Effects of Resilience Interventions for Adolescents and Young Adults Without Psychiatric Diagnoses: A Systematic Review and Network Meta-analysis of Randomized Controlled Trials

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Abstract

Although numerous resilience interventions have been developed for adolescents (age 10–19) and young adults (age 20–25), their comparative effectiveness remains unclear. This systematic review and network meta-analysis aimed to compare the efficacy of different resilience interventions and further investigate whether the intervention effects differed based on participants' condition (at-risk or non-at-risk) and age group (adolescents or young adults). A systematic search across PsycINFO, Embase, PubMed, and Web of Science was conducted from inception to October 31, 2024. A total of 46 randomized controlled trials involving 8729 participants were identified (mean age = 15.61 years; 54.18% female). The main results indicate that physical activity, psychotherapy, mindfulness, and skill training significantly enhanced resilience compared to treatment as usual. However, the effectiveness of mindfulness should be interpreted with caution, as its effect was not significant in the sensitivity analysis. Subgroup network meta-analyses suggest that physical activity, psychotherapy, and skill training were particularly effective for adolescents, while psychotherapy, psychoeducation, mindfulness, and skill training were effective for young adults. Additionally, physical activity and skill training were effective for non-at-risk populations, whereas psychotherapy, skill training, mindfulness, and psychological placebo were effective for at-risk populations. Psychotherapy was more effective than skill training for at-risk individuals. Notably, there were no studies on psychoeducation for at-risk populations and no studies on physical activity for at-risk populations and young adults. Meta-regression revealed that the level of individualism and duration per session can influence the effectiveness of these interventions. This study provides valuable insights for clinicians to tailor interventions to specific populations of adolescents and young adults and highlights the need to consider cultural factors when designing interventions.

Keywords Resilience · Intervention · Network meta-analysis · Adolescents and young adults

Introduction

Adolescence and young adulthood represent a critical transition stage characterized by rapid physical, cognitive, and socio-emotional development (Christie & Viner, 2005; Patton et al., 2016; Steinberg, 2005). During this period, young people may experience significant changes, such as new social relationships, identity development, and increased academic demands. These changes may consequently challenge their adaptation, heighten their vulnerability to stress, and even increase the risk of developing mental health illnesses (Steinberg, 2005). In fact, many mental health illnesses onset between the ages of 12 and 24 (Patel et al., 2007; Wong et al., 2023), including depression, anxiety, and eating disorders, with approximately 50% of mental health illnesses having typical onset by age 14 and 75% by age 24 (Kessler et al., 2005). Therefore, it is essential to equip young people with effective strategies to navigate these formative years successfully. In this regard, resilience has been widely acknowledged as a well-established capacity for ensuring the well-being of young people, and numerous interventions have been implemented to enhance resilience

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among this population. However, the comparative effectiveness of these interventions remains unclear. To address this gap, the present study aimed to conduct a systematic review and network meta-analysis to evaluate and compare the efficacy of different resilience interventions for adolescents and young adults.

Resilience is generally defined as the capacity to rebound from adversity, trauma, threats, or significant stress (Luthar, 2006; Masten & Cicchetti, 2016; Panter-Brick & Leckman, 2013). While traditionally conceptualized as a fixed trait, resilience is increasingly understood as a dynamic and multidimensional construct that develops over time and is shaped by individual, relational, and environmental factors (Davydov et al., 2010). At the individual level, internal characteristics such as optimism, problem solving skills, self-regulation, and self-esteem have been consistently linked to resilience outcomes (Alvord et al., 2016). At the relational level, supportive relationships with caregivers can also serve as critical protective factors (Höltge et al., 2021). At the environmental level, factors such as cultural norms may play vital roles in buffering individuals from the negative effects of adversity (Clauss-Ehlers, 2008). It is important to note that these protective factors do not function in isolation. Rather, resilience is fostered through dynamic and reciprocal interactions among these factors, enabling individuals successfully adapt to specific stressors. Accordingly, there is a growing consensus that strengthening these different factors can contribute to the development of resilience.

Numerous interventions have been developed to improve resilience in adolescents and young adults by targeting these various factors. For instance, cognitive behavior therapy (Chen et al., 2014), mindfulness (DeTore et al., 2023), social skill training (Cerit & Simsek, 2021), physical activity (Moore et al., 2021), and stress management (Rosenberg et al., 2018) are a few such interventions. In adolescents, several reviews have demonstrated that resilience-focused, school-based interventions can enhance resilience (Llistosella et al., 2023) and reduce anxiety (Bastounis et al., 2016), depression (Brunwasser et al., 2009), as well as help with internalizing problems (Dray et al., 2017). Reviews of young adult populations have found that these interventions can also enhance resilience (Diffley & Duddle, 2022) and reduce depression and stress symptoms among higher education students (Ang et al., 2022).

Despite the promising and diverse outcomes, only one recent review (Llistosella et al., 2023) has focused specifically on at-risk adolescents, whereas most other reviews have investigated resilience interventions in non-at-risk populations or school settings (Ang et al., 2022; Bastounis et al., 2016; Dray et al., 2017). Furthermore, existing reviews have primarily used pairwise comparisons between interventions and control conditions, limiting the ability to assess the relative effectiveness of different interventions. Hence, there is a

need to compare the effectiveness of different interventions to facilitate clinical decisions and development of further interventional programs.

Additionally, to ensure the effectiveness of resilience interventions, it is crucial to consider the contexts of individuals' lives (Ungar et al., 2014), as the contexts can either present risks or provide protective factors that significantly influence resilience (Khanlou & Wray, 2014). For instance, culture has been consistently recognized as a critical environmental factor influencing resilience (Clauss-Ehlers, 2008). In particular, individualism-collectivism, one of the six cultural dimensions proposed by Hofstede (2011), has been widely used in research to understand cultural differences. According to Hofstede, countries with higher individualism scores tend to value personal goals and independence, emphasizing self-reliance, direct communication, personal privacy, and the prioritization of individual tasks over relationships. In contrast, countries with lower scores—indicating greater collectivism—emphasize family and group cohesion, loyalty to group norms, strong social relationships, and the prioritization of relationships over individual tasks. Empirical evidence has provided support for the influence of cultural values on resilience. For instance, evidence suggested that a country's level of individualism can influence students' academic resilience (Özcan & Bulus, 2022). In addition, culture was found to explain a significant 12% of the variance in resilience based on data from 15 countries (Skevington, 2020). A systematic review (Blessin et al., 2022) further revealed that the resilience interventions conducted in Eastern countries demonstrated larger effect sizes compared to those in Western countries. These findings suggested that the effectiveness of resilience interventions may vary across cultural contexts, indicating the importance of considering cultural factors in meta-analyses.

Current Study

While a wide range of resilience interventions have been implemented for adolescents (age 10–19) and young adults (age 20–25), their relative effectiveness remains unclear. To date, no comprehensive synthesis has systematically compared the efficacy of these diverse interventions. The aim of the current study was to conduct a systematic review and network meta-analysis to assess the efficacy of various resilience interventions for adolescents and young adults and to examine whether intervention effects differ based on participant characteristics, including participants' condition (at-risk vs. non-at-risk) and developmental stage (adolescents vs. young adults). An additional aim was to investigate the role of cultural dimension of individualism versus collectivism in shaping the effectiveness of these interventions.

