A COLLECTION OF SYSTEMATIC REVIEWS OR META-ANALYSES ON THE EFFECTS OF BEHAVIORAL AND PSYCHOSOCIAL INTERVENTIONS FOR PSYCHOLOGICAL WELL-BEING

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Editorial: A Collection of Systematic Reviews or Meta-Analyses on the Effects of Behavioral and Psychosocial Interventions for Psychological Well-Being

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Editorial on the Research Topic

A Collection of Systematic Reviews or Meta-Analyses on the Effects of Behavioral and Psychosocial Interventions for Psychological Well-Being

Intervention research evaluating the efficacy or effectiveness of behavioral and psychosocial interventions on psychological well-being and behavioral health outcomes across the life span has grown tremendously in recent decades. Following the principles of evidence-based practice, mental health and health care professionals draw on the best available research evidence along with their clinical expertise and client preferences to inform their clinical decision-making when selecting the most effective and appropriate intervention programs for their clients (American Psychological Association, 2006). However, given the recent dramatic increase in the number of scientific publications in this area and the often inconsistent conclusions they yield, it is difficult for research consumers to identify the best available evidence. Systematic reviews and meta-analyses of randomized controlled trials (RCTs) are considered to provide the strongest evidence because they (a) employ a structured approach to identifying and evaluating empirical evidence, (b) appraise the evidence for internal validity and clinical usefulness, and (c) have greater statistical power and precision for estimating treatment effects than do individual studies (Mulrow, 1994; Evans, 2003).

We initiated this Research Topic in recognition of the extant published systematic reviews with or without meta-analyses on the efficacy or effectiveness of behavioral and psychosocial interventions aimed at treating behavioral problems or enhancing the psychological well-being of participants across the life span. We identified a total of nine systematic reviews in this Research Topic, each of which synthesizes a body of empirical evidence on the efficacy or effectiveness of various behavioral and psychosocial interventions for different populations, including children, youth, adults, and older adults. The systematic reviews also identify knowledge gaps and offer recommendations for ongoing intervention research.

INTERVENTIONS FOR CHILDREN AND YOUTH

Three systematic reviews focused on behavioral and psychosocial intervention programs for children and youth.

Li et al. synthesized recent empirical evidence drawn from 37 studies (36 RCTs and one quasi-experimental study published from 2013 to 2020) of the Triple P (Positive Parenting Program) on social, emotional, and behavioral outcomes among many different child populations, ranging from the general population to those at risk for behavioral problems. The meta-analysis found that Triple P yielded statistically significant increases in children's social competence and reductions in their emotional and behavioral problems. The review also found supportive evidence that Triple P reduced negative parenting styles, conflicts over parenting, parents' mental distress, and parent-child conflict, while improving parental self-efficacy. The review also identified a few intervention and participant characteristics that moderated the intervention's effects on child and parent outcomes.

Chan et al.'s review synthesized the effects of experiential and non-experiential learning programs on prosocial behavior, empathy, and subjective wellbeing among children and youth aged 8–25 years based on 20 RCTs. The meta-analysis found that experiential learning programs yielded statistically significant effect sizes on empathy and on subjective wellbeing, based on four studies and five studies, respectively. Statistically significant effects were not found for non-experiential learning programs for any of the three outcomes.

Aithal et al. reviewed nine studies with various research designs that evaluated the initial evidence of dance movement psychotherapy interventions on the wellbeing of children with autism spectrum disorders and found that these interventions yielded promising improvements in various social and communication skills. However, the review indicated that strong empirical evidence for the efficacy of dance movement psychotherapy is still lacking.

INTERVENTIONS FOR ADULTS

Four systematic reviews addressed behavioral and psychosocial interventions for adults.

Wang et al. synthesized five RCTs of dance-based interventions on depression and anxiety among persons with mild cognitive impairment and dementia. The review found a statistically significant average effect size of danced-based programs on reducing depressive symptoms and insufficient evidence of an effect on anxiety symptoms.

Velana et al. reviewed 27 relevant studies (including RCTs and quasi-experimental studies published from 2000 to 2020) of the individual interventions on stress management among nurses. The review suggested that technology-delivered interventions with relaxation and stress management interventions comprising cognitive-behavioral components might effectively decrease stress among nurses and improve their well-being.

Yang et al. synthesized five RCTs to explore the effects of art therapy (i.e., music therapy and painting therapy) on depression, anxiety, blood glucose, and glycated hemoglobin in patients with diabetes mellitus (DM). The results provided supportive evidence of the beneficial effects of art therapy on depression and blood glucose in patients with DM.

Zhou et al. synthesized six RCTs to examine the effect of internet-based interventions (IBI) on veterans' post-traumatic stress disorder (PTSD) symptoms. The review found supportive evidence of IBI's ability to reduce overall PTSD outcomes. Subgroup analysis showed that IBI-based cognitive behavioral therapy with peer support had a beneficial effect on PTSD outcomes among veterans. Subgroup analyses were also conducted based on outcome measures and comorbidity of participants.

INTERVENTIONS FOR OLDER ADULTS

Two systematic reviews and meta-analyses reviewed behavioral and psychosocial interventions for older adults.

Shen et al. synthesized six studies (i.e., four RCTs and two quasi-experimental studies) with 51 effect size estimates, and reported an overall positive and statistically significant treatment effect of psychosocial interventions for elder abuse-related outcomes. Interventions that used a family-based model, combined education and supportive services, and targeted both caregivers and elders yielded a significant effect size, suggesting such features should be considered for inclusion in elder abuse intervention design.

Jin et al. synthesized six RCTs to examine the effectiveness of technology-based interventions for reducing loneliness in older adults. Their meta-analysis did not find supportive evidence of the efficacy of the technology-based interventions in loneliness reduction.

CONCLUSION AND FUTURE DIRECTIONS

Interventions reviewed in this Research Topic are all multicomponent psychosocial interventions that are either (a) broad-based programs addressing multiple positive developmental outcomes among a wide range of populations of interest or (b) more targeted programs designed to reduce specific problems among at-risk populations. For either type of program, the intervention effects may vary based on intervention and participant characteristics. Although some of the included reviews tried to shed light on the moderators of the intervention effects using subgroup analysis, subgroup analysis often does not have sufficient statistical power to detect significant effects due to the limited number of included studies and effect sizes. Further, intervention mechanisms remain largely unknown because such information is often unrecorded by the original studies. Therefore, the authors of these reviews called for more high-quality RCTs with long-term

follow-ups to further understand the effects and mechanisms of the interventions. Nonetheless, these reviews are extremely beneficial because they synthesized the most recent empirical evidence and identified knowledge gaps to be studied by future intervention research.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

AUTHOR CONTRIBUTIONS

All the authors contributed to drafting the manuscript. AB and IC also contributed to revising the manuscript. All authors contributed to the article and approved the submitted version.

Art Therapy Alleviates the Levels of Depression and Blood Glucose in Diabetic Patients: A Systematic Review and Meta-Analysis

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Objective: To systematically analyze the effects of art therapy on the levels of depression, anxiety, blood glucose, and glycated hemoglobin in diabetic patients.

Methods: We searched Cochrane Library, PubMed, Embase, and ClinicalTrials.gov databases from inception to January 24, 2021. The language of publication was limited to English. Randomized controlled trials (RCTs) that used art therapy to improve mental disorders in diabetic patients were involved. After selection of eligible studies, data were extracted, including the first author's full-name, year of publication, the first author's country of residence, number of intervention and control groups, the mean age of participants, method of intervention, duration of follow-up, and outcome measures. Assessment of quality of the included studies and data extraction were independently carried out by two researchers. RevMan 5.3 software was used to perform statistical analysis.

Results: A total of 396 samples from five studies were included, and the eligible studies were RCTs with a parallel design. Methods of art therapy included music therapy and painting therapy. The results showed that compared with the control group, art therapy could positively affect the levels of depression [standardized mean difference (SMD), -1.36; 95% confidence interval (CI), $(-1.63, -1.09)$; $P < 0.00001$] and blood glucose in diabetic patients [mean difference (MD), -0.90; 95% CI, $(-1.03, -0.77)$; $P < 0.0001$], while it had no influence on the levels of anxiety [SMD, -0.31; 95% CI, $(-0.93, 0.31)$; $P = 0.32$] and glycated hemoglobin [MD, 0.22; 95% CI, $(-0.02, 0.46)$; $P = 0.07$].

Conclusion: Art therapy may have significant effects on the levels of depression and blood glucose for diabetic patients.

Keywords: art therapy, diabetes, depression, anxiety, blood glucose, meta-analysis

INTRODUCTION

Diabetes mellitus is a group of metabolic disorders characterized by a high blood sugar level over a prolonged period of time. According to the reports released by the International Diabetes Federation (IDF), diabetes has been caused 4.2 million deaths in 2019 worldwide. Besides, more than 1.1 million children and adolescents younger than 20 years old are living with type 1 diabetes (T1D), and the number of adults with diabetes will rise to 700 million in 2045. Simultaneously, the number of cases with type 2 diabetes (T2D) is increasing in several countries, and about 79% of adults suffer from diabetes (Patterson et al., 2019). In addition, diabetes is a chronic disease that requires lifetime medical treatment after diagnosis. In 2019, it was estimated that diabetes-related health expenditure totally reached $760 billion globally for individuals who aged 20–79 years old (Saeedi et al., 2019). Several studies have reported that the incidence of anxiety, depression, and other mental disorders in diabetic patients is significantly higher than that in general population (Hajós et al., 2014; Vancampfort et al., 2016; Smith et al., 2018). Meanwhile, psychological needs of diabetic patients may reduce their compliance with medication, exercise, diet, and other treatment methods, resulting in a poor control of blood glucose level (Anderson et al., 2002). Furthermore, mental disorders, such as depression and anxiety, may increase the risk of complications caused by diabetes. Prospective evidence indicated that the risks of microvascular and macrovascular complications [e.g., foot ulceration, retinopathy, chronic kidney disease (Gonzalez et al., 2010; Iversen et al., 2015; Novak et al., 2016; Khoo et al., 2019), myocardial infarction, and stroke (Lin et al., 2010; Scherrer et al., 2011; Ting et al., 2013; Rådholm et al., 2016)] were elevated in diabetic patients with depression. Therefore, it is highly essential to provide psychotherapy for diabetic patients with mental disorders.

At present, the main psychological treatment for diabetic patients is drug therapy. The 2012 Cochrane Review assessed 19 randomized controlled trials (RCTs) concentrated on pharmacological and psychological interventions for diabetic patients with depression. The results showed that application of psychological and pharmacological interventions can be clinically significant for diabetic patients with depression, and psychiatric medication can moderately control blood glucose level (Baumeister et al., 2014). However, long-term treatments are associated with a number of side effects, such as drowsiness, insomnia, agitation, sexual dysfunction, weight gain, cardiac arrhythmia, and orthostatic hypotension (Pacher and Kecskemeti, 2004). In addition, although psychological consultation has significant clinical efficacy for patients with depression and anxiety, the high cost of consultation makes it unacceptable for the majority of diabetic patients.

Art therapy is a complementary therapy that uses art as a medium to treat behavioral, neurological or mental disorders (Naumburg, 1973). There are several types of art therapy, including visual art therapy, music therapy, dance/movement therapy, drama therapy/psychodrama, etc. Numerous studies (Greco-Vigorito et al., 1996; Wallace et al., 2004; Ozdemir and Akdemir, 2009; Delinsky et al., 2010; Hughes and da Silva, 2011;

Afnan and Rosenfeld, 2015; Eum and Yim, 2015; Mandić-Gajić G., 2016; Sarid et al., 2017; Jang et al., 2018; Moghaddasifar et al., 2019) have shown that art therapy is advantageous for patients with post-stroke depression, perinatal mood and anxiety disorders, post-partum depression, post-traumatic stress disorder (PTSD), etc. However, to date, no study has evaluated the effects of art therapy on diabetic patients. The present meta-analysis aimed to assess the effects of art therapy on the psychological status and blood glucose level of diabetic patients, and our findings may provide a reliable reference for the future clinical researches.

METHODS

This systematic review and meta-analysis was conducted in accordance with the PRISMA Statement (Preferred Reporting Items for Systematic Reviews and Meta-analyses), and was registered at PROSPERO (Registration No. CRD42020157752).

Search Strategy

An online systematic search was performed using Cochrane Library, PubMed, Embase, and ClinicalTrials.gov databases from inception to January 24, 2021. The language of publication was limited to English. The search strategy is shown in **Appendix 1**. All searches used the combination of medical subject heading terms and free-text terms and were adjusted according to specification of a database.

Inclusion and Exclusion Criteria

Inclusion criteria were as follows: (1) RCTs; (2) patients who were diagnosed with diabetes (including both T1D and T2D); (3) utilization of a type of art therapy, such as painting, music, dance/movement, or drama; (4) inclusion of indicators of anxiety and depression. Exclusion criteria were as follows: (1) patients with gestational diabetes; (2) incomplete data; (3) duplicate studies.

Literature Screening, Data Extraction, and Assessment of Risk of Bias

Literature screening, data extraction, and assessment of risk of bias were independently carried out by two researchers. Any discrepancies were resolved through a consensus discussion with a third researcher. After selection of eligible studies, data were extracted, including the first author's full-name, year of publication, the first author's country of residence, number of intervention and control groups, participants' mean age, method of intervention, duration of follow-up, and outcome measures. The Cochrane risk of bias (RoB) assessment tool was herein used to evaluate the overall quality. The selection bias, performance bias, detection bias, attrition bias, reporting bias, and other sources of bias were assessed. The risk of bias for each domain was reported as low, unclear, or high.

