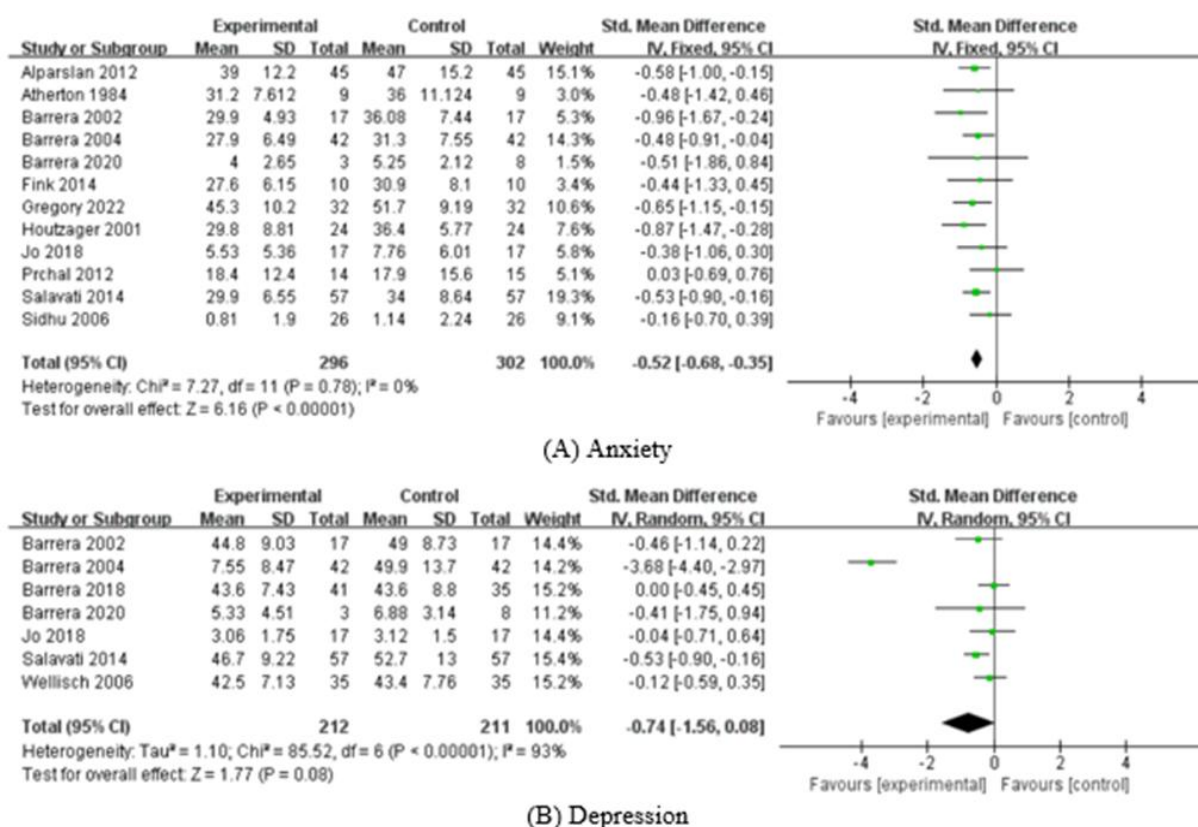


Fig. 2. Forest Plot of the Effects of Psychosocial Intervention

Table 2. Subgroup meta-analysis of anxiety

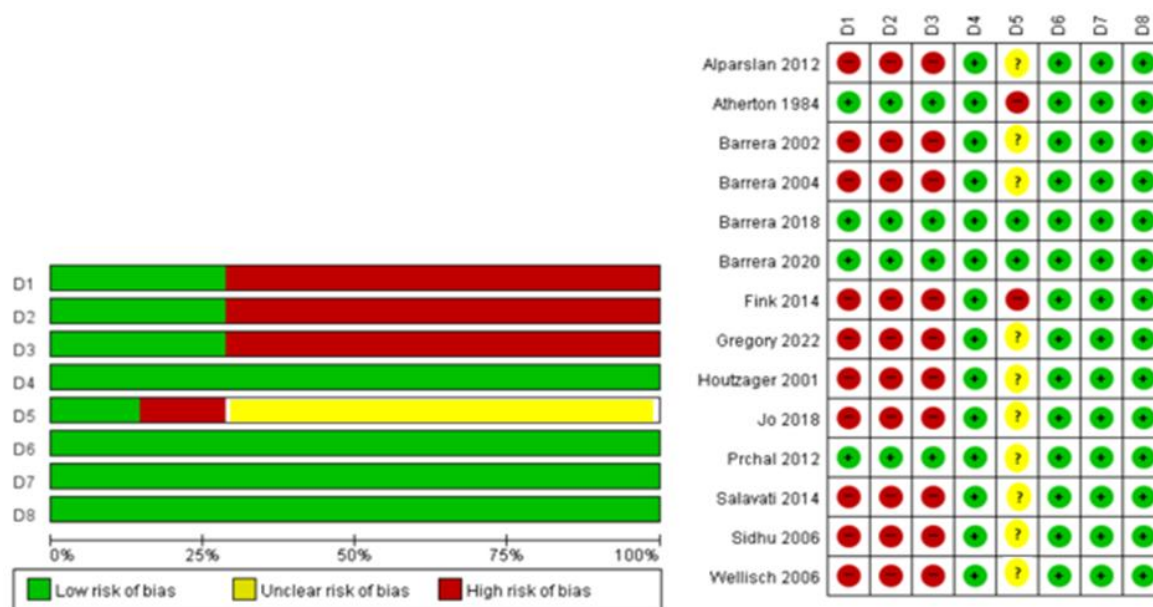
Categories		ES	95% CI	N	I ² (%)
Type	Art therapy	-0.40	-0.94, 0.14	2	0
	Camp program	-0.42	-0.79, -0.05	2	41
	CBT-based therapy	-0.50	-0.75, -0.25	4	19
	Educational or support program	-0.65	-0.98, -0.33	3	0
	Web-based intervention	-0.49	-1.31, 0.32	1	-
Session	3 ~ 5	-0.52	-0.80, -0.24	4	4
	6 ~ 9	-0.52	-0.74, -0.31	6	0
	12 ≤	-0.43	-0.95, 0.09	2	0
Format	Individual	-0.48	-1.42, 0.46	1	-
	Group	-0.51	-0.69, -0.32	9	0
	Family-based	-0.56	-0.93, -0.18	2	0

was SMD = -0.74 (95% CI: -1.56 to 0.08, p = .08), which did not reach statistical significance. Considerable heterogeneity was observed (I² = 93%), and a mild publication bias was indicated in the funnel plot.

4. Risk of Bias Assessment

Risk of bias assessments are presented in Figure 4. For blinding of outcome assessment, two studies (14.3%) in which researchers themselves conducted outcome evaluations were rated as having high risk

of bias. Ten studies (71.4%) did not specify whether assessors were blinded, resulting in unclear ratings. Single-group pre-post studies (10 studies, 71.4%) exhibited high risk of bias in domains such as comparison possibility of participants, selection of participants, and control of confounding variables. In other domains, most studies were assessed as having low risk of bias.



D1=Comparison possibility of participants; D2=Selection of participants; D3=Confounding variables; D4=Measurement of exposure; D5= Blinding of the outcome assessments; D6=Outcome evaluation; D7=Incomplete outcome data; D8=Selective outcome reporting

Fig. 3. Assessment of Risk of Bias

V. Discussion

This meta-analysis comprehensively examined the effects of psychosocial interventions on anxiety reduction in cancer siblings. The pooled effect size across interventions was SMD = -0.52 (95% CI: -0.68 to -0.35, $p < .001$), corresponding to a moderate effect. This indicates that psychosocial interventions have a clinically meaningful impact on reducing anxiety among cancer siblings. Furthermore, the absence of heterogeneity ($I^2 = 0\%$) demonstrated that the included studies showed consistent findings. These results are in line with previous systematic reviews and meta-analyses reporting that psychosocial interventions alleviate anxiety in children. For example, Alderfer et al.