Methods

This systematic review and network meta-analysis were conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (Moher et al., 2009) (Supplementary Methods1), and was registered in the International Prospective Register for Systematic Reviews (PROSPERO; registration number: CRD42023437329). Network meta-analysis is a statistical approach that integrates both direct and indirect evidence by comparing multiple interventions against each other. This method allows for the identification of the most effective treatments and offers valuable insights to guide clinical decision-making.

Search Strategy and Inclusion Criteria

A systematic search across PsycINFO, Embase, PubMed, and Web of Science was conducted from inception to October 31, 2024. To identify relevant studies, the following search terms were used: ("resilience intervention" OR "promoting resilience" OR "promoting resiliency" OR "resilience-based intervention") AND ("young adults" OR "emerging adults" OR "adolescents" OR "student" OR "teenager").

Studies were included if they: (1) were randomized control trials with any comparison group; (2) were published in peer-reviewed journals; (3) were reported in English, consistent with previous resilience reviews to ensure feasibility of screening and data extraction; (4) used validated resilience measures, such as the Connor-Davidson resilience scale (CD-RISC) or Resilience Scale (RS); (5) were designed to enhance the resilience; (6) the mean age of the participants should range from 10 to 19 (adolescents) (World Health Organization, 2024) or 20 to 25 (young adults); and (7) had at least two intervention sessions. Participants identified as refugees or with clinical diagnosis of mental health problems were excluded.

Study Selection

Study selection was conducted by two reviewers (ZC and HT). Discrepancies were resolved through discussions among the research team. In the initial screening phase, titles and abstracts of all identified references were evaluated based on eligibility criteria. In the second phase, full-text articles of the eligible studies were assessed in detail. Each reviewer independently determined whether the studies met the inclusion criteria.

Data Extraction

Data extraction was conducted by two reviewers (ZC and HT). When data was missing, the corresponding author of the study was contacted to obtain further information. Discrepancies were resolved through discussions among the research team. The following information was extracted from the included articles: country, participant characteristics (e.g., at risk or non-at-risk), sample size, age, gender, intervention details (e.g., type, delivery mode, intervention frequency and duration), and outcome measures (e.g., measurements, length of follow-up). Scores of individualism were obtained from Hofstede's database (2024). The scores range from 0 to 100, with higher values indicating a greater degree of individualistic cultural orientation. Interventions were classified based on the descriptions provided in each study, and the definitions were illustrated in the supplementary Table 2. Means and standard deviations (SDs) were extracted for both intervention and comparison groups. For those studies that did not provide immediate post-intervention results, data from the nearest available time point was extracted.

Risk of Bias Assessment and Credibility Assessment

The risk of bias for each study was assessed using the Cochrane Risk of Bias Tool 2 (RoB 2.0; Sterne et al., 2019), which evaluates five domains: the randomization process, deviations from intended interventions, missing outcome data, measurement of the outcome, and selection of the reported result. Each domain was rated as having a low risk of bias, some concerns, or a high risk of bias. To assess the certainty of evidence for each comparison, the Confidence-In-Network-Meta-Analysis (CINeMA) framework was used (Nikolakopoulou et al., 2020). This framework examines six domains: within-study bias, reporting bias, indirectness, imprecision, heterogeneity, and incoherence. Each domain was rated as having no concerns, some concerns, or major concerns. The overall certainty of evidence was downgraded by one level for domains with some concerns and by two levels for those with major concerns. Based on these evaluations, the overall certainty for each comparison was categorized as high, moderate, low, or very low. All assessments using both the RoB 2.0 and CINeMA frameworks were independently conducted by two reviewers (ZC and HT), with any discrepancies resolved through discussion among the research team.

Evaluation of Network Meta-analysis Assumptions and Publication Bias

The transitivity assumption of network meta-analysis requires that the distribution of effect modifiers is similar

across all studies included in the network. To assess this assumption, the Kruskal–Wallis rank sum test was conducted to examine potential effect modifiers (sample size, age, and female proportion). Furthermore, the consistency assumption, which implies agreement between direct and indirect evidence, was evaluated using a design-by-treatment interaction model for global inconsistency and a node-splitting model for local inconsistency. Publication bias was assessed using Egger's test, which examines the association between study effect sizes and their standard errors to detect potential small-study effects. A statistically significant result (p < 0.05) indicates potential publication bias among the included studies (Egger et al., 1997).

Data Synthesis and Analyses

Network meta-analysis (NMA) was conducted using a frequentist framework with a random-effects model. Standardized mean differences (SMDs) (Hedges' g) were calculated by determining the mean change in scores (post-test minus pre-test) for both the intervention and control groups, and then standardizing the difference using the pooled standard deviations of the change score. Statistical significance was determined if the 95% Confidence Intervals (CIs) did not include 0. The league table was used to present direct and indirect comparisons between interventions.

Subgroup network meta-analyses were further conducted to assess whether intervention efficacy differed by population (adolescents, age 10–19 years; young adults, age 20–25 years) and the condition of participants (at risk and non-at-risk). Studies with mixed-age groups were excluded for the subgroup analyses. Meta-regression considering individualism, age, gender, sample size, duration per session, and duration of the whole intervention was also conducted to assess whether these moderators can influence efficacy. Sensitivity analysis was performed by excluding studies with a high risk of bias (other than the domain "measurement of the outcome") and studies that used follow-up assessments. All statistical analyses were performed in R 4.2.3 with the netmeta package.

Results

Study Selection and Characteristics

The initial search resulted in 7897 records for screening. After removing duplicates and screening abstracts, 233 records were assessed for full-text eligibility. Based on the inclusion criteria, 46 studies published between 2008 and 2024 were included in the review, comprising a total of 8729 participants (see Fig. 1).