Statistical Analysis

RevMan 5.3 software was used to perform statistical analysis. For analysis of the levels of blood glucose and glycated hemoglobin, mean differences (MDs) with 95% confidence intervals (CIs)

were employed. With respect to different psychological assessment methods, for the outcomes of anxiety and depression, standardized mean differences (SMDs) with 95% CIs were used. The I^2 statistic was utilized, describing the percentage of variations across studies due to heterogeneity. Considering the influences of heterogeneity caused by confounding factors on the results, a random-effects model was used to carry out meta-analysis. Subgroup analysis was undertaken to investigate sources of heterogeneity. When at least 10 studies could be involved, the funnel plot and Egger's test were used to assess risk of publication bias.

RESULTS

Literature Screening

The literature screening resulted in identification of 5 RCTs with inclusion of a total of 396 diabetic patients (Zhao et al., 2005; Harel et al., 2013; Mandel et al., 2013; Eum and Yim, 2015; Singh, 2015; Gelernter et al., 2016; Brandão et al., 2019). Initially, 1,698 studies were screened, of which 393 duplicate studies were excluded using EndNote X9 software. After reading title and abstract of remaining studies, 1,244 articles that did not meet the inclusion criteria were excluded. Besides, 56 studies were removed after reading their full-text, including no RCTs ($n = 23$), no relevant outcomes ($n = 21$), non-English studies ($n = 2$), and incomplete data ($n = 10$). The literature screening process is shown in **Figure 1**.

Characteristics of the Included Studies

The characteristics of the included RCTs are summarized in **Table 1**. It was revealed that five studies were published in China, Israel, the United States, and India from 2005 to 2016. The sample size of the studies ranged from 13 to 182, and the duration of follow-up ranged from 28 days to 2 years. The included studies were RCTs with a parallel design. The methods used in the intervention group were music therapy and painting therapy. Routine nursing was mostly provided to the control group. The outcomes of the studies included blood glucose level, glycated hemoglobin level, State-Trait Anxiety Inventory (STAI), Beck Depression Inventory (BDI), and the Symptom Checklist-90-R (SCL-90-R).

Quality of the Included Studies

Among five studies, four mentioned "random" in the main text. Besides, three studies adequately generated random allocation sequences (Mandel et al., 2013; Singh, 2015; Gelernter et al., 2016), and one study did not describe the method of generation of random numbers (Zhao et al., 2005). Allocation concealment-associated information was presented in two studies (Mandel et al., 2013; Gelernter et al., 2016). There were two double-blind studies (Singh, 2015; Gelernter et al., 2016), in addition to a single-blind study (Mandel et al., 2013). For incomplete outcome data, only one study had a high-risk of bias as the rate of loss to follow-up was remarkable (33%) (Mandel et al., 2013). All the included studies had a low-risk of reporting bias originated from selective outcome reporting. One study that used guided imagery

was suspected of having other sources of bias (Gelernter et al., 2016). The summary of risk of bias is illustrated in **Figure 2**.

Meta-Analysis

For anxiety-associated outcomes, three studies (Zhao et al., 2005; Mandel et al., 2013; Singh, 2015) that enrolled 354 subjects were included in the meta-analysis. The results of pooled analysis revealed that there was no significant difference in anxiety between intervention and control groups ($P = 0.32$) with a SMD of −0.31 [95% CI, −0.93 to 0.31]. There was a high level of heterogeneity among the included studies ($P = 0.0004$, $I^2 = 87\%$; **Figure 3**).

For depression-associated outcome, two studies (Zhao et al., 2005; Singh, 2015) that enrolled 262 subjects were included in the meta-analysis. The results of pooled analysis showed that there was a significant difference in depression between intervention and control groups ($P < 0.00001$) with a SMD of −1.36 [95% CI, −1.63 to −1.09]. There was no heterogeneity among the included studies ($P = 0.44$, $I^2 = 0\%$; **Figure 4**).

For blood glucose level, three studies (Zhao et al., 2005; Harel et al., 2013; Singh, 2015) that enrolled 291 subjects were included in the meta-analysis. The results of pooled analysis indicated a significant difference in blood glucose level between intervention and control groups ($P < 0.0001$) with a MD of −0.90 [95% CI, −1.03 to −0.77]. There was no heterogeneity among the included studies ($P = 0.65$, $I^2 = 0\%$; **Figure 5**).

For glycated hemoglobin level, four studies (Harel et al., 2013; Mandel et al., 2013; Singh, 2015; Gelernter et al., 2016) that enrolled 287 subjects were included in meta-analysis. The results of pooled analysis revealed that there was no significant difference in glycated hemoglobin level between intervention and control groups ($P = 0.07$) with a MD of 0.22 [95% CI, −0.02 to 0.46]. There was no heterogeneity among the included studies ($P = 0.73$, $I^2 = 0\%$; **Figure 6**).

Subgroup Analysis and Publication Bias

Among the five studies included, four studies used music therapy, only one study employed painting therapy, and subgroup analysis is not meaningful. The publication bias was not assessed, because the number of included RCTs was <10.

DISCUSSION

This meta-analysis was carried out to comprehensively assess the effects of art therapy on diabetic patients. The analysis of eligible studies showed that art therapy can significantly influence diabetic patients via decreasing blood glucose level and alleviating symptoms of depression, while it has no significant effect on levels of glycated hemoglobin and anxiety. This is the first systematic review on the effects of art therapy on diabetic patients with psychological disorders. Boehm et al. conducted a systematic review and meta-analysis to assess the effects of art therapy on breast cancer patients' levels of anxiety, depression, and quality of life. Their results revealed that art therapy has a positive effect on cancer patients' anxiety, while it has no influence on the level of depression or quality of life (Boehm et al., 2014). Bradt et al. (2015) pointed out that dance/exercise
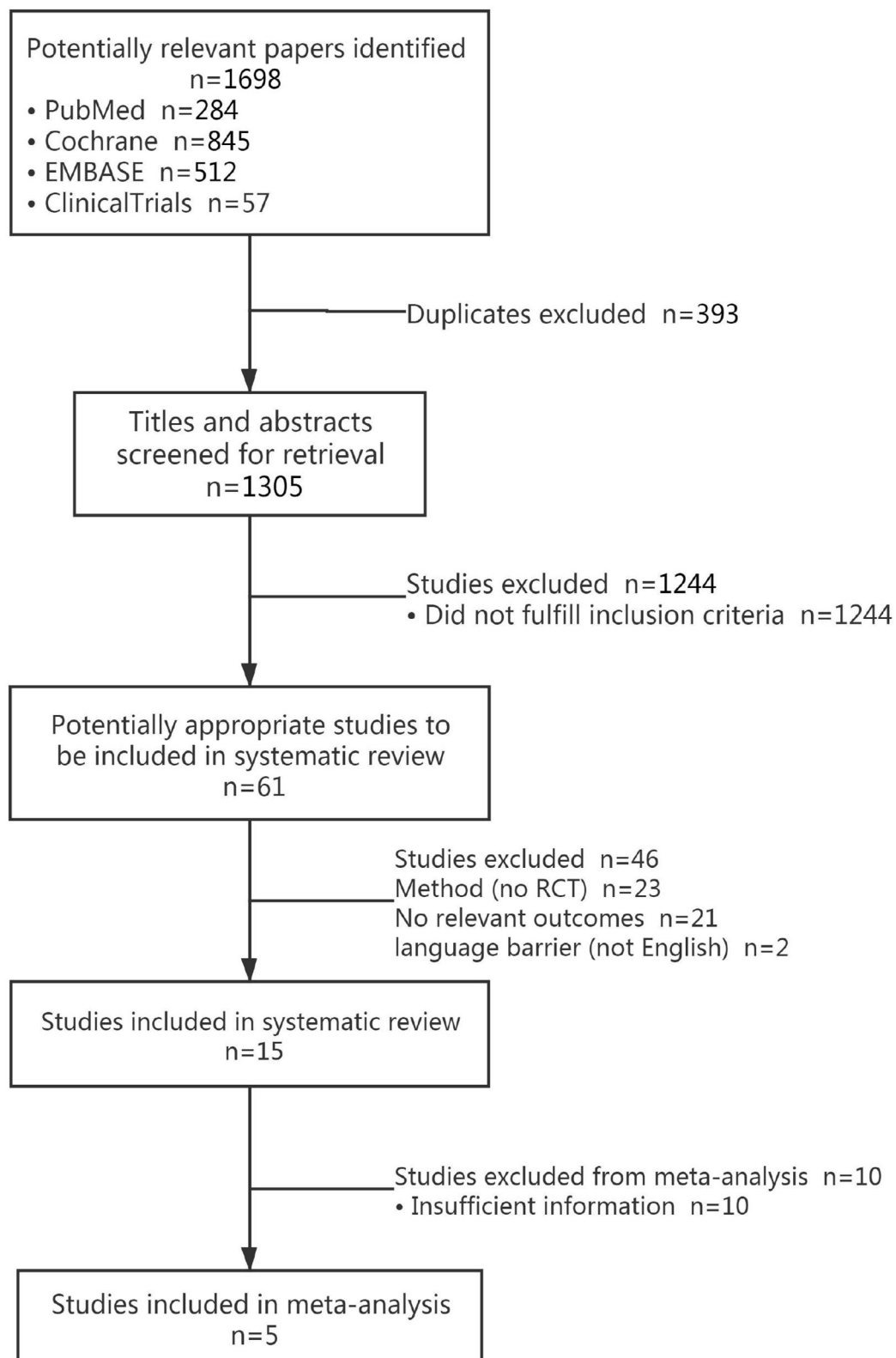
FIGURE 1 | Flowchart of study selection process.

therapy can positively affect cancer patients' levels of depression, stress, anxiety, fatigue, and body image. Tang et al. (2019) demonstrated that art therapy is significant for treating anxiety, depression, and fatigue for patients with breast cancer. Baker et al. (2018) systematically evaluated the effects of art therapy on PTSD. Their findings revealed that symptoms of PTSD were markedly alleviated with the aid of art therapy. Brandão et al. (2019) investigated the effects of art therapy on depression, and their results indicated that art therapy is a safe and reliable therapeutic approach not only for depression, but also for other mental disorders.

In the present systematic review, we found that art therapy can lower blood sugar level, while no previous study has described the underlying mechanism. According to the findings of some related studies, the underlying mechanism may be related to improved function of hypothalamic-pituitary-adrenal (HPA) axis and reduction of cortisol level. During stress, HPA axis is activated. Hypothalamic neurons within the HPA axis secrete corticotropin-releasing hormone that causes the release of adrenocorticotrophic hormone (ACTH) from the pituitary. The ACTH causes the adrenal gland to secrete cortisol (a stress hormone). Together, catecholamines and cortisol increase available sources of energy by promoting lipolysis and the conversion of glycogen into glucose (i.e., blood sugar). D'Cunha et al. (2019) figured out that individuals with dementia are able to improve the function of the HPA axis after undergoing museum therapy. Kaimal et al. (2016) conducted a quasi-experimental study, and investigated the effect of visual art production on the cortisol level of 39 healthy adults, and found that that visual art production could significantly reduce cortisol levels.

Regarding intervention methods, in the current meta-analysis, we noted that the main intervention method was music therapy. However, other types of art therapy possessed certain advantages for the treatment of diabetes, especially visual art therapy. For instance, Isla Pera et al. attempted to indicate whether drawing is significant in the detection of problems associated with psychosocial adaptation in children and adolescents with T1D. Their outcomes showed that the majority of patients had a well-balanced personality, whereas there were also signs of affective or psychosocial difficulties (Isla Pera et al., 2013). Vanelli et al.'s research revealed that painting can promote communication between T1D children and medical staff. Compared with verbal psychotherapy, patients can better perceive diabetes through artistic expression (Vanelli et al., 2018). Moreover, we found that the majority of diabetic patients who had received visual art therapy were adolescents and children with T1D, and there were fewer middle-aged and elderly patients with T2D. This may be related to the fact that art therapy can better facilitate communication with children whose language functions are underdeveloped. However, about 90–95% of diabetic patients suffer from T2D (Deshpande et al., 2008). For such patients, visual art therapy may be a convenient, safe, and easy intervention to manage negative emotions. Therefore, for such patients, especially elderly patients with T2D, it is highly essential to develop further effective classes of art therapy due to the decline in cognitive function, limited activity,

TABLE 1 | Characteristics of included studies.

Study	Country	Type of diabetes	Intervention group					Control group				Outcome	Measurement timepoint (month)
			Sample size	Age (year)	Female (%)	Type of Art therapy	Intervention frequency	Sample size	Age (year)	Female (%)	Intervention		
Gelernter et al., 2016	Israel	T1DM	7	11.60 ± 3.03	57.14	AGI+BM	Clinic stay 5 days, 1 session/day; 3 months, 1 session/2 weeks, 7 min/session	6	12.17 ± 2.30	66.67	BMS	HbA1c	3
Harel et al., 2013	Israel	T1DM	16	9.3 ± 2.5	75.00	AT	1 session/1–2 weeks for the first 3 months, 1 session/4–6weeks until 9 months, 1 session/8–12 weeks for maintenance therapy	13	9.3 ± 3.4	54.00	SC	BS, HbA1c	24
Mandel et al., 2013	USA	T1DM or T2DM	39	30–85	68.70	MT+DSME/T	1 session/2 weeks, 1.5 h/session	53	30–85	76.60	DSME/T	HbA1c, STAI,	3
Singh, 2015	Indian	T2DM	92	50.4 ± 8.5	44.57	MT	2 sessions/day, 0.5 h/day	90	49.4 ± 8.7	45.46	SC	HbA1c, STAI, BDI	6
Zhao et al., 2005	China	T2DM	40	67.25 ± 5.04	37.50	MT	2 times/day, 0.5 h/times	40	67.43 ± 4.03	37.50	SC	FBS, SCL90	1

T1DM, type 1 diabetes; T2D, type 2 diabetes; AGI, auditory guided imagery; BM, background music; BMS, background music solely; AT, art therapy; SC, standard care; HbA1c, glycated hemoglobin; BS, blood sugar; FBS, fasting blood sugar; MT, music therapy; DSME/T, diabetes self-management education/training; STAI, state trait anxiety inventory; BDI, beck depression inventory; SCL90, symptom checklist-90.