[41] found that educational/supportive, counseling, and family-based interventions significantly improved emotional adaptation in cancer siblings, while Morsi et al.[42] reported similar positive effects of psychosocial programs for families, including siblings, in reducing anxiety and improving adjustment.

Subgroup analyses revealed significant effects depending on intervention type. Educational/supportive programs (SMD = -0.65) and CBT-based interventions (SMD = -0.50) significantly reduced anxiety, consistent with Oppenheim et al.[43], who demonstrated the benefits of emotional support programs, and Barrera et al.[44], who reported significant reductions in anxiety and stress among cancer siblings following CBT. Of note, educational/supportive programs yielded the largest effect size, suggesting that even relatively simple interventions combining information provision with emotional support may substantially reduce siblings' psychological burden. Camp programs also demonstrated significant effects (SMD = -0.42), consistent with the positive outcomes of intensive camp-based interventions reported by Haggerty et al.[45] in selective mutism and McCarty et al.[46] in childhood anxiety disorders. These findings underscore that camp programs, beyond recreational activities, may provide peer support and positive social

experiences that contribute to anxiety reduction.

Regarding the number of sessions, both 3-5 and 6-9 sessions showed identical effect sizes ($SMD = -0.52$), confirming that relatively brief interventions may still produce meaningful benefits. This is consistent with Haugland et al.[47], who reported the efficacy of short-term group programs, suggesting opportunities for efficient intervention design in resource-limited settings. By contrast, interventions delivered over ≥ 12 sessions did not show significant effects. Possible explanations include participant fatigue, dilution of intervention intensity, or reduced continuity due to extended intervals. Additionally, life stressors or environmental changes during long programs may offset intervention benefits[48]. Thus, when designing long-term programs, strategies such as repeated reinforcement of core skills, adjustment of session intervals, and increased family involvement should be considered to sustain effectiveness.