29 studies focused on adolescents, 15 on young adults, and two on both groups. 54.18% of participants identified as females, with two studies not reporting gender data. The mean age of the participants was 15.61. The studies were conducted in 13 countries and most of them were performed in the United States (k = 16) and China (k = 11). Among the 46 studies, 17 targeted at-risk populations, including individuals affected by natural disasters (k = 2), individuals with disadvantaged experiences (k = 7), with physical illnesses (k = 6), and with mental health problems without diagnosable conditions (k = 2). Five different interventions were found, including psychotherapy (k = 11), physical activity (k = 3), skill training (k = 20), mindfulness (k = 11), psychoeducation (k = 4) (Table 1). Six studies using active comparisons were categorized as psychological placebo. For inactive comparisons, 20 studies involved no treatment controls, 17 involved waitlist controls, and 9 involved treatment as usual. Since all studies were conducted under comparable conditions without significant differences in the control groups, "no treatment" and "waitlist" were grouped under the category of "treatment as usual" as the reference group for the network meta-analysis (Supplementary Table 2). The frequency of sessions ranged from daily to once every 2 weeks, and the duration of the interventions ranged from 2 days to 1 academic year. Further details on the intervention types, delivery details, and follow-up are described in Supplementary Table 1.
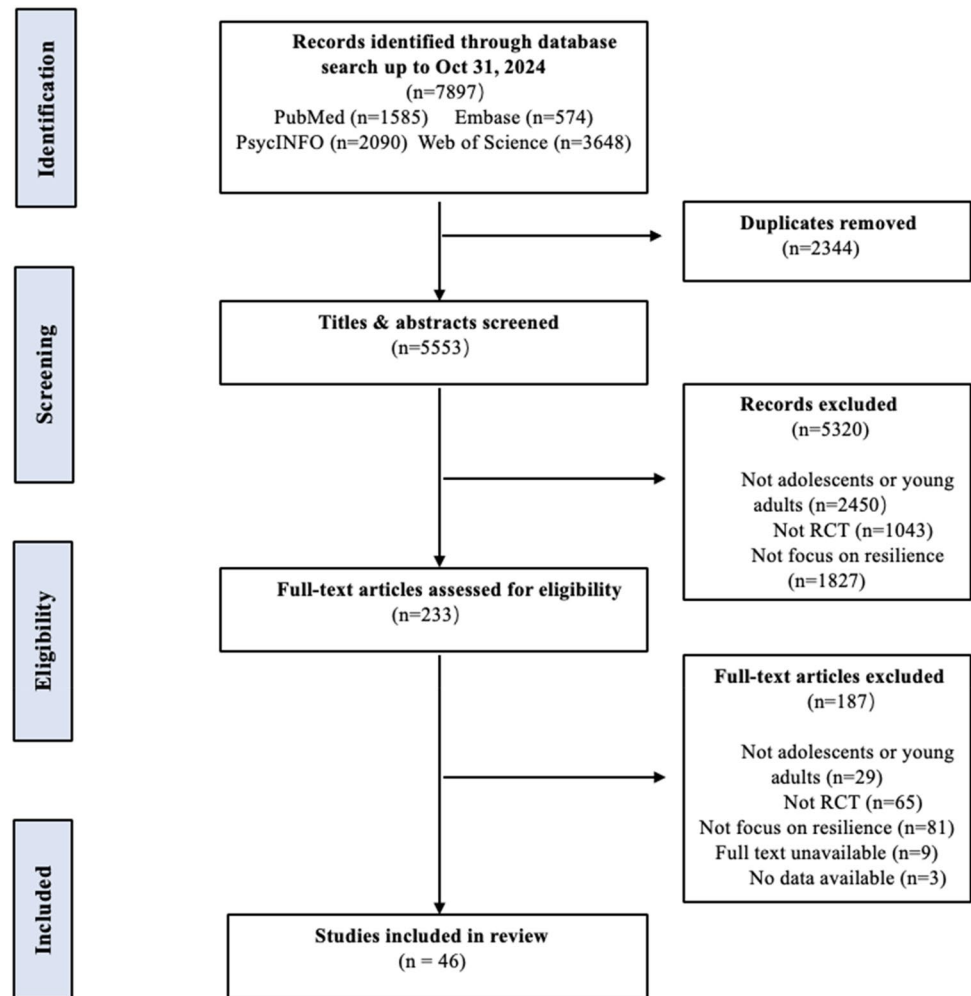
Effects of Various Interventions on Resilience

The network meta-analysis found 12 pairs of direct comparison and 11 closed loops. The findings revealed that physical activity (SMD = 0.858, 95%CI 0.295 to 1.420, p = .003), psychotherapy (SMD = 0.760, 95%CI 0.449 to 1.071, p < .001), mindfulness (SMD = 0.482, 95%CI 0.186 to 0.779, p = .001), skill training (SMD = 0.429, 95%CI 0.209 to 0.649, p < .001) had significant effects on increasing resilience compared to the treatment as usual. Conversely, psychoeducation and psychological placebo did not show any significant effects compared to treatment as usual (see Fig. 2). The league table further indicates that no single intervention was superior to other interventions (Table 2). The tests of global inconsistency and local inconsistency were not significant, indicating no inconsistency between the direct and indirect evidence for the results (Supplementary Methods2). Evaluation of transitivity did not show any uneven distribution of potential effect modifiers across the comparisons (Supplementary Table 3).

Subgroup Network Meta-analyses

For the adolescent group, physical activity (SMD = 0.860, 95%CI 0.211 to 1.510, p = .009), psychotherapy (SMD = 0.756, 95%CI 0.360 to 1.152, p < .001), and skill

Fig. 1 PRISM flowchart

training (SMD = 0.396, 95%CI 0.084 to 0.707, $p < .001$) were shown to be significantly more effective than treatment as usual.

For the young adult group, psychotherapy (SMD = 1.569, 95%CI 0.349 to 2.790, $p = .012$), psychoeducation (SMD = 0.792, 95%CI 0.055 to 1.529, $p = .035$), mindfulness (SMD = 0.537, 95%CI 0.149 to 0.925, $p = .007$), and skill training (SMD = 0.544, 95%CI 0.091 to 0.996, $p = .019$) were shown to be significantly more effective than treatment as usual (see Fig. 3).

In at-risk populations, psychotherapy (SMD = 1.185, 95%CI 0.817 to 1.553, $p < .001$), psychological placebo (SMD = 1.182, 95%CI 0.247 to 2.117, $p = .01$), mindfulness (SMD = 0.649, 95%CI 0.222 to 1.076, $p = .003$), and skill training (SMD = 0.585, 95%CI 0.301 to 0.869, $p < .001$) were shown to be significantly more effective than treatment as usual.

In non-at-risk populations, physical activity (SMD = 0.856, 95%CI 0.344 to 1.367, $p = .001$) and skill training (SMD = 0.327, 95%CI 0.067 to 0.588, $p = .014$)

were shown to be significantly more effective than treatment as usual (see Fig. 3).

The network and comparisons between interventions indicate that no single intervention was superior to the others in subgroup analyses, except in at-risk populations, where psychotherapy was found to be superior to skill training (SMD = 0.600, 95%CI 0.165 to 1.035) (Supplementary Fig. 3).

Meta-regression

The meta-regression analysis across all interventions revealed that individualism showed a significant negative association with resilience scores ($\beta = -0.02$, $p < .0001$), indicating that higher individualism was associated with lower intervention efficacy. Conversely, duration per session showed a significant positive association with resilience scores ($\beta = 0.08$, $p = .02$), indicating that longer sessions were associated with greater efficacy. Other covariates, including age, gender, publication year, sample size, and

Table 1 Study characteristics of randomized controlled trials

Author(s), year	Country	Individualism	Name of intervention	Approach	Participants	Condition of participants	Age group	Sample size	Total age (M±SD)	Gender (female%)	Resilience measures
Amin et al. (2020)	Pakistan	14	Students Exposed to Trauma Program	Psychotherapy	Flood-Impacted Children elementary students	At risk	Adolescent	I: 38 C: 37	11.43±1.44	34.70	Child and Youth Resilience Measure (CYRM-28)
Bischops et al. (2024)	Germany	67	REThink app and coaching program	Psychotherapy	Youth with a chronic medical condition	At risk	Adolescent	I: 24 C: 23	14.20 (NA)	59.60	Resilience Scale (RS-13)
Cerit and Simsek (2021)	Turkey	37	Social skill training program	Skill training	High school students	Non-at-risk	Adolescent	I: 36 C: 34	14.90±0.80	54.20	Resilience Scale (RS)
Chen et al. (2014)	China	20	Cognitive behavioural therapy	Psychotherapy	Secondary school students who lost parents	At risk	Adolescent	I: 12 C: 12 C: 16	14.50±0.71	68.00	Connor-Davidson Resilience Scale (CDRISC)
Cheng et al. (2024)	China, Hong Kong	20	Multicomponent positive psychology program	Skill training	Primary school students	Non-at-risk	Adolescent	I: 137 C: 127	10.83±1.18	63.00	Child and Youth Resilience Measure (CYRM-12)
Chung et al. (2021)	China, Hong Kong	20	Adventure-based training	Skill training	Secondary school students	Non-at-risk	Adolescent	I: 115 C: 113	13.00±0.80	45.20	Resilience Scale (RS-14)
DeTore et al. (2023)	USA	91	Resilience training	Mindfulness	University students with mild mental health symptoms	At risk	Young adult	I: 54 C: 53	18.82±1.12	64.30	Connor-Davidson Resilience scale (CDRISC)
Erogul et al. (2014)	USA	91	Abridged mindfulness-based stress reduction	Mindfulness	University students	Non-at-risk	Young adult	I: 28 C: 29	23.50±1.70	45.60	Resilience Scale
Felver et al. (2019)	USA	91	School-based mindfulness intervention	Mindfulness	High school students	Non-at-risk	Adolescent	I: 15 C: 11	16.39±1.04	67.00	Social-Emotional Assets and Resilience Scales (SEARS-SF)
Flett et al. (2019)	New Zealand	79	Mobile mindfulness meditation	Mindfulness	University students	Non-at-risk	Young adult	I: 72 C: 73 C: 63	17.80±0.47	NA	Brief Resilience Scale