FIGURE 2 | **(A)** Assessment of risk of bias with selected studies. **(B)** Risk of bias graph and summary.

FIGURE 3 | The effects of art therapy on anxiety.

FIGURE 4 | The effects of art therapy on depression.

vision loss, and increased incidence of complications caused by long-term diseases.

Regardless of newly diagnosed children or elderly people who had been sick for several years, they all should undergo

a long-term treatment. In the period of treatment, they are more prone to negative emotions, such as anxiety, stress, depression, loneliness, embarrassment, and isolation. A poor psychological status may affect the control of blood sugar

FIGURE 5 | The effects of art therapy on blood glucose level.

FIGURE 6 | The effects of art therapy on glycated hemoglobin level.
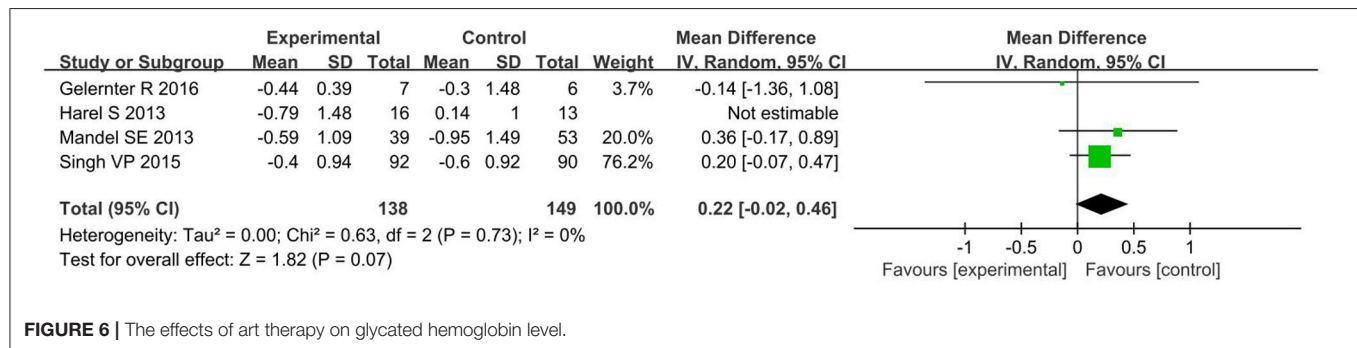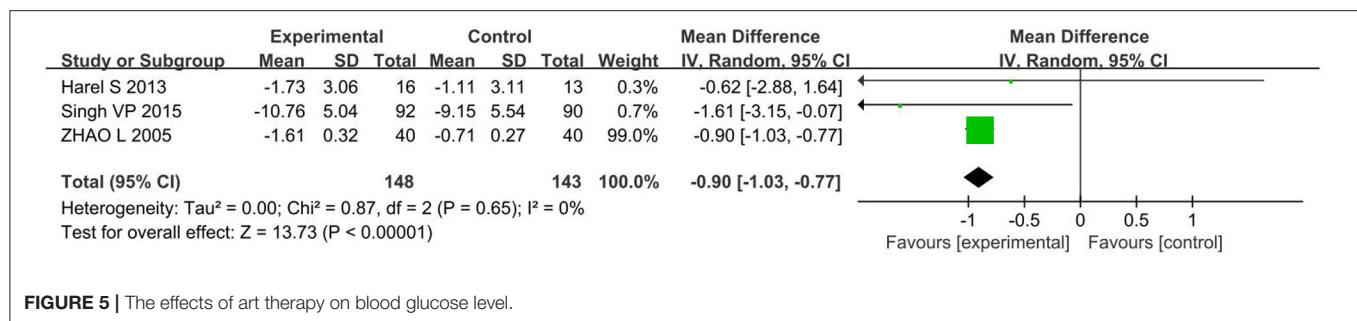
level. Therefore, treatment of diabetes not only requires medical interventions, but also psychological and emotional adjustment. As a complementary therapy, art therapy possesses the advantages of low cost, high safety, relatively fixed teaching methods, easy replication, etc.

The current systematic review contains a number of limitations. Firstly, heterogeneity could not be avoided because of differences in intervention methods, follow-up time, sample size, etc. Secondly, due to the limitation in the number of included documents, we could not perform a meaningful subgroup analysis, which hindered us to understand the effects of art therapy under different conditions. Finally, this systematic review only concentrated on anxiety and depression in diabetic patients, and other clinically meaningful indicators, such as quality of life and social function, were not analyzed, which limited evaluation of the clinical effects of art therapy on diabetic patients.

CONCLUSIONS

The application of art therapy is significant to treat diabetic patients with high levels of blood glucose and depression. However, it is highly essential to include further high-quality RCTs with larger sample size to deeply assess the effects of different types of art therapy on mental health status of diabetic patients.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author/s.

AUTHOR CONTRIBUTIONS

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2021.639626/full#supplementary-material

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The Effectiveness of Psychosocial Interventions for Elder Abuse in Community Settings: A Systematic Review and Meta-Analysis

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As a global public health concern, elder abuse negatively affects health, psychosocial wellbeing, and mortality among elders. Research and practice efforts made to explore effective prevention and intervention strategies are growing. Despite the growing number of intervention studies on elder abuse, research synthesis on the empirical literature seems lacking. This study aims to identify the pooled effect size of prevention and interventions targeted ultimate and intermediate outcomes for elder abuse that occurred in community settings. Following the Cochrane guideline, our team searched across eight electronic databases and manually searched reference lists of eligible studies and existing systematic reviews for all potentially eligible studies. A random-effects model of 51 effect size estimates reported an overall positive and statistically significant treatment effect of psychosocial interventions for elder abuse, $d = 0.63$, $p < 0.05$. The overall treatment effect was approaching statistical significance at 0.1 level for ultimate outcomes, $d = 0.32$, $p = 0.09$, and intermediate outcomes, $d = 0.75$, $p = 0.1$. An overall significant effect size was found among family-based interventions, $d = 0.59$, $p < 0.05$, and interventions targeting older adults and their caregivers, $d = 0.45$, $p < 0.05$. Existing evidence supports an overall significant effect for psychosocial interventions for elder abuse. Interventions that used a family-based model, combined education and supportive services, and targeted both caregivers and elders, showed significant effect size, suggesting such features being considered in elder abuse intervention design. Future intervention research is needed to shed light on the link between intervention activities and ultimate change in elder abuse behaviors.

Keywords: elder abuse, psychosocial intervention, community settings, systematic review, meta-analysis

INTRODUCTION

Elder abuse refers to intentional or unintentional harmful acts toward an older person where trust is expected. Common types of elder abuse include physical, psychological, sexual abuse, financial exploitation, and neglect (World Health Organization, 2002; Acierno et al., 2010). As a global public health concern, about 1 in 6 community-dwelling older adults experienced

some form of abuse in the last 12 months as found in a meta-analysis that explored prevalence rates of elder abuse (Yon et al., 2017). The prevalence rate of abuse in elder care facilities is even higher as two-thirds of care staff members reported abusive behaviors (Yon et al., 2019). The profound impact of elder abuse on victim's health, finances, quality of life, and even mortality (Acierno et al., 2010) deserves attention.

Current elder abuse interventions include public education and advocacy, caregiver support, psychological support for victims, care coordination, and multidisciplinary case management to name a few (Acierno et al., 2010). Based on existing literature, programs that suggest the effectiveness of elder abuse are through providing (1) caregiver supportive services (Livingston et al., 2013), (2) money management coaching (Sacks et al., 2012), (3) telephone helplines (van Bavel et al., 2010), (4) emergency shelters for older victims (Heck and Gillespie, 2013), and (5) access to a multidisciplinary team (Teaster et al., 2003). Educational or training interventions are more accessible than supportive services or case management interventions (Sacks et al., 2012; Livingston et al., 2013). Elder abuse preventions and interventions tend to achieve two types of outcomes: reducing the occurrence of abusive behaviors (Hsieh et al., 2009; Khanlary et al., 2016), and mitigating elder abuse risk factors, such as psychosocial stress and lack of awareness or competency among nursing staff, family caregivers, and older adults themselves (Pellfolk et al., 2010; Baker et al., 2016; Estebsari et al., 2018).

Most meta-analysis studies regarding elder abuse focus on the prevalence and risk factors rather than on elder abuse intervention effects (Yon et al., 2017, 2019). Despite the growing number of intervention studies on elder abuse, research synthesis on the pooled effect for elder abuse interventions remains lacking. From the limited available systematic reviews of elder abuse intervention programs, either found a lack of sufficient evidence to establish the effectiveness of elder abuse (Ploeg et al., 2009; Alt et al., 2011; Fearing et al., 2017) programs or programs that did not use rigorous evaluations to assess the effectiveness of said programs (Rosen et al., 2019).

Furthermore, the only meta-analysis to our knowledge synthesized 24 studies of elder abuse interventions (Ayalon et al., 2016). This study found an overall small but significant treatment effect for restraint use reduction, $d = -0.24$, 95% CI $(-0.38, -0.09)$. While highly valuable, this meta-analysis primarily focused on the restraint use as an abuse outcome, which can be questionable as the use of physical restraints with a physician's order can be medically necessary rather than abusive.

Despite the above evidence that supports the potential effect of intervention programs for elder abuse, the conclusion is far from definitive because of the limited number of studies and a narrowed scope of outcomes reviewed in these systematic reviews (Ploeg et al., 2009; Alt et al., 2011; Fearing et al., 2017). Elder abuse preventions and interventions typically aim for changes in intermediate or ultimate outcomes. Ultimate outcomes refer to the reduction in the occurrence or reoccurrence of abusive behaviors, while intermediate outcomes include the mitigation of risk factors (e.g., psychosocial stress) and promotion of protective factors (e.g., improving knowledge of abuse and enhancing the competency of addressing abuse) that will lead to the reduction of elder abuse. Both intermediate and ultimate outcomes need to be considered for a competent narrative for the effectiveness of elder abuse interventions.

Therefore, our systematic review and meta-analysis study aims to examine prevention and intervention studies that targeted ultimate and intermediate outcomes for elder abuse that occurred in community settings. Acknowledging that these two outcome types of elder abuse, though interrelated, reflect distinctive features, we hence examined the pooled effect of all outcomes combined and the respective effect for different outcome types.

MATERIALS AND METHODS

Search Strategy
The identification of relevant studies was performed in two steps. The first step consisted of searching eight academic databases from Jan 1990 to December 2020: Cumulative Index to Nursing and Allied Health (CINAHL), Cochrane Library/ Central Register of Controlled Trials, Database of Abstracts of Reviews of Effects (DARE), PsycINFO, PubMed, MEDLINE, BIOSIS, and Science Direct. Key search terms included "older abuse," "elder abuse," "elder neglect," "elder mistreatment/ maltreatment," or "older neglect" and "physical abuse," or "emotional abuse" or "financial abuse" and "intervention" or "program." To identify the right design of the intervention, search terms included "control group" or "RCT." The set of keywords was used for both study title and study abstract search across databases. Second, the reference lists of studies and systematic reviews identified from the database search were reviewed for additional relevant studies.

Inclusion Criteria
The inclusion criteria for studies published in English are those that (1) assessed the effectiveness of a prevention or intervention program designed to address abuse or neglect of elders aged 65 or older living the community settings, (2) targeted at elders or family members, (3) used randomized controlled trials (RCTs) or controlled trials (without random assignment), (4) reported at least one elder abuse intervention outcome, and (5) reported statistical information sufficient to calculate effect size required for meta-analysis. We did not limit the location of the studies. Outcomes consisted of (1) ultimate outcomes: occurrence or reoccurrence of elder abuse behaviors; and (2) intermediate outcomes: reduction of risk factors for elder abuse, such as reduced stress, improved knowledge of abuse, and enhanced competency of addressing abuse.

Data Collection and Extraction
Three researchers conducted data collection and extraction. Two reviewers (YS and FS) screened titles and abstracts for eligible studies independently with decisions blind to one another. If any disagreement existed, two reviewers would

discuss first and if unresolvable, a third reviewer (AZ) would intervene and make a final decision. The three-person team adopted the same process in later full article review and quality assessment. Inter-screener reliability was 92% and inter-rater reliability of full articles was 85%.

Measures of ultimate outcomes included occurrence or reoccurrence of elder abuse, here termed as behavioral outcomes, and intermediate outcomes (i.e., risk or protective factors for elder abuse) included psychosocial stress, knowledge of elder abuse, and competency of addressing elder abuse.

Basic information extracted from studies consisted of participant demographic characteristics (i.e., age, gender, and ethnicity), geographic areas of the study (i.e., United States, Asia, and Europe), and study design (i.e., RCT and non-randomized controlled trial). Intervention characteristics consisted of intervention type (i.e., family, individual, and mixed), target population (i.e., elders, family caregivers, or both), intervention approach (i.e., education, supportive services, and mixed), and intervention frequency and duration.

Risk of Biases Assessment

Quality of studies was assessed using the Jadad scale (Halpern and Douglas, 2005), also known as the Oxford quality scoring system. Studies' risk of bias was assessed using the Cochrane Collaboration's tool for risk of bias in randomized trials (Alderson et al., 2008). The research team resolved discrepancies and reached a consensus on these ratings. Publication bias was assessed using a funnel plot (visual analysis) and the Vevea and Wood sensitivity weighted function analysis (statistical analysis; Vevea and Woods, 2005). For funnel plot, we plotted independent effect sizes only first and then plotted all effect sizes with some of them are dependent of each other.