With respect to delivery format, both family-based and group-based interventions showed significant effects. This aligns with Wergeland et al.[49], who emphasized the importance of family involvement, and Xie et al.[50], who highlighted the benefits of peer support within groups. The slightly larger effect size for family-based interventions ($SMD = -0.56$) compared with group-based interventions ($SMD = -0.51$) suggests that strengthening family communication and emotional bonds through joint participation of parents and siblings may play a crucial role in reducing anxiety.

In contrast, the pooled effect on depression was not statistically significant ($SMD = -0.74$, $p = .08$), with considerable heterogeneity ($I^2 = 93\%$). This lack of significance may be attributed to the limited number of available studies, the diversity of study designs, and the possibility that interventions exert more immediate effects on anxiety than on depression. As highlighted in recent research, depressive symptoms tend to be more chronic and internalized compared to anxiety, rendering them

less responsive to short-term interventions[51]. Duagi et al.[52] reported that among adolescents, long-term follow-up over 12-24 months demonstrated small but sustained improvements in depressive symptoms, whereas short-term interventions yielded only limited benefits. Similarly, Dickerson et al.[53] found that greater session attendance in CBT-based depression prevention programs was associated with prolonged symptom-free periods, underscoring the importance of intervention "dosage" in achieving sustained effects. Moreover, the variability in measurement tools and assessment time points across studies may have diluted the observed outcomes, while differences in program characteristics and family or sociocultural contexts may have further contributed to the heterogeneity[54]. Taken together, these findings emphasize the need for long-term and multidimensional intervention strategies to effectively address depressive symptoms among siblings, and they highlight the importance of future studies developing longer, structured programs that specifically target depression in this population.

Notably, four studies (28.6%) conducted follow-up assessments 3-6 months post-intervention, attempting to evaluate the sustainability of intervention effects. However, the small number of follow-up studies limits conclusions about long-term impacts. Future research should incorporate extended follow-up periods to evaluate sustained outcomes.

A methodological concern is that the majority of included studies employed single-group pre/posttest designs, while only four RCTs (28.6%) were available. Although single-group studies allow for observation of temporal changes, they are limited in establishing causal relationships due to uncontrolled confounders such as external influences, natural recovery, and measurement reactivity[55]. This limitation is not unique to sibling intervention research; Jewell et al.[56], in their meta-analysis of parent-only interventions for

child and adolescent anxiety, also reported that the predominance of non-randomized designs compromised the reliability of effect estimates. Expanding the use of randomized controlled designs is therefore essential. Accumulating evidence from RCTs will strengthen the basis for evidence-based practice in interventions for cancer siblings.

This study has several limitations. First, the analysis of depression showed high heterogeneity, warranting caution in interpretation. This may have resulted from differences in intervention methods, timing of outcome assessment, and participant characteristics. Future studies should employ more homogeneous samples and standardized intervention designs. Second, the relatively small proportion of RCTs limits causal inference and external validity. Third, analysis of long-term intervention effects was restricted: only four studies conducted 3–6 month follow-up assessments, making it difficult to draw conclusions regarding sustained impacts.

Despite these limitations, this study has important implications. It systematically synthesized evidence on psychosocial interventions for cancer siblings and identified how intervention type, number of sessions, and delivery format influenced anxiety reduction. By highlighting specific intervention characteristics associated with stronger effects, this meta-analysis provides practical guidance for designing future interventions and clinical programs. The findings support the development of tailored psychosocial and nursing interventions for siblings of children with cancer and emphasize the need for further research evaluating long-term outcomes.

VI. Conclusion

This study systematically reviewed and synthesized the effects of psychosocial interventions for siblings of children with cancer

through meta-analysis. The findings demonstrated a moderate effect in reducing anxiety, with significant benefits observed particularly for educational and supportive programs, CBT-based interventions, camp programs, interventions delivered over 3–5 or 6–9 sessions, and those conducted in family-based or group formats. In contrast, the pooled effect on depression was not statistically significant, and substantial heterogeneity across studies requires cautious interpretation.

Academically, this study makes important contributions by addressing a critical gap: unlike previous systematic reviews and meta-analyses that mainly focused on patients or parents, it treated siblings as an independent analytic group. By synthesizing findings that were previously fragmented across small-scale studies, the study strengthens the evidence base for sibling-focused psychosocial interventions. Moreover, subgroup analyses identified differences in effectiveness according to intervention characteristics, providing practical implications for the design of future programs.

Future research should accumulate high-quality RCT, with particular attention to evaluating the sustainability of intervention effects and the long-term trajectories of depression. Overall, this study not only offers direction for psychosocial interventions tailored to siblings of children with cancer but also provides both an academic foundation and a practical framework for promoting their psychological well-being and reinforcing family-centered supportive care systems.

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