Table 1 (continued)

Author(s), year	Country	Individualism	Name of intervention	Approach	Participants	Condition of participants	Age group	Sample size	Total age (M±SD)	Gender (female%)	Resilience measures
Flett et al. (2020)	New Zealand	79	App-based mindfulness meditation	Mindfulness	University students	Non-at-risk	Young adult	I: 124 C: 126	20.08±2.8	67.60	Brief Resilience Scale
Gerson and Fernandez (2013)	USA	91	Program for accelerated thriving and health	Skill training	University students	Non-at-risk	Young adult	I: 15 C: 15	19.90±2.17	61.00	Connor Davidson Resilience Scale (CDRISC-10)
Greco et al. (2019)	Italy	76	Shotokan karate intervention	Physical activity	Secondary school students	Non-at-risk	Adolescent	I: 24 C: 25	14.60±0.70	61.20	Child and Youth Resilience Measure (CYRM-28)
Green et al. (2021)	USA	91	SPARK pre-teen mentoring curriculum	Skill training	High school students	Non-at-risk	Adolescent	I: 183 C: 174	12.30 (NA)	32.80	Resiliency Scales for Children and Adolescents (RSCA)
Guo et al. (2023)	China	20	Mindfulness group intervention	Mindfulness	Primary school students from single-parent families	At risk	Adolescent	I: 32 C: 32	I: 10.63±1.12 C:10.22±0.94	56.25	Resilience Scale for Chinese Adolescents
Hatamizadeh et al. (2020)	Iran	41	Resilience intervention	Skill training	Adolescents with hearing loss	At risk	Adolescent	I: 61 C: 61	13.65±1.00	39.30	Connor-Davidson Resilience Scale (CDRISC)
Houston et al. (2017)	USA	91	Resilience and coping intervention	Psychotherapy	University students	Non-at-risk	Young adult	I: 58 C: 61	19.98±1.24	72.10	Connor-Davidson Resilience Scale (CDRISC)
Hyun et al. (2010)	South Korea	18	Cognitive behavioral therapy	Psychotherapy	Adolescents with alcohol-dependent parents	At risk	Adolescent	I: 15 C: 13	I:12.60±0.51 C:12.47±0.52	0.00	Korean Adolescent Resilience Scale
Johnstone et al. (2020)	Australia	90	Universal school-based prevention programs	1.Psychotherapy 2.Skill training	Primary school students	Non-at-risk	Adolescent	I: 61 I: 154 C: 17	11.04±1.40	52.50	Child and youth resilience measure (CYRM-12)
Kadian et al. (2022)	India	48	Brief resilience interventions	Psychoeducation	University students	Non-at-risk	Young adult	I: 110 C: 110	19.31±1.17	86.80	The Brief Resilient Coping Scale

Table 1 (continued)

Author(s), year	Country	Individualism	Name of intervention	Approach	Participants	Condition of participants	Age group	Sample size	Total age (M±SD)	Gender (female%)	Resilience measures
Khalsa et al. (2012)	USA	91	Yoga	Physical activity	Secondary school students	Non-at-risk	Adolescent	I: 66 C: 34	16.80±0.60	62.20	The Resilience Scale (RS)
Khodakarami et al. (2023)	Iran	41	Cognitive-behavioral counseling	Psychotherapy	Adolescents with Premenstrual Syndrome	At risk	Adolescent	I: 60 C: 60	Age 15–17	51.00	Connor-Davidson resilience scale (CDRISC)
Kuhlthau et al. (2023)	USA	91	Resilience intervention	Mindfulness	Siblings of children with Autism Spectrum Disorder	At risk	Adolescent	I: 19 C: 17	15.00±1.20	88.90	Current Experiences Scale (CES)
Lanz, (2020)	USA	91	Resilience intervention	Skill training	University students	Non-at-risk	Young adult	I: 14 C: 13	21.48±1.31	43.00	Connor-Davidson Resilience Scale (CDRISC)
Li et al. (2021)	China	20	Model-based group counseling	Psychotherapy	Adolescents from poor areas	At risk	Adolescent	I: 38 C: 38	I:14.07±0.51 C:13.8±0.56	60.50	Resilience Scale for Chinese Adolescents
Li et al. (2017)	China	20	Resilience intervention	Skill training	Children affected by HIV/AIDS	At risk	Adolescent	I: 595 C: 195	10.51±2.00	48.40	Connor-Davidson Resilience Scale (CDRISC)
Liang et al. (2018)	China	20	Psychological intervention	Skill training	Left-behind university students	At risk	Young adult	I: 38 C: 35	NA	NA	Positive Psychological Capital Questionnaire
Mejia-Downs, (2020)	USA	91	Resilience curriculum	Skill training	University students	Non-at-risk	Young adult	I: 22 C: 21	I: median 25 C: median 24	72.10	Connor-Davidson Resilience Scale (CDRISC)
Moir et al. (2016)	New Zealand	79	Peer-Support and Mindfulness Program	Mindfulness	University students	Non-at-risk	Young adult	I: 111 C: 121	21±3.0	53.00	The Resilience Scale (RS)
Moore et al. (2021)	Australia	90	Martial arts training	Physical activity	Secondary school students	Non-at-risk	Adolescent	I: 125 C: 118	12.76±0.68	50.50	Child and Youth Resilience Measure (CYRM)

Table 1 (continued)