Meta-Analytic Procedures

We used the R software for data analysis. Treatment effect sizes were estimated for each individual study to determine treatment clinical effects. For continuous outcomes, the standardized mean difference (SMD) was calculated to obtain Hedges' g statistic (Cooper et al., 2009). For binary outcomes, an odds ratio (OR) was calculated first, followed by taking the log transformation of the odds ratio (i.e., log odds ratio). The log OR statistic was further transformed into the same effect size metric as the Hedges' g statistic using procedures suggested by Cooper et al. (2009). The Hedges' g was further bias corrected using a J function (Cooper et al., 2009) to obtain an unbiased estimation of the treatment effect, noted as d for the rest of the text. When meta-analyzing the effect size estimates, we used the inverse variance weight, which is considered as an optimal weight estimate in meta-analysis (Marín-Martínez and Sánchez-Meca, 2010).

Between-study and between-effect size, heterogeneity was assessed using multilevel modeling with R's *metafor* package (Viechtbauer, 2010). A pooled overall treatment effect and potential moderator analyses were achieved through meta-regression with robust variance estimation (RVE) using R's *robumeta* package (Tanner-Smith et al., 2016). The intercept only in the meta-regression model offered overall averages of treatment effect sizes across studies; and models with covariates allowed the identification of effects of potential moderators on treatment effect sizes. Meta-regression using the RVE method effectively handles the statistical dependence created by one study reporting multiple effect size estimates on the same outcome (Hedges et al., 2010). For example, a study may use more than one measure to evaluate a provider's knowledge of elder abuse, resulting in the two knowledge measures within the same study being potentially dependent on each other (see **Table 1**, outcome measures). The RVE approach not only effectively addresses the dependent issues but also produces robust estimation regardless of the heterogeneity assumption, meaning results robust across fixed- and random-effects models (Hedges et al., 2010). Given the small number of studies included in this review, we also conducted a small sample size correction to the meta-regression analysis, and for an estimate with degrees of freedom greater than 4, $p < 0.05$ is considered statistically significant. For an estimate with degrees of freedom lower than 4, $p < 0.01$ is considered statistically significant. Sensitivity analyses were conducted by averaging dependent effect sizes within each study. Because both methods produced the same statistical inference, we reported the RVE results in this paper (Tipton, 2015).

RESULTS

Search Results

The review process is summarized in **Figure 1**. A total of 2,986 studies were identified through a comprehensive search strategy for interventions to prevent or stop elder abuse in the community or an institutional setting. After 1,578 duplicate studies were removed, 1,255 studies were further excluded based on a title and abstract review. Of the remaining 153 studies, 147 studies were excluded for reasons, such as single arm trial without a control group or without statistical data, resulting in an analytical sample of six studies, containing 51 effect size estimates, in the final meta-analysis.

Characteristics of Included Studies

Study characteristics are presented in **Table 1**. Of the six primary studies, four studies (67%) were published after 2010 and one (17%) was published in the 1990s. The six studies included a total sample of 1,305 participants. Participants' ages averaged at 64.65 ($SD = 4.15$), and 64.52% were female ($SD = 17.13$). Four studies (66.7%) included at least one intermediate outcome measure and four studies (66.7%) included at least one ultimate outcome on elder abuse. Specifically, three studies included psychosocial stress outcomes, four studies encompassed outcomes related to knowledge and competency, and four studies addressed ultimate abuse-related behavioral outcomes.

Most interventions in reviewed studies were delivered in a family format ($n = 3$, 50%), which lasted on average over 10 months ($SD = 7.55$, range = 3–18 months). Two individual-based interventions (33.3%) were on average 21 months in

TABLE 1 | Study characteristics of six included studies.

Author	Geo.	Setting	Design	Demographics	Sample size (baseline)	Intervention target	Intervention type and approach	Intervention duration	Outcome measures
Filinson (1993)*	United States	Community based	CT	Older adults 73.4 years old 81% female	Eighty-four elders and their caregivers T = 42; C = 42	Older adults and their families	Elderly Abuse Support Project	Eightteen-month period	Social isolation; accessing service; legal action
Davis et al. (2001)	United States	Community based	RCT	Older adults 65 years old (median) 81% female	Four hundred and three elders T = 202, C = 201	Older adults	Public education and home visit	six months follow-up 12 months follow-up	CTS
Rabiei et al. (2013)	Iran	Community based	CT	Older adults 67.9 years old 51.6% female	Sixty-four elders and their families T = 32, C = 32	Older adults and their families	Family-based empowerment education	Ten forty-five-min sessions, 3-month period	Self-efficacy; self-esteem; perceived threat
Khanlary et al. (2016)	Iran	Community based	RCT	Older adults 65 years old 14.8% female	Thirty elders and their families T = 15, C = 15	Older adults and their families	FBCBSW	Five forty-five-min sessions	DEAQ
Cooper et al. (2016)*	UK	Community based	RCT	Caregivers: 58.2 years old 68.5% female Older adults: 79.0 years old 58.5% female	Two hundred and sixty caregivers T = 173; C = 87	Family caregivers	A psychological intervention START	Eight-session, short term (4 and 8 month) and long term (12 and 24 months)	MCTS
Estebsari et al. (2018)*	Tehran.	Community based	RCT	Older adults 65.9 years old 50% female	Four hundred and sixty-four older adults T = 232, C = 232	Older adults	An empowerment educational intervention to prevent elder abuse.	Twenty 45-to-60-min training sessions over 6-month, 18-month period	Elder abuse knowledge questionnaire; SCARED questionnaire

CTS, Conflict Tactics Scale; FBCBSW, Family-Based Cognitive Behavioral Social Work; DEAQ, Domestic Elder Abuse Questionnaire; START, STrAtegies for RelaTives; MCTS, Modified Conflict Tactic Scale; SCARED, Stress level, Coping, Argument, Resources, Events, and Dependence. *Indicates effect sizes were estimated through transformation of odds ratio.

duration (SD = 4.24, range = 18–24 months) across studies. Three studies directed at both older adults and family members, two studies targeted older adults and one study targeted family members. Two interventions adopted an education approach, three used supportive services, and one incorporated both educational and supportive service interventions. Study sites covered Europe (n = 2, 33.3%), the United States (n = 2, 33.3%), and Asia (n = 2, 33.3%).

Quality Assessment of Included Studies and Risk of Bias

Both RCT studies (n = 4) and non-randomized controlled trial studies (n = 2) were rated using the Jadad scale (Halpern and Douglas, 2005) for reporting controlled trials and the Cochrane risk of bias assessment tool. Using the Jadad scale (see Supplementary Table 1), the six trials had an average score of 2.8 (SD = 1.17) out of 5, indicating acceptable quality. These studies were rated satisfactory in mentioning randomization (5/6), tracking all participants (6/6), and randomization (4/6). However, these studies done were not satisfactory using appropriate blinding, just two studies mentioned blinding. Using the Cochrane Collaboration's tool for assessing the risk of bias (see Supplementary Table 2), studies were rated most satisfactorily in selective outcome reporting (6/6), random sequence generation (4/6), and handling incomplete outcome data (4/6). Risk of bias was observed in allocation concealment (0/6), blinding of study participants and personnel (0/6), and blinding of outcome data assessment (2/6).

Both visual and statistical examination suggested an absence of publication bias (see **Figure 2**). The funnel plot seemed reasonably symmetric and showed no concerning outliers. The Vevea and Wood sensitivity weighted function analysis further confirmed the absence of publication bias.

Meta-Analysis Results and Subgroup Analyses

Multilevel modeling and the Q statistic used in heterogeneity assessment indicated a significant amount of heterogeneity across both effect size estimates and studies [$Q(50)$ = 5914.3, p < 0.01], suggesting a random-effects model is appropriate. We found an overall positive and statistically significant treatment effect (d = 0.63, 95% CI [0.02, 1.24], p < 0.05).

Effect sizes were found depending on outcomes in subgroup analyses. The overall treatment effect was approaching statistical significance at 0.1 level for ultimate outcomes (d = 0.32, 95% CI [−0.1, 0.73], p = 0.09) and intermediate outcomes (d = 0.75, 95% CI [−0.27, 1.77], p = 0.10). More specifically for intermediate outcomes, effect size for psychosocial stress outcomes was 0.57 (95% CI [−0.29, 1.44], p = 0.1), and for knowledge and competency outcomes (d = 0.66, 95% CI [−0.42, 1.75], p = 0.15).

In terms of intervention characteristics, we found that significant effect sizes across intervention type and target population. An overall significant effect size was found among family-based interventions (d = 0.59, 95% CI [0.18, 1.01],

FIGURE 1 | PRISMA chart of literature search.
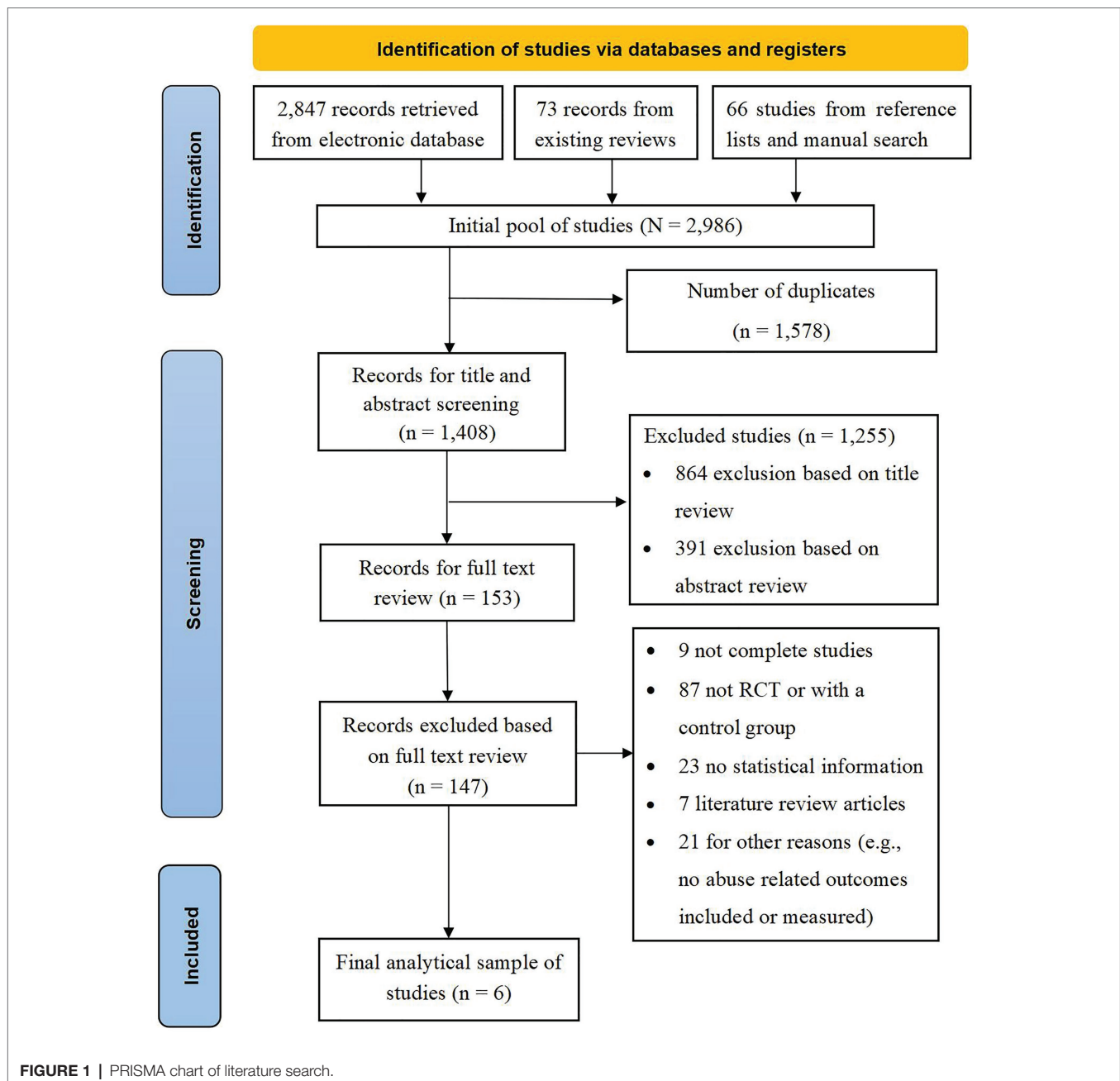
$p < 0.05$), but not among individual-based interventions ($d = 0.86$, 95% CI [−9.08, 1.8], $p = 0.47$). In terms of targeted populations, an overall statistically significant treatment effect was observed among interventions targeting both entities (e.g., older adults and their family caregivers; $d = 0.45$, 95% CI [0.01, 0.89], $p < 0.05$), but not among those targeting sole older adults or family caregivers.

Subgroup analyses using other study characteristics failed to show significance. Both RCT and non-randomized controlled trial studies reported non statistically significant treatment effect size ($d = 0.67$, 95% CI [−0.51, 1.85], $p = 0.17$) and ($d = 0.54$, 95% CI [−0.3, 1.38], $p = 0.08$) respectively. Subgroup analyses among studies published in the United States, Europe, and

Asia did not yield any significance either. Specific results are presented in **Table 2**.

Moderator Analyses

Results of moderator analyses are presented in **Table 3**. Only two univariate meta-regression models revealed a significant moderator that explains the heterogeneity between studies and effect sizes. Interventions targeting older adults reported significantly greater treatment effects than those targeting caregivers, or both. Intervention using a family centered approach had a greater treatment effect than the intervention delivered using a mixed format which included group and individual interventions.

DISCUSSION

Our major finding identified a statistically significant effect size ($d = 0.63$) of psychosocial interventions for elder abuse, suggesting that the effectiveness of available elder abuse prevention and interventions are moderately supported by evidence. Addressing elder abuse needs a multisystem effort that targets various change agents (e.g., elders, family, and caregivers) and along with multiple domains such as abuse awareness, knowledge, and behaviors (World Health Organization, 2002). Although the overall effect size sounds promising, the findings from the subgroup analyses shed further light on the effectiveness regarding different intervention outcomes and provided specific directions for future research.