Author(s), year	Country	Individualism	Name of intervention	Approach	Participants	Condition of participants	Age group	Sample size	Total age (M±SD)	Gender (female%)	Resilience measures
Moran et al. (2024)	USA	91	Building Resilience for Healthy Kids	Skill training	Primary school students	Non-at-risk	Adolescent	I: 160 C: 70	I:11.60±0.52 C:11.60±0.53	43.40	Child and Youth Resilience Measure (CYRM)
Niu et al. (2021)	China	20	Resilience intervention	Skill training	Adolescents living with natural hazards risks	At risk	Adolescent	I: 28 C: 28	Age 17–19	51.30	Connor–Davidson Resilience Scale (CDRISC)
O'Connor et al. (2022)	Ireland	70	Universal process-based CBT intervention	Psychotherapy	Primary school students	Non-at-risk	Adolescent	I: 169 C: 237	11.07±0.67	59.77	Connor–Davidson Resilience Scale (CDRISC)
Peter et al. (2022)	India	48	Mindfulness-based cognitive therapy	Mindfulness	Adolescents with anxiety symptoms	At risk	Adolescent	I: 33 C: 32	13.10±0.60	52.30	The Bharathiar University Resilience Scale
Rich et al. (2022)	USA	91	Resilience Builder Program	Skill training	Primary school students	Non-at-risk	Adolescent	I: 82 C: 87	10.82±0.56	36.50	Resiliency scales for children and adolescent (RSCA)
Roghanchi et al. (2013)	Iran	41	REBT interventions and art therapy	Psychotherapy	University students	Non-at-risk	Young adult	I: 12 C: 12	21.50±0.79	66.70	Connor–Davidson Resilience Scale (CDRISC)
Rosenberg et al. (2018)	USA	91	Promoting resilience in stress management (PRISM) intervention	Skill training	Adolescents and young adults with cancer	At risk	Adolescent and young adult	I: 48 C: 44	Age 12–25	43.00	Connor–Davidson Resilience Scale (CDRISC)
Rosenberg et al. (2024)	USA	91	Promoting resilience in stress management (PRISM) intervention	Skill training	Adolescents and young adults receiving hematopoietic cell transplantation	At risk	Adolescent and young adult	I: 50 C: 44	16.70±4.20	46.00	Connor–Davidson Resilience Scale (CDRISC)

Table 1 (continued)

Author(s), year	Country	Individualism	Name of intervention	Approach	Participants	Condition of participants	Age group	Sample size	Total age (M±SD)	Gender (female%)	Resilience measures
Steinhardt and Dolbier (2008)	USA	91	Transforming lives through resilience education	Psychoeducation	University students	Non-at-risk	Young adult	I: 30 C: 27	22.79 (NA)	51.00	Connor–Davidson Resilience Scale (CDRISC)
Şenocak and Demirkran (2023)	Turkey	37	Problem-solving skills development training	Skill training	University students	Non-at-risk	Young adult	I: 36 C: 25	19.97±1.39	72.20	Resilience scale for nurses
Tang et al. (2022)	China	20	Peer education training course	Psychoeducation	Secondary school students	Non-at-risk	Adolescent	I: 669 C: 669	12.34±1.64	50.70	Resilience Scale for Chinese Adolescents
Volanen et al. (2020)	Finland	63	Mindfulness-based intervention	Mindfulness	Secondary school students	Non-at-risk	Adolescent	I: 1228 C: 1196 C: 356	Age 12–15	51.60	Resilience scale (RS-14)
Yeun and Woo (2018)	South Korea	18	Interpersonal relationship improvement program	Skill training	Adolescents	Non-at-risk	Adolescent	I: 30 C: 32	14.50 (NA)	77.40	Ego-resiliency scale
Yi-Frazier et al. (2024)	USA	91	Promoting resilience in stress management (PRISM) intervention	Skill training	Adolescents with Type 1 Diabetes	At risk	Adolescent	I: 85 C: 87	15.70±1.60	56.00	Connor–Davidson Resilience Scale (CDRISC)
Zhang et al. (2022)	China	20	Mindfulness-based emotion management Intervention	Mindfulness	University students	Non-at-risk	Young adult	I: 36 C: 36	I:19.14±1.27 C:18.68±1.30	62.50	Resilience Scale for Chinese Adolescent
Zhang et al. (2021)	China	20	Psychological counseling	Psychotherapy	Secondary school students	Non-at-risk	Adolescent	I: 76 C: 77	I:15.70±2.05 C:15.90±1.07	47.70	Healthy Kids Resilience Assessment

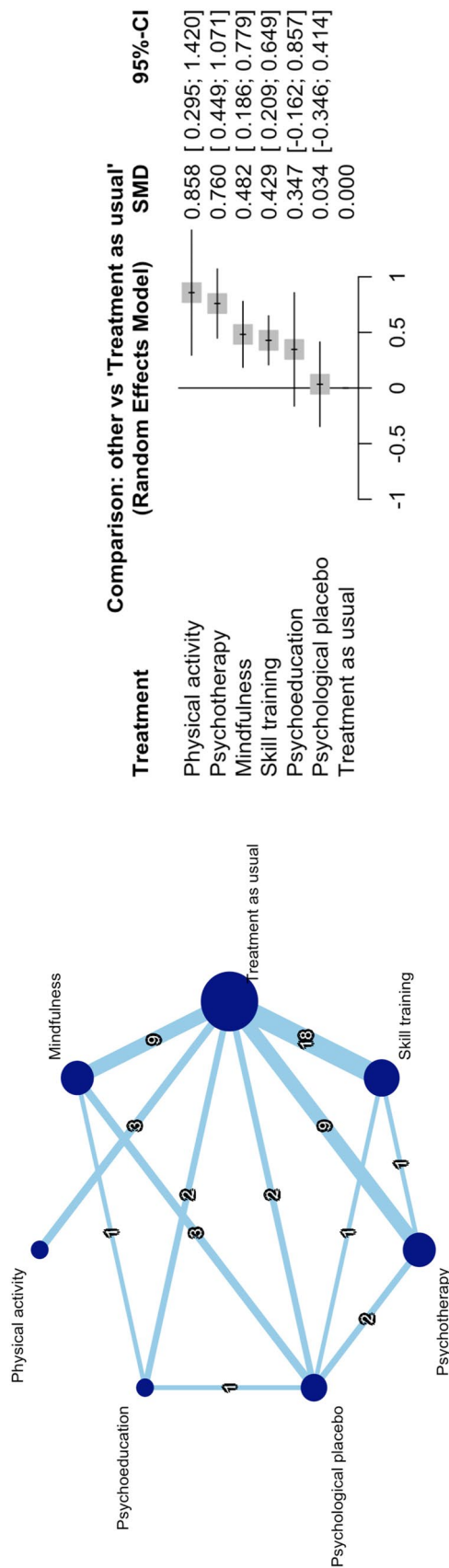*I* intervention group; *C* control group; *NA* not available

Fig. 2 Network graph of the comparisons (left). The nodes and edges are weighted based on the number of studies that evaluated each treatment and the number of studies that assessed the treatment comparisons. Forest plot of network meta-analysis for main outcomes (right). Effects of all available types are compared with treatment as usual

duration of intervention did not show significant effects (Table 3).

When analyzed by intervention category, skill training interventions also found a significant negative association between individualism and intervention efficacy ($\beta = -0.02$, $p = .03$), and duration per session showed a significant positive association with efficacy ($\beta = 0.01$, $p < .01$). Similar results were also found in psychotherapy, as individualism had a significant negative association with efficacy ($\beta = -0.03$ $p < .01$). Duration per session also showed a significant positive association with efficacy ($\beta = 0.02$, $p = .04$). For mindfulness interventions, only individualism showed a strong negative association with efficacy ($\beta = -0.03$, $p < .0001$). For physical activity, both duration of intervention ($\beta = 0.08$, $p = .04$) and duration per session ($\beta = 0.02$, $p = .04$) showed significant positive associations with efficacy (Supplementary Table 4).

Sensitivity Analysis

The results of the sensitivity analysis were largely consistent with those of the main analysis (Supplementary Fig. 4). Excluding studies that used follow-up assessments did not affect the overall conclusions. However, when studies with a high risk of bias (other than domain "measurement of the outcome") were excluded, mindfulness was not found to be significantly effective.