The treatment effect for intermediate outcomes ($d = 0.75$, $p = 0.1$) and for the ultimate outcomes ($d = 0.19$, $p = 0.09$) approached significance at 0.1 level. Because of the small power due to a limited number of articles included in the meta-analysis, these findings, though should be interpreted with caution, appear encouraging and promising. Intermediate outcomes can be viewed as mediators which bring about elder abuse reduction. Interventions reviewed in this study leaned toward an effective impact on intermediate outcomes, such as psychosocial stress, knowledge, and competency. This finding corresponds to a conclusion based upon an earlier Cochrane review of interventions for abuse prevention (Baker et al., 2016). As abuse-related knowledge outcomes are often treated as intermediate outcomes, research needs to improve their knowledge-related outcome measures to capture notable changes in abuse awareness and attitude, along with their impact on the occurrence of elder abuse. Moreover, research should not stop arriving at satisfactory intermediate outcomes, but rather continue to disclose the pathway between changes in psychosocial stress and abuse reduction.

Effect size is significant among interventions that were family-based, geared toward elders, and family members, and adopted multiple approaches (e.g., combining education and services). The effectiveness of family-based interventions suggests the change of family dynamics can mitigate abuse. Consistently, an overall statistically significant treatment effect was observed among interventions targeting both elders and family members. As we had a limited number of interventions solely on elders or caregivers, we could not speculate the effect size for each respective group. Elder abuse mostly occurs in family settings, where perpetrators are most family members. Thus, targeting family issues through mitigating risk factors on both sides, potential victims and perpetrators, are likely to yield ideal outcomes (Dong, 2015).

The use of various intervention approaches (e.g., education and supportive services) appeared to be effective, as mixed approach interventions showed an overall significant treatment effect. As there are multiple risks for elder abuse, intervention using mixed approaches can be more effective than interventions using one approach. Future interventions need to incorporate education, support, and services to assist older victims. Enhancing one's awareness of elder abuse through education is important to the prevention of abuse; however, information itself is far from sufficient to trigger changes in attitude and behavior. Often, elders vulnerable to abuse or have been abused are likely to have other pressing social, health, financial, and legal needs. Similarly, mixed approaches better serve family caregivers who need tangible support to help manage challenging care tasks and emotional support for stress and burden.

Several limitations are inherent to systematic review and meta-analysis studies that should be noted. First, chances could be that one or more studies were missed in our search.

The total number of studies included was small, and a limited sample in subgroup analyses may have failed to show significance due to insufficient power. The small sample size, i.e., a small number of included studies, also prevented us from conducting certain subgroup analyses such as an overall treatment effect for interventions targeting different target population.
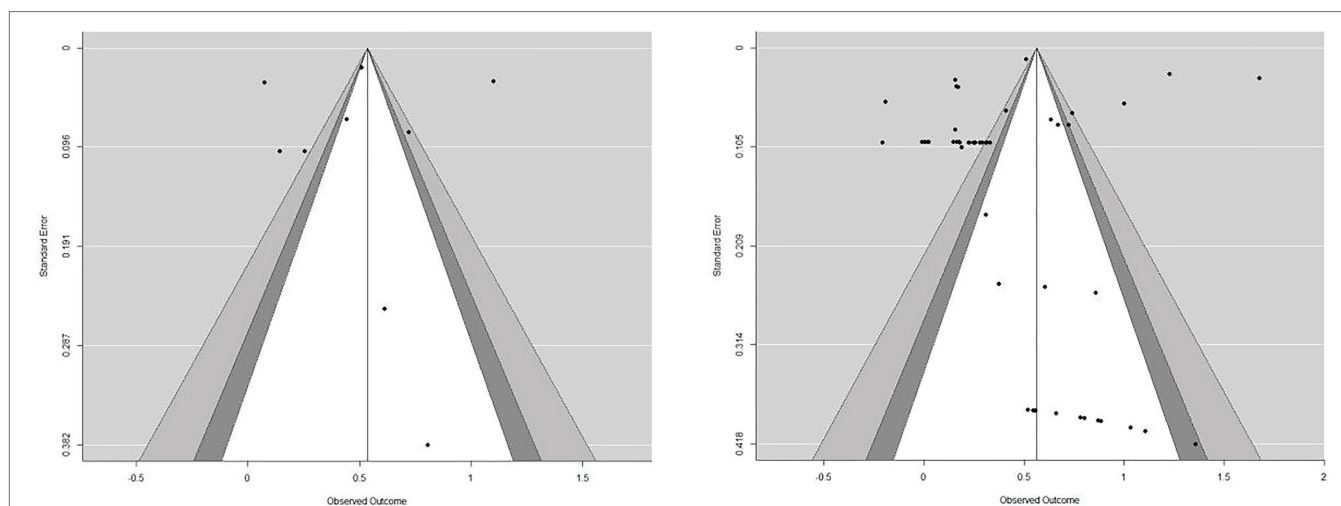
FIGURE 2 | Funnel plot for publication bias. We plotted independent effect sizes ($n = 9$ from 6 studies) in the left plot and plotted all effect sizes (some dependent of each other) in the right plot.

TABLE 2 | Overall and sub-group meta-analysis.[†]

	Estimate	t (df)	K/N	95% CI	p
Overall treatment effect	0.63	2.64 (4.99)	6/51	[0.02, 1.24]	p < 0.05
Outcome type I					
Intermediate outcomes	0.75	2.33(3)	4/25	[−0.27, 1.77]	p = 0.10
Ultimate outcomes	0.32	2.59 (2.69)	4/26	[−0.1, 0.73]	p = 0.09
Outcome type II					
Psychosocial stress	0.57	2.99(1.91)	3/8	[−0.29, 1.44]	p = 0.10
Knowledge and competency	0.66	1.94(3)	4/17	[−0.42, 1.75]	p = 0.15
Behavior outcomes	0.32	2.59 (2.69)	4/26	[−0.1, 0.73]	p = 0.09
Intervention type					
Family	0.59	6.68(1.84)	3/23	[0.18, 1.01]	p < 0.05
Individual	0.86	1.09 (1)	2/9	[−9.08, 1.8]	p = 0.47
Mixed	--	--	1/19	--	--
Target population					
Mixed population	0.45	3.52(2.65)	4/42	[0.01, 0.89]	p < 0.05
Older adults[††]	--	--	1/5	--	--
Caregivers[††]	--	--	1/4	--	--
Intervention approach					
Education	1.13	2.2 (1)	2/8	[−5.39, 7.65]	p = 0.27
Support	0.39	1.97 (1.85)	3/24	[−0.53, 1.30]	p = 0.20
Mixed approaches	--	--	1/19	--	--
Intervention design					
Randomized controlled trials	0.67	1.8 (2.99)	4/40	[−0.51,1.85]	p = 0.17
Non-randomized controlled trials	0.54	8.11 (1)	2/11	[−0.3, 1.38]	p = 0.08
Study location					
United States	0.33	2.14 (1)	2/27	[−1.61, 2.26]	p = 0.28
Europe	0.86	1.09(1)	2/9	[−9.08, 1.8]	p = 0.47
Asia	0.67	7.53 (1)	2/15	[−0.46, 1.8]	p = 0.08

K, number of studies; N, number of effect size estimates.
[†]If df < 4, coefficient significance should be interpreted with caution.
[††]Coefficient cannot be estimated because only 1 study falls under this category.

Future studies should consider these analyses when more studies become available. Second, while two coders independently coded all studies and a team of experienced researchers resolved any disagreements, the results of this study are still subject to human errors. Third, as we used an advanced method to synthesize effect size estimates across outcomes, individual outcome contains distinctiveness in conceptualization. In the subgroup outcome analyses, some outcomes may suffer from a small sample size. As a result, we were unable to identify if the non-significant findings were due to low power. The same issue may exist in the moderator analyses, which prevented us from drawing any definitive conclusions. Fourth, as we focused on our search for psychological interventions, we did not include legal or policy interventions. As this area may play a role in elder abuse, these should be considered in future studies. Furthermore, research with a larger number of studies included will help explain the variations across effect sizes and studies.

CONCLUSION

This study represents an initial effort to examine the pooled effect of elder abuse preventions and interventions *via* meta-analyses. Existing evidence is supportive of a modest effect

(approaching significance at 0.1 level) of psychosocial interventions for elder abuse. Evidence appears promising for interventions on modifiable intermediate outcomes such as psychosocial stress, knowledge, and competency that are typically theorized to lead to changes in elder abuse occurrence, as well as interventions targeting ultimate outcomes (i.e., abuse reduction). Interventions that used a family-based model, combined education and supportive services, and targeted both caregivers and elders, showed significant effect size, suggesting such features incorporated in elder abuse intervention design. Yet, more research evidence is still needed, in particular, research that will shed further light on the link between intervention activities and changes in elder abuse behaviors.

Community-based approach that draws on the concerted efforts from multiple stakeholders (e.g., elders, families, and service professionals) and tackles multi-domain elder abuse risk factors (e.g., knowledge, competency, and support) is worth pursuing (Dong, 2015). Geriatric health and social care providers as well public health workers in the field of aging should be updated on the status of currently available interventions, adapt evidenced-informed interventions, and account for the heterogeneity of factors at the individual, agency, and cultural levels when promoting a safe and free of abuse environment for older adults.

TABLE 3 | Single-predictor meta-regression analysis.

	Estimate	t (df)	K/N	95% CI	p
Outcome type I (ref: intermediate outcomes) b_0	0.83	2.07 (2.46)	6/51	[−0.62, 2.28]	$p = 0.15$
Ultimate b_1	−0.42	−0.94 (4.40)	6/51	[−1.62, 0.78]	$p = 0.39$
Outcome type (ref: psychosocial stress) b_0	0.58	2.37 (1.68)	6/51	[−0.68, 1.83]	$p = 0.17$
Knowledge and competency b_1	0.34	0.65 (2.16)	6/51	[−1.79, 2.48]	$p = 0.58$
Behavior b_2	−0.17	−0.53 (2.41)	6/51	[−1.31, 0.98]	$p = 0.64$
Intervention type (ref: Family) b_0	0.63	6.67 (2.00)	6/51	[−0.22, 1.03]	$p = 0.02$
Individual b_1	−0.23	0.29 (2.32)	6/51	[−2.75, 3.21]	$p = 0.80$
Mixed b_2	−0.45	−4.83 (2.00)	6/51	[−0.86, −0.05]	$p = 0.04^*$
Target population (ref: older adults) b_0	1.64	2e + 16 (3.79)	6/51	[1.64, 1.64]	$p = 0.00$
Caregiver b_1	−1.56	inf (4.53)	6/51	[−1.56, −1.56]	$p = 0.00^*$
Mixed b_2	−1.13	−8.54 (2.98)	6/51	[−1.55, −0.71]	$p = 0.00^*$
Intervention approach (ref: education) b_0	1.14	2.22 (1.00)	6/51	[−5.38, 7.65]	$p = 0.27$
Support b_1	−0.70	−1.27 (2.29)	6/51	[−2.82, 1.42]	$p = 0.32$
Mixed b_2	−0.97	−1.88 (1.00)	6/51	[−7.48, 5.55]	$p = 0.31$
Type of design (ref: RCT) b_0	0.67	1.80 (2.99)	6/51	[−0.52, 1.85]	$p = 0.17$
Non-RCT b_2	−0.13	−0.33 (2.08)	6/51	[−1.69, 1.44]	$p = 0.77$
Study location (ref: United States) b_0	0.33	2.13 (1)	6/51	[−1.61, 2.26]	$p = 0.28$
Europe b_1	0.53	0.67 (2)	6/51	[−2.90, 3.96]	$p = 0.57$
Asia b_2	0.38	2.10 (2)	6/51	[−0.40, 1.16]	$p = 0.17$

K, number of studies; N, number of effect sizes. *If df < 4, coefficient significance should be interpreted with caution. Although presented in the same table, predictors were entered one-by-one individually to the model. "inf" denotes the number is infinitely large.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

AUTHOR CONTRIBUTIONS

YS screened and coded all studies, drafted the entire manuscript. FS screened and coded all studies, drafted the discussion section of the manuscript, and proofread the entire manuscript. AZ designed the search strategy, resolved conflict, conducted preliminary analysis, drafted the entire manuscript, and proofread the entire manuscript. KW conducted all the meta-analysis and led the writing of the method and result section and proofread the entire manuscript. All authors contributed to the article and approved the submitted version.

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Individual-Level Interventions for Decreasing Job-Related Stress and Enhancing Coping Strategies Among Nurses: A Systematic Review

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Background: Nurses are facing unprecedented amounts of pressure because of the ongoing global health challenges. Improving nurses' resilience to job-related stress and enhancing their strategies to cope effectively with stressors are key issues facing many health care institutions during the COVID-19 pandemic. This literature review aimed to: a) provide a thorough overview of individual-level interventions for stress management among nurses, b) identify measurement tools utilized to evaluate nurses' stress level, and c) provide the best evidence-based recommendations for future research and practice adapted to the current restrictions.

Design: Systematic review.

Data Sources: Studies published between January 2000 and October 2020 were retrieved from the following sources: EBSCOhost, Dortmund University Library, PubMed, Medline, Google Scholar, *Applied Nursing Research*, and reference lists from relevant articles.

Review methods: Individual-level interventions with a control group or a placebo intervention were included in the final sample. Primary outcome was defined as a change in individual stress level or stress symptoms which were measured by objective or subjective instruments with evidence of validity. Articles published in English or German were included in the present review.

Results: In total, 27 relevant studies were included into the current review. There are some indications that technology-delivered interventions with relaxation and stress management interventions comprising cognitive-behavioral components might be effective in decreasing stress among nurses and improving their well-being. Furthermore, although there were some attempts to collect objectively measured parameters for assessing the primary outcome of stress, the majority of the interventions utilized self-reported stress scales.

Conclusion: A wide range of interventions are available for nurses. However, it is of utmost importance to develop and implement stress management programs that are conveniently accessible in the workplace and above all, meet the current restrictions for minimizing human contacts. To this end, innovative interventions delivered through

digital technology, such as virtual reality, seem to be a promising solution for combating the detrimental impact of stress on nurses. Special attention should be also paid to applying standardized objective measurement tools to allow the assessment of sensitive physiological indices and the generalizability of scientific knowledge.

INTRODUCTION

Nowadays, nurses are facing unprecedented amounts of pressure not only due to the growing global health demands but also the current COVID-19 pandemic. The rapid spread of the virus during the last year has placed a huge burden on many health care systems scrambling to cover the needs for intensive care unit beds, personal protective equipment for both health care professionals and patients, and offer high-quality health services to their end-users (Arnetz et al., 2020). The current pandemic outbreak can be considered as a stressor that has significantly affected nurses' mental health. According to stress literature, when the existence of an organism is threatened by exposure to either a physiological or a psychological stressor, the system reacts to the stressful situation in a generalized, complex fashion (Matousek et al., 2010). The transactional model of stress postulates that one's perception of a stressor will depend on the degree to which an individual assesses this stressor as meaningful and relevant to them in a given context (Lazarus and Folkman, 1984). Further, meaningfulness will shape the strength of one's reaction to the event. On physiological level, stress triggers an initial activation of the sympathetic nervous and adrenomedullary systems resulting in increases in cardiac activity (Zhang et al., 2018). Furthermore, activation of the hypothalamus-pituitary-adrenal (HPA) axis provokes endocrine and immune changes leading to the release of cortisol and cytokines in an effort to re-establish body balance (Matousek et al., 2010). Stress research has showed that stressful events at the workplace can cause high physiological and psychological workload which can lead, in turn, to serious health problems and burnout [Lazarus and Folkman, 1984; Eatough et al., 2011; Velana and Rinkenauer (in press)].

In stressful occupations, such as nursing, the experience of stress deriving from lack of social support, heavy workload, conflicts with colleagues and other critical job-related factors is strongly linked with poor health (Tyler and Cushway, 1995). In fact, scientific evidence supports such an association, as stress in nurses can cause health problems and psychosomatic disorders, absenteeism, workplace injuries and errors related to patient care (Shirey, 2006). Moreover, study findings have indicated that nursing profession is associated with high rates of psychiatric outpatient referrals and suicide (Jones, 1987). More recently, in a cross-sectional study among 1257 Chinese health care providers from 34 national hospitals, female nurses, especially those who work in Wuhan, reported more severe symptoms on distress, anxiety and depression as compared to physicians (Lai et al., 2020). Another cross-sectional study that was conducted in

Germany, indicated that nurses reported higher levels of stress and subjective burden as well as lower levels of job satisfaction and experienced support than physicians (Kramer et al., 2020). In a broader context, the present health crisis urges attention on nurses' mental health and on the strategies that should be developed to enhance their well-being and quality of life. Therefore, developing and implementing innovative approaches may be a best practice policy to reduce stress and improve health (Hatcher et al., 2006).

Improving resilience to stress and enhancing nurse's strategies to respond effectively to stressors are key issues facing many health care institutions during the COVID-19 pandemic. Resilience is considered one's ability to recover easily and quickly from adverse circumstances that happen over the course of their life (Zautra et al., 2010). Applying this notion to an organizational environment, resilience to stress implies that, in general, employees can respond in a productive way when encounter significant job-related changes or pressure to reach outcomes (Home and Orr, 1998). In nursing profession, this can be proved particularly challenging, as nurses often have to deal with human suffering, interpersonal difficulties and other job-related issues such as bullying and violence (Jackson et al., 2007), conditions that are associated with high levels of stress and demand adequate personal resources and coping strategies. Hence, enhancing nurses' resources and support may have the potential to develop their capacities to deal with stress and workplace adversities. The last years health care organizations around the globe have developed and implemented various individual-level interventions and strategies to empower employees to tackle setbacks at the workplace. In particular, interest has been growing in highlighting the effects of interventions on stress management and improving nurses' mental health, such as mindfulness, meditation and relaxation techniques (Delgado et al., 2017; Ghawadra et al., 2019). Furthermore, in his study, Cottrell (2001) showed that focused interventions for mental health nurses can enhance work-related factors, such as job satisfaction, and ameliorate stressors at workplace. Another literature review revealed that different stress management programs, such as training in therapeutic skills or in behavioral techniques, may help nurses address stress (Edwards and Burnard, 2003). Nevertheless, the rigor of a number of studies has induced methodological weaknesses related, for example, to measurement tools utilized, study sample size or statistical methods used for the analysis of their results. Although many interventions appear promising to effectively decrease stress and improve well-being among nurses, there is another body of evidence that indicates only moderate or no

intervention effects, and calls for further research in this field (Chesak et al., 2019; Li et al., 2019). In light of the current contact restrictions, it still remains unclear what strategies would be suitable to tackle job-related stress throughout the COVID-19 crisis and the era after it.

Since nurses experience high levels of stress at the workplace, it is of vital importance to review and systematically evaluate the studies that utilized various individual-level strategies as a method to reduce their stress. Therefore, the present literature review aims to address the following issues: (a) to provide a thorough overview of the stress management interventions targeted at helping nurses develop skills to cope effectively with stress, (b) to identify measurement tools utilized to evaluate nurses' stress level (i.e., subjective and objectively measured parameters), and (c) to provide future research and practice with fruitful evidence-based directions adapted to the current restrictions.

METHODS

Search Strategies

In an effort to examine the current state of the science regarding individual-level interventions for reducing job-related stress in nurses, studies published between January 2000 and October 2020 were retrieved from the following sources: EBSCOhost, Dortmund University Library, PubMed, Medline, Google Scholar, *Applied Nursing Research*, and reference lists from relevant articles. Although job-related stress in nurses and their coping strategies has drawn researchers' attention for over 30 years (e.g., Jones, 1987; Tyler and Cushway, 1995), the authors decided to focus on the advances of the last two decades so that they would provide the readers with a thorough insight about the topic and at the same time, suggest up-to-date directions for future studies that would align with the present global challenges. Specific search strategies were developed for each database to identify relevant interventions for this literature review. The present literature search was performed utilizing the following key terms: nurses, stress reduction interventions, stress management programs, (workplace) mental health interventions, job stress and coping strategies, in various combinations. Particularly, the following keyword combinations were applied: nurses AND stress reduction interventions, nurses AND stress management programs AND job stress, nurses AND mental health interventions AND job stress AND coping strategies, nurses AND workplace mental health interventions AND job stress. Special attention was paid to the differences among the databases in regard to vocabulary and syntax rules. The search was performed in November 2020.

The review protocol included two main steps: the first step involved reviewing of databases, while the second step consisted of identifying and screening all relevant papers according to inclusion and exclusion criteria. In order to ensure consistency and rigor, the guideline of "The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)" was utilized (Moher et al., 2009).

Inclusion Criteria

According to research literature, nurses are more likely to experience higher levels of job-related stress compared to other hospital employees and health professionals (Moustaka and Constantinidis, 2010; Golshiri et al., 2012; Kramer et al., 2020). Although stressful events and emergency situations seem to be common phenomena for hospital employees, nurses are prone to stress because of the psychological, physical and social attributes embedded in their occupational sector (Moustaka and Constantinidis, 2010). Building on this notion, only empirical research articles that focused on nurses who work in health care facilities, aiming at stress reduction were included in the final sample. Furthermore, two individual-level interventions should have been compared to each other, or an individual-level intervention should have been be compared to a control or placebo group in a prospective way. For instance, randomized controlled studies with or without random assignment, studies with quasi-experimental design and pre-posttest design studies with control group and/or placebo cohort were considered for further evaluation. Studies were also considered for further analysis, if the components of the stress management intervention, such as methods, frequency and duration of the intervention, were clearly described. Primary outcome was defined as a change in individual stress level or stress symptoms which were measured by objective or subjective instruments with evidence of validity. Secondary outcomes could be, but not limited to: burnout, depression, anxiety, quality of life, job satisfaction, etc. Articles published in English or German were included in the present review.

Exclusion Criteria

Interventions that focused not only on nurses (e.g., nursing students, nurse aids) or studies that included other health care professionals were excluded from this review. Other exclusion criteria were pure qualitative studies, one group pre-post designs, studies aiming at organization level changes and articles published earlier than 2000.

Data Extraction

Data were extracted and formatted based on the review aim utilizing a pre-defined data extraction worksheet in Excel. **Table 1** summarizes all relevant characteristics of identified studies. Particularly, the headings include: (1) study characteristics (author, year of publication, place of study, sample size and setting), and (2) intervention characteristics (design, duration and components, measurement tools, follow-up, and main findings). This process was checked by the two review authors.

RESULTS

Search Outcome

Based on inclusion and exclusion criteria, first the two review authors independently screened the titles and abstracts of all relevant articles. Next, full-text versions of all potentially eligible articles were evaluated independently by the two authors to define whether all inclusion criteria were met. External experts would be consulted to achieve a consensus in case

TABLE 1 | Summary of articles included in the current literature review.

Author (year) and place	Sample size and setting	Design	Duration and components	Measurement tools	Follow-up	Main findings
Alkhawaldeh et al. (2020), Jordan	Total (N = 184): Treatment (n = 92); Control (n = 92); CHCC	Cluster-RCT	2-week SMIP (six 2-hour sessions twice a day) Waitlist control group	NSS Brief COPE Scale	Baseline, after the intervention and follow-up 2 months after the intervention	↓ stress after the intervention and at follow-up (p =0.001) ↑ coping strategies after intervention and at follow-up (p =0.001)
Bahmanzadeh and Haji Alizadeh (2017), Iran	Total (N = 30): Treatment (n = 15); Control (n = 15); Hospital	Quasi-experimental, pretest-posttest study with control	8-week cognitive-behavioral training (75 min/week) Passive control group	DASS WHOQOL-BREF	Baseline and after the intervention	↓ stress and anxiety (p < 0.05) ↑ quality of life (p < 0.05)
Bernburg et al. (2019), Germany	Total (N = 86): Treatment (n = 44); Control (n = 42); Psychiatric hospitals	Randomized controlled pilot study	12-week mental health program (1.5–2 h/week) Waitlist control group	PSQ ERSQ-27 BRCS SWOP-K9 QRI Evaluation form	Baseline and three follow-ups over a period of 36 weeks (after 3 months, T1; after 6 months, T2; after 12 months, T3)	↓ stress at T1 (p < 0.01), T2 (p < 0.01) and T3 (p < 0.01) ↑ for all additional outcomes at T1, T2 and T3 (p < 0.05) ↑ program evaluation
Bernburg et al. (2020), Germany	Total (N = 94): Treatment (n = 47); Control (n = 47); Hospital	RCT	12-week work-related self-care skill training (1.5 h/week) Waitlist control group	PSQ COPSOQ MBI-EE ERSQ-27 Evaluation form	Baseline and three follow-ups over a period of 36 weeks (after 3 months, T1; after 6 months, T2; after 12 months, T3)	↓ stress at T1 (p < 0.001), T2 (p < 0.001) and T3 (p < 0.01) ↑ emotional exhaustion and emotion regulation skills at T1, T2 and T3 (p < 0.05) ↑ job satisfaction at T1 (p = 0.01) ↑ program evaluation
Calder Calisi (2017), USA	Total (N = 46): Treatment (n =24); Control (n =22); General Hospital	Randomized, waitlist control design	8-week RR (45-min session; self-practice 10-20 min twice a day) Waitlist control group	STAI Semantic differential scales	Baseline and after the intervention	↓ anxiety (p = 0.02) and stress (p = 0.003) ↑ confidence in teaching RR (p < 0.001)
Cohen-Katz et al. (2005), USA	Total (N = 27): Treatment (n = 14); Control (n = 13); Academic-community—based Hospital	Pretest-posttest control group design with randomization	8-week MBSR program (2.5 h/week; home-based practice 6 days/week) Waitlist control group	MBI BSI MAAS Evaluation form	Baseline (T1), after the intervention (T2) and 3-month follow-up (T3)	↓ emotional exhaustion (MBI) at T2 and T3 (p < 0.05) ↑ MAAS at T2 (p = 0.004) and T3 (p = 0.002) ↑ program evaluation
Collier et al. (2018), USA and UK	Total (N = 16): Treatment (n = 8); Control (n = 8); Psychiatric inpatient unit (Hospital and Mental Health Services)	Randomized trial	4-week MSET (two 40-min sessions/week) Control group; standard unit lounge	Pulse rate STAI POMS Evaluation form	Before and after each session	↓ pulse rate (p = 0.001), in State scale (p < 0.001) and Trait scale (p = 0.015) ↑ Confusion Bewilderment sub-scale of POMS (p = 0.004) ↑ program evaluation
Ghawadra et al. (2020), Malaysia	Total (N = 249: Treatment (n = 123); Control (n = 126); Teaching hospital	RCT	4-week mindfulness-based intervention (2-hour workshop; self-practice guided by a website) Waitlist control group	DASS-21 JSS MAAS	Baseline, after the intervention and follow-up 8 weeks after the intervention	↓ stress (p < 0.001), anxiety (p = 0.001) and depression (p < 0.001) over time ↑ mindfulness (p < 0.001) over time ↑ job satisfaction (p <0.001)
Gollwitzer et al. (2018), Germany	Total (N = 129): Treatment (MCII, n = 41; IIMCII, n = 41); Control (n = 47); Health institutions	Randomized factorial design	3-week MCII (mental exercise daily) 3-week IIMCII (modified mental exercise daily) Passive control group	PSQ-20 Physical symptoms subscale of BOSS II UWES-9	Baseline and after the intervention	↓ stress in the MCII group compared to the control group (p = 0.019) ↑ work engagement in the MCII group as compared to the IIMCII (p = 0.029) and the control group (p = 0.046)

(Continued)