Risk of Bias Assessment

Only four studies were rated as having low to moderate risk of biases for outcome measurement, while the others were considered as having high risk of bias. This is due to the nature of psychological interventions, which involve active therapist–participant interactions. Such interactions make it challenging to blind participants and providers, thereby increasing the risk of bias in the domain "measurement of the outcome". Twelve studies were rated low risk for the selection of reported results, as the remaining studies did not report study protocols. The randomization process, deviations from intended interventions, and outcome data in most studies were judged to have a low or unclear risk of bias. The results of the risk of bias are shown in Supplementary Fig. 1.

Publication Bias and Credibility Assessment

Egger's test was significant ($p = .038$), suggesting potential publication bias (Supplementary Fig. 2). Confidence-In-Network-Meta-Analysis (CINeMA) was used to assess the credibility of the comparisons. 14 comparisons were rated as having low confidence, while seven comparisons were classified as very low. The results are presented in the Supplementary Methods 3.

Table 2 League table

Mindfulness	Physical activity	Psychoeducation	Psychological placebo	Psychotherapy	Skill training	Treatment as usual
Mindfulness	…	0.948 [-0.248; 2.145]	0.199 [-0.328; 0.726]	…	…	**0.477 [0.153; 0.801]**
-0.376 [-1.011; 0.260]	**Physical activity**	…	…	…	…	**0.858 [0.295; 1.420]**
0.135 [-0.409; 0.679]	0.511 [-0.248; 1.270]	**Psychoeducation**	0.366 [-0.546; 1.278]	…	…	0.572 [-0.096; 1.240]
0.448 [0.053; 0.843]	**0.824 [0.145; 1.502]**	0.313 [-0.241; 0.868]	**Psychological placebo**	**-0.871 [-1.601; -0.140]**	-0.686 [-1.598; 0.226]	0.161 [-0.550; 0.873]
-0.278 [-0.693; 0.138]	0.098 [-0.545; 0.741]	-0.413 [-0.997; 0.171]	**-0.743 [-1.174; -0.313]**	**Psychotherapy**	0.577 [-0.472; 1.626]	**0.671 [0.328; 1.015]**
0.054 [-0.309; 0.416]	0.429 [-0.175; 1.033]	-0.082 [-0.631; 0.468]	**-0.443 [-0.851; -0.034]**	0.331 [-0.035; 0.697]	**Skill training**	**0.422 [0.192; 0.652]**
0.482 [0.186; 0.779]	**0.858 [0.295; 1.420]**	0.347 [-0.162; 0.857]	0.015 [-0.354; 0.384]	**0.760 [0.449; 1.071]**	**0.429 [0.209; 0.649]**	**Treatment as usual**

Pairwise meta-analyses (direct comparisons) are presented in the upper right triangle and the network meta-analysis (indirect comparisons) are presented in the lower left triangle. Values are SMD with associated 95% confidence intervals. SMD smaller than 0 favors the row-defining treatment. SMD larger than 0 favors the column-defining treatment. Some cells are unavailable due to the absence of studies evaluating the corresponding comparison. Significant results are presented in bold

Discussion

Resilience is widely recognized as a critical capacity for maintaining and promoting the well-being of young people. Accordingly, diverse resilience interventions have been developed for adolescents and young adults. While previous reviews have investigated the overall effectiveness of these interventions, their comparative efficacy remains unclear. Furthermore, most reviews have focused on non–at-risk populations and have not examined how cultural factors, such as individualism and collectivism, might affect intervention efficacy. To address these gaps, the present study conducted the first network meta-analysis to evaluate the comparative efficacy of different resilience interventions among adolescents and young adults. In addition, subgroup network meta-analyses were performed to examine whether intervention effects vary by participants' condition (at-risk vs. non–at-risk) and age group (adolescents vs. young adults). The influence of cultural orientation (individualism vs. collectivism) on intervention efficacy was also explored.

The main analysis indicates that physical activity, psychotherapy, mindfulness, and skill training significantly enhanced resilience compared to treatment as usual. However, sensitivity analysis showed that the effect of mindfulness was not significant when studies with a high risk of bias (other than domain "measurement of the outcome") were excluded, suggesting that the results may be influenced by the methodological quality of the included studies. Nevertheless, the current study provides preliminary support for the potential of these interventions, especially physical activity, psychotherapy, and skill training, in improving resilience. Future high-quality randomized controlled trials are needed to further investigate the role of mindfulness in enhancing resilience.

Subgroup network meta-analyses suggest that the effectiveness of interventions may be influenced by developmental stage and the condition of participants. Specifically, physical activity, psychotherapy, and skill training were significantly effective in adolescents (age 10–19) while psychotherapy, psychoeducation, mindfulness, and skill training were found to be significantly effective in young adults (age 20–25). Furthermore, psychotherapy, skill training, mindfulness, and psychological placebo were found to be significantly effective in at-risk populations, while physical activity and skill training were the effective interventions in the non-at-risk population. Additionally, between-intervention comparisons found that psychotherapy was more effective than skill training for at-risk populations. It should be noted that psychoeducation and physical activity were excluded for at-risk populations due to the lack of studies on these interventions. Physical activity was also excluded for young adults due to the lack of studies. Furthermore, meta-regression indicates that the level of individualism had a negative association with the effectiveness of interventions, and the duration per session had a positive association with their effectiveness.