TABLE 1 | Continued

Author (year) and place	Sample size and setting	Design	Duration and components	Measurement tools	Follow-up	Main findings
Hersch et al. (2016), USA	Total (N = 104): Treatment (n = 52); Control (n = 52); Hospital	RCT	12-week web-based *BREATHE* program (unlimited online access) Waitlist control group	NSS Symptoms of Distress Coping with Stress WLQ Use of Substances for Stress Relief Drinking Quantity and Frequency Understanding Depression and Anxiety Nurses Job Satisfaction Scale	Baseline and after the intervention	↓ stress (p <0.001) and NSS sub-scales (p < 0.05) apart from sub-scale lack of support No effect on additional outcomes
Hsieh et al. (2020), Taiwan	Total (N = 135): Treatment (BT, n = 49; SDBT, n = 47) Control (n = 39); Psychiatric wards	Quasi-experimental study	6-week BT (1 h/week) 6-week SDBT (once a week) Waitlist control group	CES-D OSI-2 RS Physiological parameters (HRV: SDNN, LF, HF; RR) Rehabilitation strength chart Simplified health scale	Baseline and after the intervention	↓ stress (p =0.013) in SDBT group ↑ depressive symptoms (p < 0.001), resilience (p < 0.001), and respiration rate for BT (p < 0.001) and SDBT (p = 0.002)
Hwang and Jo (2019), Korea	Total (N = 60): Treatment (n = 30); Control (n = 30); College hospital	RCT	4-week app-based stress-management program (twice a week for at least 10 min) Waitlist control group	PSS KOSS (PHQ)-9 (GAD)-7 Korean-Emotional Labor scale WHO-5 Well-Being Index Self-efficacy (Likert) scale Evaluation form	Baseline and after the intervention	↓ stress (PSS, p = 0.035; KOSS, p = 0.04) and emotional labor (p = 0.027) ↑ well-being (p = 0.005) and self-efficacy (p = 0.025) ↑ program evaluation
Kurebayashi et al. (2012), Brazil	Total (N = 75): Treatment (Needle group, n = 27; Seed group, n = 26); Control (n = 22); Teaching hospital	RCT	8-week auriculotherapy with needles (eight sessions, 5-10 min/week) 8-week auriculotherapy with seeds (eight sessions, 5-10 min/week) Passive control group	LSS Folkman and Lazarus' Ways of Coping questionnaire	Baseline, after 4 sessions, after 8 sessions and follow-up 15 days after the intervention	↓ stress after 8 sessions (p = 0.020) and at follow-up (p = 0.003) in the needle group ↑ Distancing domain (p = 0.039) and Confrontive Coping domain (p = 0.029) at follow-up in the needle group ↑ Seeking Social Support domain (p = 0.022) after 8 sessions in the seed group
Lary et al. (2019), Iran	Total (N = 70): Treatment (n = 35); Control (n = 35); Teaching hospital	Quasi-experimental study	6-week McNamara educational method (1 h/week) Waitlist Control group	SRI	Baseline, after the intervention and follow-up 8 weeks after the intervention	↓ stress (p = 0.021) over time
Lin et al. (2019), China	Total (N = 90): Treatment (n = 44); Control (n = 46); General hospital	Randomized controlled design	Modified 8-week MBSR program (group sessions 2 h/week and home-based practice 20 min× 6 days/week) Waitlist control group	PSS PANAS CD-RISC MMSS	Baseline, after the intervention (T1), and follow-up 3 months later (T2)	↓ stress and negative affect at T1 (p < 0.01) and T2 (p < 0.05) respectively ↑ positive affect at T1 and T2 (p < 0.05) and resilience at T2 (p < 0.05) No effect on job satisfaction
McElligott et al. (2003), USA	Total (N = 20): Treatment (n = 12); Control (n = 8); University Hospital	Quasi-experimental design	4-week AMMA therapy (1 h/week) Control group; 4-week STTP	Physiologic Parameters (blood pressure, heart rate, pulse oximetry, and skin temperature) VAS Evaluation interview questionnaires	Baseline, before and after each treatment, and at completion of the study	↓ anxiety over time No effect on physiologic parameters ↑ program evaluation

(Continued)

TABLE 1 | Continued

Author (year) and place	Sample size and setting	Design	Duration and components	Measurement tools	Follow-up	Main findings
Moeini et al. (2011), Iran	Total ($N = 58$): Treatment ($n = 29$); Control ($n = 29$); Training hospital	Quasi-experimental study	3-week cognitive-behavioral program based on PRECEDE model (five 60-90 min sessions) Passive control group	NSS Questionnaire based on PRECEDE model Evaluation form	Baseline and follow-up 1.5 months after the intervention	↓ stress ($p < 0.001$) ↑ PRECEDE model constructs and stress management behaviors ($p < 0.001$)
Nazari et al. (2015), Iran	Total ($N = 66$): Treatment (n = 33); Control ($n = 33$); ICUs (Hospital)	RCT	4-week massage therapy (25-min sessions twice a week) Passive control group	OSI	Baseline, after the intervention and follow-up 2 weeks after the intervention	↓ stress ($p < 0.001$) and subscale scores ($p < 0.05$) over time
Niva et al. (2020), India	Total ($N = 30$): Treatment ($n = 15$); Control ($n = 15$); Tertiary care hospital	RCT	Mahamantra chanting intervention for 45 days (20 min/day) Passive control group	Stress biomarkers (Serum cortisol, DHEA-S, SAA) Biochemical parameters (Glucose and lipid profile)	Baseline and follow-up after 2 menstrual cycles after the intervention	↓ serum cortisol ($p = 0.012$), SAA level ($p = 0.04$), glucose ($p = 0.001$), HbA1c ($p = 0.041$), total cholesterol ($p < 0.001$), LDLc ($p < 0.001$) and TGL ($p = 0.17$) ↑ HDLc ($p = 0.033$)
Orly et al. (2012), Israel	Total ($N = 36$): Treatment ($n = 20$); Control ($n = 16$); Hospital	Pre-posttest design study with control	16-week CBI course (4 h/week) and five job-related 3-hour seminars Control group; five job-related 3-hour seminars	SOC PSS POMS	Baseline and after the intervention	↓ stress ($p < 0.05$) and POMS fatigue ($p < 0.05$) ↑ SOC ($p < 0.05$) and POMS vigor ($p < 0.05$)
Palumbo et al. (2012), USA	Total ($N = 14$): Treatment ($n = 7$); Control ($n = 7$); Hospital	RCT	15-week Tai Chi program (group practice 45 min/week and self-practice at least 10 min × 4 days /week) Passive control group	SF-36 Health Survey NSS PSS Sit-and-reach test Isometric knee extensor strength test dynamometer Functional reach test Nordic Musculoskeletal Questionnaire WLQ Work absenteeism	Baseline and after the intervention	No effect on stress ↑ work productivity ($p = 0.03$) and functional reach ($p < 0.01$)
Prado et al. (2018), Brazil	Total ($N = 168$): Treatment (Auriculotherapy, $n = $ 56; Placebo, $n = $ 56); Control ($n = 56$); Hospital	Randomized, single-blind, controlled trial	Auriculotherapy with stress points (12 sessions, twice a week) Sham auriculotherapy with sham points (12 sessions, twice a week) Waitlist control group	LSS	Baseline, after eight sessions, 12 sessions and follow-up 15 days after the end of the applications	↓ stress in the treatment group after eight sessions and at follow-up ($p < 0.001$) ↓stress in the placebo group after 12 sessions ($p < 0.001$) and at follow-up ($p <0.05$)
Singh and Jain (2017), India	Total ($N = 40$): Treatment ($n = 20$); Control ($n = 20$); Hospital	Pre-posttest design with control	Self-help intervention (four 30-min sessions with an interval of 10 days) Passive control group	Psychosocial Stress Questionnaire Occupational Stress Index	Baseline and after the intervention	↓ occupational stress and in psychosocial stress ($p < 0.01$)
Villani et al. (2013), Italy	Total ($N = 30$): Treatment ($n = 15$); Control ($n = 15$); Oncology hospital	Between-subjects design	4-week M-SIT (15-min sessions twice a week) Control group; neutral stimuli (15-min sessions twice a week)	MSP STAI COPE-4 JCQ	Baseline, before and after each session, after the intervention	↑ state anxiety ($p < 0.001$), trait anxiety ($p = 0.041$) and coping skills acquisition ($p < 0.05$)

(Continued)

TABLE 1 | Continued

Author (year) and place	Sample size and setting	Design	Duration and components	Measurement tools	Follow-up	Main findings
Walker (2006), USA	Total (N = 98): Treatment (n = 58); Control (n = 40); Hospital	Quasi-experimental design	4-week HRTT HeartTouch technique (3-hour educational session; self-practice; 1-hour session 2 weeks after the initial session; final follow-up session) Control group (2-hour educational session; final follow-up session)	PSS SWB DRS Diary HeartTouch questionnaire	Baseline and after the intervention	↓ stress ($p < 0.001$), and ↑ hardiness ($p < 0.001$) and spiritual well-being ($p < 0.05$) in the treatment group ↓ stress ($p < 0.001$) and ↑ hardiness ($p < 0.05$) in the control group
Wang et al. (2017), Taiwan	Total (N = 78): Treatment (MBSR, n = 35; Humanities class, n = 35); Control (n = 12); Hospital	Quasi-experimental design	8-week MBSR intervention (3 h/week) 8-week humanities class (3 h/week) Passive control group	FFMQ NSC	Baseline (T0), after 1st month of MBSR (T1), after the intervention (T2), at 3rd month (T3) and 6th month (T4)	↑ mindfulness ($p = 0.031$) in the MBSR group
Yang et al. (2018), China	Total (N = 100): Treatment (n = 50); Control (n = 50); Psychiatric departments	Pre-posttest design with control	8-week MBSR therapy (once a week; either group training or home-based practice) Control group; routine psychological support	SCL-90 SDS SAS NSS	Baseline and after the intervention	↓ stress, anxiety and depression scores ($p < 0.001$) ↑ mental health ($p < 0.001$)

↓ decrease, ↑ improvement or positive. AMMA therapy, a healing art of therapeutic massage; BOSS II, Burnout Screening Scales II inventory; Brief COPE Scale, Brief Coping Orientations for Experienced Problems Scale; BRCS, Brief Resilient Coping Scale; BREATHE, Stress Management for Nurses program; BSI, Brief Symptom Inventory; BT, biofeedback training; CBI, cognitive-behavioral intervention; CD-RISC, Connor–Davidson Resilience Scale; CES-D, Center for Epidemiological Studies Depression; CHCC, Comprehensive Health Care Centers; COPE, Brief Coping Orientation to Problems Experienced questionnaire; COPSOQ, Copenhagen Psychosocial Questionnaire; DASS, Depression, Anxiety and Stress Scale; DHEA-S, sulphated metabolite of dehydroxyepiandrosterone; DRS, Dispositional Resilience Scale; ERSQ-27, Emotion Regulation Skills Questionnaire; FFMQ, five facet mindfulness questionnaire; GAD-7, Generalized Anxiety Disorder; HbA1c, glycated hemoglobin; HDLc, high density lipoprotein cholesterol; HF, high frequency; HRTT, HeartTouch technique; HRV, heart rate variability; IIMCII, modified strategy of MCII; JCQ, Job Content Questionnaire; JSS, Job Satisfaction Scale for Nurses; KOSS, Korean Occupational Stress Scale; LDLc, low density lipoprotein cholesterol; LF, low frequency; LSS, Stress Symptom List; MAAS, Mindfulness Attention Awareness Scale; MBI-EE, emotional exhaustion subscale of the Maslach Burnout Inventory; MBSR, mindfulness-based stress reduction; MCII, mental contrasting with implementation intentions; MMSS, McCloskey/Mueller satisfaction scale; MSET, multisensory environmental therapy; M-SIT, Mobile Stress Inoculation Training; MSP, Mesure du Stress Psychologique; NSC, nurse stress checklist; NSS, Nursing Stress Scale; OSI, Occupational Stress Inventory; OSI-2, Occupational Stress Indicator; PANAS, positive and negative affect schedule; PHNs, public health nurses; PHQ-9, Patient Health Questionnaire; POMS, Profile of Mood States; PRECEDE, predisposing, reinforcing and enabling factors; PSQ, Perceived Stress Questionnaire; PSQ-20, Perceived Stress Questionnaire-20; PSS, Perceived Stress Scale; QRI, German Quality of Relationship Inventory; RCT, Randomized controlled trial; RR, Relaxation Response; RR, respiration rate; RS, Resilience Scale; SAA, salivary alpha amylase; SAD, stress, anxiety or depression; SAS, Self-rating anxiety scale; SCL-90, Symptom Checklist-90; SDBT, smartphone-delivered biofeedback training; SDNN, standard deviation of normal to normal; SDS, Self-rating depression scale; SMIP, stress management interventional program; SOC, Sense of Coherence; SRI, Stress Response Inventory; STAI, State Trait Anxiety Inventory; STTP, Standardized Touch Therapy Protocol; SWB, Spiritual Well-Being Scale; SWOP-K9, Self-Efficacy, Optimism and Pessimism questionnaire; TGL, triglycerides; UWES-9, Utrecht Work Engagement Scale; VAS, Visual Analog Scale; WHOQOL-BREF, World Health Organization Quality-of-Life Scale; WLQ, Work Limitations Questionnaire.

of disagreement. However, this was not the case for the current review.

In total, records 5,931 were retrieved. Additionally, three studies were identified from the reference lists of previously published literature reviews (Chesak et al., 2019; Ghawadra et al., 2019; Bakker et al., 2020). 5,892 records were left for screening after removing duplicates. Next, titles and abstracts were assessed and 5,833 were excluded, leaving 59 potentially relevant articles. Screening of the full-text articles indicated that 32 did not fulfill the inclusion criteria, leaving 27 studies for this literature review. **Figure 1** tracks the selection process of the relevant studies

utilizing a modified version of the PRISMA flow diagram (Moher et al., 2009).