Psychotherapy and skill training were effective in both age groups, suggesting that these interventions can be applied across adolescence and young adults. Psychotherapy includes cognitive behavior therapy and behavioral activation, while skill training includes stress management, social skill training, emotion management, and problem-solving skill training. These active intervention ingredients might be cognitive reappraisal, social competence, and self-regulation. Specifically, cognitive reappraisal refers to the process of rethinking and reinterpreting an emotion-eliciting situation in a more adaptive way (Gross & John, 2003). This adaptive strategy enables individuals to reinterpret negative experiences and enhance flexibility in thinking
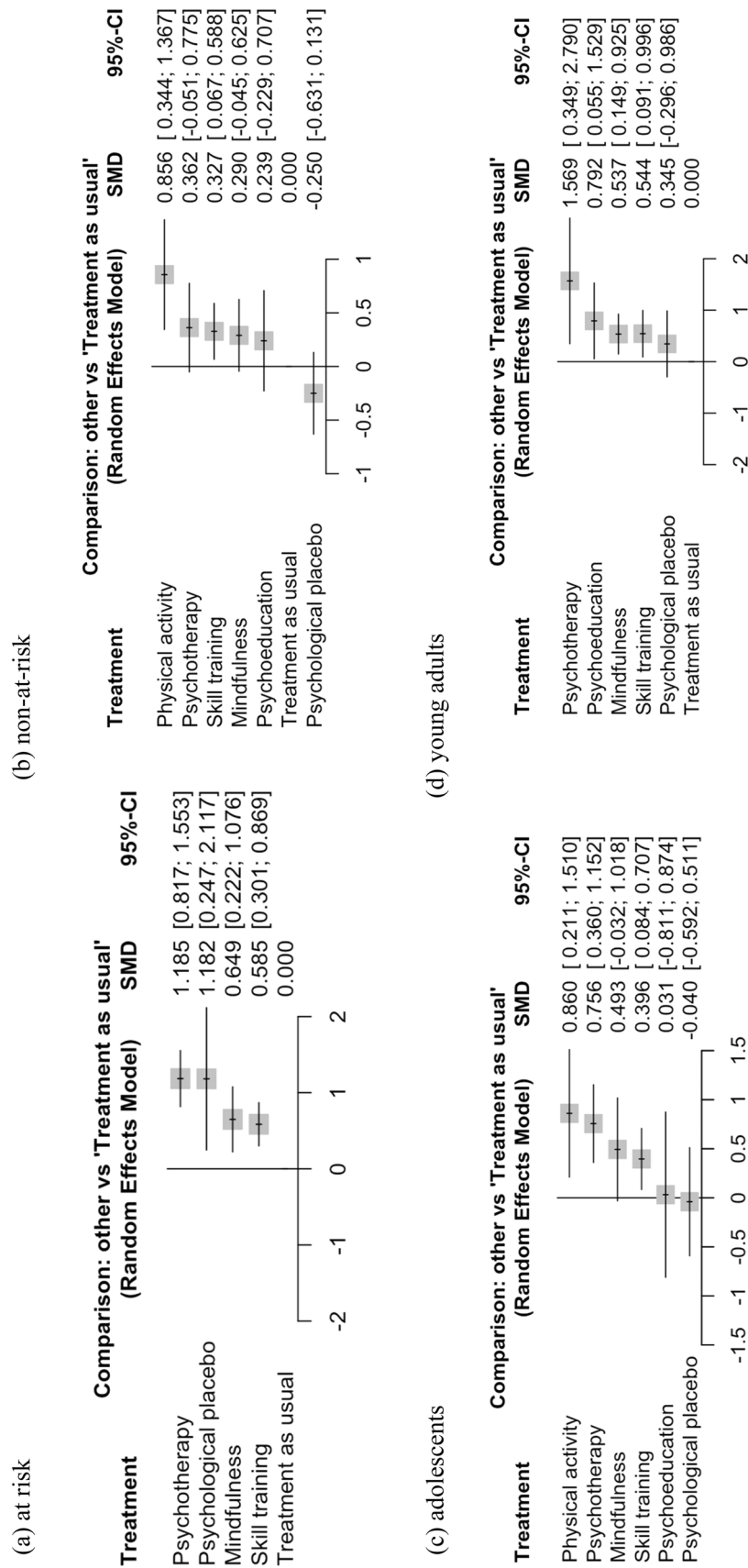
(a) at risk

Comparison: other vs 'Treatment as usual'
(Random Effects Model)

Treatment	SMD	95%-CI
Psychotherapy	1.185	[0.817; 1.553]
Psychological placebo	1.182	[0.247; 2.117]
Mindfulness	0.649	[0.222; 1.076]
Skill training	0.585	[0.301; 0.869]
Treatment as usual	0.000	

(b) non-at-risk

Comparison: other vs 'Treatment as usual'
(Random Effects Model)

Treatment	SMD	95%-CI
Physical activity	0.856	[0.344; 1.367]
Psychotherapy	0.362	[-0.051; 0.775]
Skill training	0.327	[0.067; 0.588]
Mindfulness	0.290	[-0.045; 0.625]
Psychoeducation	0.239	[-0.229; 0.707]
Treatment as usual	0.000	
Psychological placebo	-0.250	[-0.631; 0.131]

(c) adolescents

Comparison: other vs 'Treatment as usual'
(Random Effects Model)

Treatment	SMD	95%-CI
Physical activity	0.860	[0.211; 1.510]
Psychotherapy	0.756	[0.360; 1.152]
Mindfulness	0.493	[-0.032; 1.018]
Skill training	0.396	[0.084; 0.707]
Psychoeducation	0.031	[-0.811; 0.874]
Psychological placebo	-0.040	[-0.592; 0.511]

(d) young adults

Comparison: other vs 'Treatment as usual'
(Random Effects Model)

Treatment	SMD	95%-CI
Psychotherapy	1.569	[0.349; 2.790]
Psychoeducation	0.792	[0.055; 1.529]
Mindfulness	0.537	[0.149; 0.925]
Skill training	0.544	[0.091; 0.996]
Psychological placebo	0.345	[-0.296; 0.986]
Treatment as usual	0.000	

Fig. 3 Forest plot of the network meta-analysis for **a** at risk populations; **b** non-at-risk populations; **c** adolescents; **d** young adults. Effects of all available types are compared with treatment as usual

Table 3 Meta-regression analysis of resilience interventions by covariates

Covariate	β	SE	95% Lower	95% Upper	Z	p value
Individualism	−0.02	0.00	−0.03	−0.01	−4.26	<.0001***
Age	0.00	0.02	−0.04	0.05	0.15	.88
Gender	−0.00	0.01	−0.02	0.01	−0.37	.71
Publication year	0.00	0.03	−0.05	0.05	0.15	.88
Duration of intervention	0.06	0.03	−0.01	0.12	1.80	.07
Duration of session	0.08	0.00	0.00	0.01	2.31	.02*
Sample size	−0.00	0.00	−0.00	0.00	−1.30	.20

*p < .05; ***p < .001

and problem-solving, thereby improving adaptation to adversity (Besser & Zeigler-Hill, 2014; Troy et al., 2023). Social competence is defined as the ability to actively and appropriately participate in social situations (Rubin & Rose-Krasnor, 1992; Waters & Sroufe, 1983). Having good social competence can promote positive connections with peers and family, providing individuals with a pool of resources to guard against the negative effects of stressors (Alvord et al., 2016; Cloitre et al., 2008). In fact, the ability to connect, attach, and relate has been regarded as the foundation of building resilience (Luthar, 2006). Self-regulation is broadly defined as an individual's ability to manage attention, behavior, and emotions (Berger et al., 2007). Mastery of self-regulation can increase self-esteem and contribute to a stronger capacity to cope with challenges and adversity (Alvord et al., 2016).

Indeed, skill training was also the only intervention approach that was effective for both at-risk and non-at-risk populations. One possible explanation is that skill training is more directly effective in targeting resilience-protective factors than other interventions. Although skill training has relatively broad applicability, psychotherapy was more effective than skill training for at-risk populations. For these populations which typically experienced heightened levels of stress (Backman et al., 2023; Bernaras et al., 2018), and faced specific challenges during the intervention process, addressing cognitive restructuring and facilitating cognitive change may be more critical for improving mental health outcomes. These results suggest that intervention with psychotherapeutic components should be recommended for the at-risk population for improving resilience.

Mindfulness, defined as the practice of intentionally paying attention to the present moment in the mind, body, and external environment with nonjudgmental awareness (Germer, 2005), has been found only to be effective in young adults and at-risk populations. Mindfulness can enhance an individual's self-regulation by accepting the present moment in a nonjudgmental way, thus shifting one's attention and managing negative emotions (Yuan, 2021). This result aligns with previous findings that young adults benefit more from mindfulness than adolescents (Gómez-Odriozola & Calvete,

2021). This is likely because practicing mindfulness requires a level of cognitive maturity that adolescents may not have developed (McKeering & Hwang, 2019). In contrast, young adults have begun to develop abstract thinking and enhanced cognitive abilities, enabling more effective engagement with mindfulness practices (Johnson & Wade, 2019). Furthermore, adolescents may not recognize the importance of acquiring tools to face future challenges, resulting in lower motivation to engage in such practices (Johnson et al., 2016). In addition, since mindfulness works by enabling individuals to better manage their internal and external experiences in facing challenge and stress (Thompson et al., 2011), its impact might be more noticeable in at-risk populations, who are more frequently exposed to stress, than in non-at-risk populations.

Physical activities in the current studies, including yoga and martial arts, have been shown to be effective for both the adolescent populations and the non-at-risk populations. This should be interpreted with caution, as no studies have been conducted to investigate this as an intervention for young adults and at-risk populations so far. The effectiveness of physical activity may be linked to changes in brain structure and function, which continue to develop during adolescence. One systematic review (Belcher et al., 2021) has indicated that physical activity may enhance the development of neural circuits involved in self-regulation. This, in turn, may improve the ability to manage stress and challenges during this critical stage of development.

Though psychoeducation was not significant in comparison with treatment as usual in main analysis, subgroup analysis found it to be effective for young adults. This finding suggests that age may play a role in the effectiveness of psychoeducational interventions. Similar to mindfulness, young adults may benefit more from psychoeducation than adolescents due to factors such as cognitive development and greater engagement with the material. The lack of significant results in adolescents may indicate the need for tailored modifications to better suit this age group.

These findings align with the multidimensional nature of resilience, which emphasizes individual and relational protective factors. Specifically, psychotherapy and mindfulness

primarily target individual-level capacities, particularly by enhancing cognitive reappraisal and self-regulation. Physical activity may also support individual-level resilience through neurobiological mechanisms that enhance self-regulation and stress management. Psychoeducation, which facilitates reflection and knowledge acquisition, may reinforce individual-level capacities by increasing mental health literacy. Furthermore, skill training, by incorporating components such as emotion management, stress management, and social skills, bridges both the individual and relational levels, fostering self-regulation alongside adaptive interpersonal functioning. Taken together, the varied pathways of these interventions underscore the complex, systemic nature of resilience and support the need for theoretically grounded, developmentally responsive interventions.

While individual and relational protective factors have been identified across different resilience interventions, the meta-regression results also highlight the critical role of environmental factors in influencing resilience outcomes. The results suggest that greater effectiveness of resilience interventions was observed in collectivist cultures compared to individualist cultures. One possible explanation is that most studies included in the analysis used face-to-face and group interventions, which may align more closely with the values emphasized in collectivist cultures, such as group cohesion and belonging (Hofstede, 2011). In such cultural contexts, psychological security and emotional well-being may depend on strong social relationships and a sense of community. Group interventions, therefore, may foster a supportive and empathetic environment where individuals feel understood and connected, enhancing the intervention's effectiveness in building resilience. In contrast, individuals in individualist cultures may find group-based interventions less compatible with their cultural expectations. Such cultures typically value independence, self-reliance, and personal achievement (Hofstede, 2011). Group settings, which require cooperation, compromise, and open sharing of personal experiences, may feel restrictive or uncomfortable for individuals who prioritize autonomy and privacy. Instead, they may prefer interventions that allow for individual goal-setting, self-paced progress, and confidentiality. Therefore, personalized individual formats may be more suitable and effective than standardized group formats for individuals from individualist cultures. These findings also supported the "Culturally-Focused Resilient Adaptation" model proposed by Clauss-Ehlers (2004), which emphasizes that resilience is dynamic and depends not only on individual traits but also on sociocultural factors. Thus, when designing resilience interventions, it is essential to account for cultural appropriateness and the specific contexts of individual lives, rather than solely teaching young people to adapt to potentially unsupportive environments. Given the meta-regression results, there should be sufficient duration for each intervention session to ensure the effectiveness of the intervention.

This study suggests several considerations for future research and clinical practice. First, this study highlights key components of the intervention designed to enhance resilience, such as social competence training and self-regulation training. For future research, it is crucial to evaluate the effectiveness of these components based on their specific schedules. Second, the impact of physical activity and psychoeducation in at-risk settings, as well as physical activity in young adults, has not been explored in randomized controlled trials, indicating a research gap that requires further investigation. In clinical practice, although mindfulness was found to be significantly effective in the main analysis, this effect was not observed in the sensitivity analysis. On the other hand, evidence of the effectiveness of psychotherapy, skill training, and physical activity demonstrated were relatively robust. Therefore, clinicians could prioritize these interventions when allocating resources and designing interventions. Since the approach to improving resilience can be context-dependent (Rutter, 2012), this study also provides important insights for clinicians to tailor interventions to the specific characteristics of different populations. Notably, clinicians should also consider cultural appropriateness and the intervention duration per session when designing interventions.

Several limitations of the current study should be addressed. First, some intervention types, such as physical activity and psychoeducation, are based on a limited number of studies, which may undermine the statistical power to detect differences between interventions. Additionally, the overall risk of bias was moderate to high, and the credibility of the comparisons between interventions was low, potentially affecting the validity of the result. However, this is due to the inherent challenges of implementing blinding in psychological interventions, where the nature of therapist–participant interaction makes it impractical to implement double-blinding with regard to the assigned condition. Another limitation is that excluding non-English articles could introduce additional bias into the search, as potential publication bias has already suggested that some studies may be systematically missing from the published literature. In addition, the use of only full-form search terms such as "teenager" may have unintentionally narrowed the scope of the literature retrieved, even though a total of 7897 records were identified. Furthermore, the limited number of studies using individual (k = 7) or digital delivery formats (k = 4) prevented a subgroup analysis based on these modalities. While these formats may influence intervention effectiveness, the small sample size of studies in these categories suggest that further research is needed to more thoroughly explore their impact on outcomes. Furthermore, the content of the "treatment-as-usual" comparator was insufficiently

reported in most studies, making it difficult to ascertain the specific conditions participants experienced and potentially limiting the interpretability of the findings. Lastly, while standardized mean differences (SMDs) were used to facilitate comparisons across studies, the conceptual heterogeneity in how resilience is defined and measured across interventions may affect the interpretation of the findings. These findings highlight the need for a more standardized conceptual and operational definition of resilience to enable consistent measurement and comparison across studies.

Conclusion

Despite the growing number of resilience interventions targeting adolescents and young adults, their relative effectiveness has remained unclear. The current study provides the first network meta-analysis synthesizing evidence on resilience interventions in this population. The results support the effectiveness of physical activity, psychotherapy, mindfulness, and skill training in enhancing resilience, although the effect of mindfulness was not robust in sensitivity analysis. Specifically, physical activity, psychotherapy, and skill training were effective for adolescents (age 10–19), while psychotherapy, psychoeducation, mindfulness, and skill training were effective for young adults (age 20–25). For at-risk populations, psychotherapy, skill training, mindfulness, and psychological placebo were effective, whereas for non-at-risk populations, only physical activity and skill training showed significant effects. Psychotherapy was found to be more effective than skill training for at-risk individuals. Notably, psychoeducation and physical activity were excluded from the at-risk group due to insufficient data, and physical activity was also excluded from the young adult group for the same reason. Additionally, interventions conducted in collectivist cultures were more effective than those in individualist cultures. While the overall evidence was limited by low confidence ratings, several promising patterns emerged. These findings may help guide clinicians in tailoring intervention modalities for specific subpopulations of adolescents and young adults. Further high-quality randomized controlled trials are needed to inform culturally and developmentally responsive resilience interventions.

Declarations

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Literature included in the network meta-analysis is denoted by an asterisk

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