STUDY CHARACTERISTICS

Place of Study

Four of these studies were carried out in European countries, and the other studies were from different countries: Brazil (n = 2), China (n = 2), India (n = 2), Iran (n = 4), Israel (n = 1), Jordan (n = 1), Korea (n = 1), Malaysia (n = 1), Taiwan (n = 2), USA (n =

FIGURE 1 | Search strategy for the inclusion and exclusion of articles based on a modified version of PRISMA flow diagram (Moher et al., 2009).
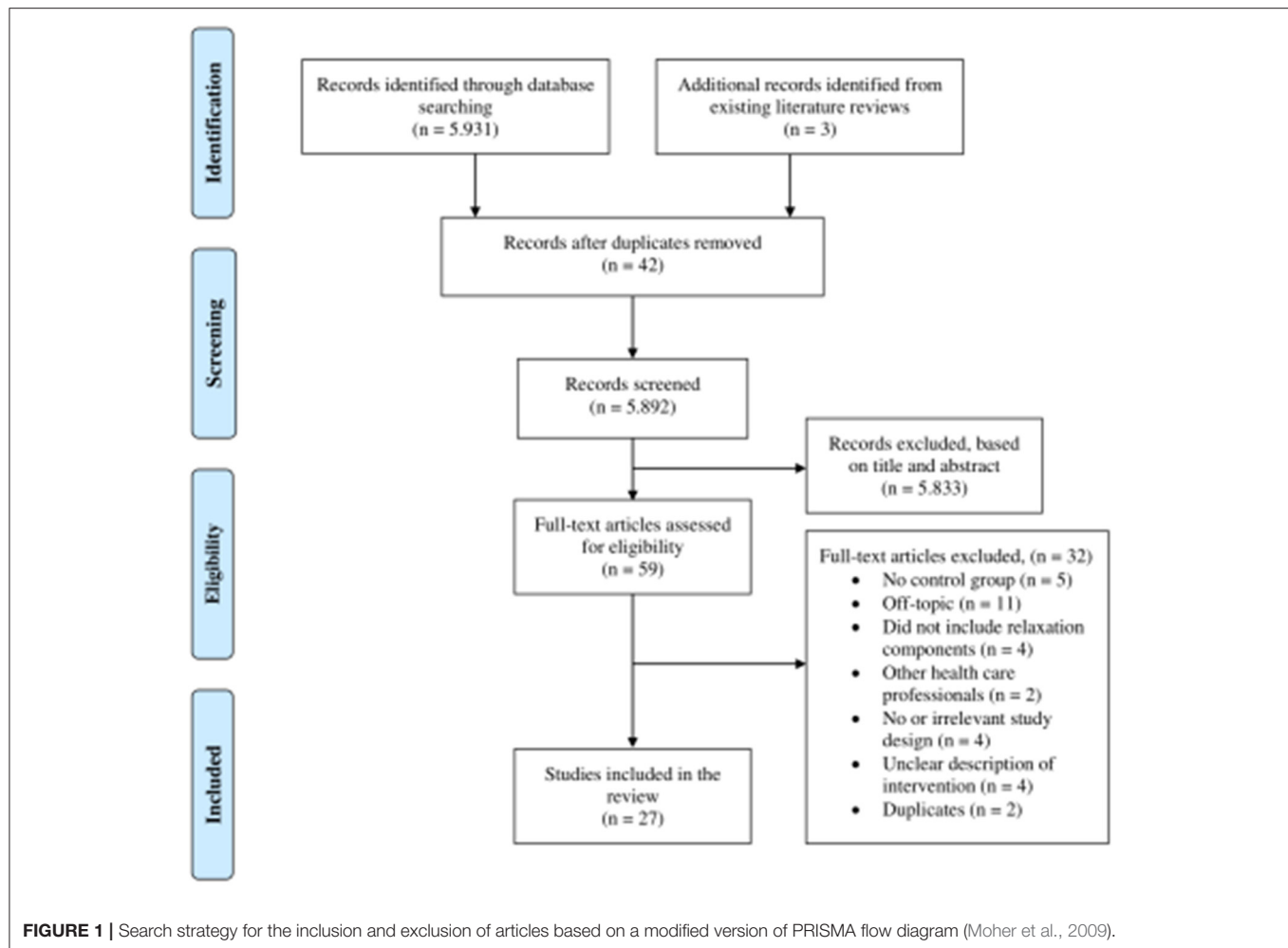
6). Furthermore, one study took place in health care institutions based in two different countries, namely the USA and the UK.

Sample Size and Setting

The sample size of the included studies varied widely, from 14 participants (Palumbo et al., 2012) to 249 participants (Ghawadra et al., 2020). Participant work settings included hospitals (McElligott et al., 2003; Cohen-Katz et al., 2005; Walker, 2006; Moeini et al., 2011; Kurebayashi et al., 2012; Orly et al., 2012; Palumbo et al., 2012; Villani et al., 2013; Hersch et al., 2016; Bahmanzadeh and Haji Alizadeh, 2017; Calder Calisi, 2017; Singh and Jain, 2017; Wang et al., 2017; Prado et al., 2018; Hwang and Jo, 2019; Lary et al., 2019; Lin et al., 2019; Bernburg et al., 2020; Ghawadra et al., 2020; Niva et al., 2020), settings that focus on mental health (Collier et al., 2018; Yang et al., 2018; Bernburg et al., 2019; Hsieh et al., 2020), intensive care units (Nazari et al., 2015), and health care institutions with different organizational and hierarchical structures (Gollwitzer et al., 2018; Alkhawaldeh et al., 2020).

INTERVENTION CHARACTERISTICS

Design

Fifteen studies used a randomized controlled trial to study the effects of the treatment on nurses' stress level (Kurebayashi et al., 2012; Palumbo et al., 2012; Nazari et al., 2015; Hersch et al., 2016; Calder Calisi, 2017; Collier et al., 2018; Gollwitzer et al., 2018; Prado et al., 2018; Bernburg et al., 2019, 2020; Hwang and Jo, 2019; Lin et al., 2019; Alkhawaldeh et al., 2020; Ghawadra et al., 2020; Niva et al., 2020). However, only three studies employed blind procedures (Prado et al., 2018; Alkhawaldeh et al., 2020; Bernburg et al., 2020). The rest of these studies either did not use blinding procedures or did not report any attempts of blinding. Seven studies used a quasi-experimental design (McElligott et al., 2003; Walker, 2006; Moeini et al., 2011; Bahmanzadeh and Haji Alizadeh, 2017; Wang et al., 2017; Lary et al., 2019; Hsieh et al., 2020) and the remaining five studies utilized a pre-posttest design with control group (Cohen-Katz et al., 2005; Orly et al., 2012; Villani et al., 2013; Singh and Jain, 2017; Yang et al., 2018). Out of the 27 studies included in the review, only eight studies conducted a psychological screening

to define whether participants suffered from moderate or high levels of psychological stress prior to being invited to take part in the research study (Kurebayashi et al., 2012; Villani et al., 2013; Nazari et al., 2015; Singh and Jain, 2017; Prado et al., 2018; Yang et al., 2018; Ghawadra et al., 2020; Niva et al., 2020).

Intervention Duration and Components

All the interventions included in the current review aimed at treatment of the individual. The intervention duration ranged from 2 weeks (Alkhawaldeh et al., 2020) to 16 weeks (Orly et al., 2012). As for the modalities, the most common interventions were technology-delivered interventions for stress management and mental health. Particularly, three studies implemented self-help programs guided by a website (Hersch et al., 2016; Gollwitzer et al., 2018; Ghawadra et al., 2020) and three additional interventions investigated the effectiveness of mobile phone-delivered programs for stress management (Villani et al., 2013; Hwang and Jo, 2019; Hsieh et al., 2020). Other commonly used modality types included mindfulness-based programs (Cohen-Katz et al., 2005; Walker, 2006; Wang et al., 2017; Yang et al., 2018; Lin et al., 2019), cognitive-behavioral interventions (Moeini et al., 2011; Orly et al., 2012; Bahmanzadeh and Haji Alizadeh, 2017), self-care interventions (Singh and Jain, 2017; Lary et al., 2019; Alkhawaldeh et al., 2020), auriculotherapy (Kurebayashi et al., 2012; Prado et al., 2018), massage (McElligott et al., 2003; Nazari et al., 2015), psychological competence trainings combined with cognitive-behavioral components (Bernburg et al., 2019, 2020), breathing exercises (Calder Calisi, 2017), chanting mantras (Niva et al., 2020), physical activity training (Palumbo et al., 2012) and multisensory environmental therapy (Collier et al., 2018).

Measurement Tools and Follow-Up

Diverse instruments were used depending on the research aims of each study. The present review focuses on the subjective and objective assessment tools for measuring stress in nurses. Among the 27 articles, 18 different instruments were utilized to assess subjective stress experience. The most commonly used tools to record stress were the Perceived Stress Scale (PSS) and the Nursing Stress Scale (NSS), which were used in 10 studies. Other instruments that were frequently utilized, were the Perceived Stress Questionnaire (PSQ), the Stress Symptom List (LSS), the State Trait Anxiety Inventory (STAI), and the Depression, Anxiety, and Stress Scale (DASS). Furthermore, the primary outcome of stress was also objectively measured in four interventions. In particular, physiological parameters, such as blood pressure, pulse oximetry, skin temperature, respiration rate and cardiac response, were assessed to quantify stress level (McElligott et al., 2003; Collier et al., 2018; Hsieh et al., 2020). One study evaluated serum stress markers and metabolic parameters without utilizing self-report (Niva et al., 2020).

In these studies, assessments of the primary outcome were performed for all participants before the beginning of the intervention, at baseline. All the interventions repeated the stress assessment after the completion of the treatment. However, only in 11 interventions, the measurements were conducted for a longer period of time, following the participants after the end of the treatment (Cohen-Katz et al., 2005; Kurebayashi et al., 2012;

Nazari et al., 2015; Wang et al., 2017; Prado et al., 2018; Bernburg et al., 2019, 2020; Lary et al., 2019; Lin et al., 2019; Alkhawaldeh et al., 2020; Ghawadra et al., 2020). The end point for these follow-up examinations ranged from 2 weeks (Kurebayashi et al., 2012; Nazari et al., 2015; Prado et al., 2018) to 36 weeks (Bernburg et al., 2019, 2020) after the intervention.

Main Findings

Twenty-three studies showed that stress level decreased after the intervention. However, two studies measured perceived stress only either with Visual Analog Scale [VAS; (McElligott et al., 2003)] or State Trait Anxiety Inventory [STAI; (Collier et al., 2018)]. Although one intervention mentioned decrease in self-reported measures, they did not report p values (McElligott et al., 2003). Furthermore, four studies did not indicate changes in perceived stress (Cohen-Katz et al., 2005; Palumbo et al., 2012; Villani et al., 2013; Wang et al., 2017). On physiological level, it was shown that the treatment had a significant effect on objectively measured stress indices (Collier et al., 2018; Hsieh et al., 2020; Niva et al., 2020). Nevertheless, one study reported no changes in the measured physiological parameters (McElligott et al., 2003). Overall, nine studies indicated long-term decrease in perceived work-related stress (Kurebayashi et al., 2012; Nazari et al., 2015; Prado et al., 2018; Bernburg et al., 2019, 2020; Lary et al., 2019; Lin et al., 2019; Alkhawaldeh et al., 2020; Ghawadra et al., 2020).

DISCUSSION

This systematic review of the literature investigating individual-level interventions for stress management in nurses revealed a wide variety of programs that can be mainly classified into: (a) technology-based interventions for stress management and mental health either guided by a website or delivered through mobile phones, (b) mindfulness-based and spiritual interventions, (c) programs with cognitive-behavioral components, and (d) programs addressing body. In particular, there are some indications that technology-delivered interventions with relaxation components and stress management interventions comprising self-care skills, cognitive-behavioral components and relaxation might be effective in reducing stress among nurses and improving their mental well-being. In this direction, earlier research reviews have indicated that a wide range of interventions are available and seem promising for decreasing psychological distress (Delgado et al., 2017; Ghawadra et al., 2019; Bakker et al., 2020). Although evidence supports the effectiveness of these mechanisms in tackling stress, the rapid changes in health care systems and the unpreceded pressure that nurses experience, highlight the need to develop interventions adapted to the new overwhelming demands. Indeed, the prevalence of mental health problems among health care workers, especially during and after outbreaks, is high (Ricci-Cabello et al., 2020). Furthermore, these problems are usually associated with long-term mental health burden and thus, hinder the immediate response to health threats, such as the present COVID-19 crisis.

It is of utmost importance to develop and implement stress management interventions that are not only conveniently accessible in the workplace but also, they meet the strict conditions for minimizing human contacts. To this end, evidence-based interventions and self-care practices for those in immediate need delivered through digital technology seem to be a promising solution for combating the detrimental psychological and physiological impact among nurses. For example, there is recently an emerging body of studies that examines the implementation of a self-help virtual reality (VR) protocol to overcome the negative consequences of the quarantine by reliving stress among individuals (Riva and Riva, 2020; Riva et al., 2020). The protocol is designed to simulate a natural environment, while the user can perform daily exercises aiming at self-concertation and relaxation. By transferring this idea to a demanding workplace, where restrictions for social contact apply, it might be an effective way to enhance nurses' resilience and generally, improve their mental health. Therefore, future research will be needed to examine, if the continuous use of technology-based stress management and the refinement of its technological capabilities would lead to individually tailored self-help programs and to a more positive effect.

Furthermore, the most commonly utilized instrument for assessing the primary outcome of stress was self-reported scales. However, the current review of the literature identified some efforts from these interventions to include objectively measured parameters in order to explore the effect of strategies developed on physiological level. The experience of high job stress can cause alternations in the physiological processes that the human body mobilizes in an attempt to re-establish inner balance. In psychophysiological studies, the exposure to a stressful event is associated with intense cardiac activity (Johnston et al., 2016) which may be considered as a predisposing factor for the onset of lifestyle diseases, such as depression and heart disease. Additionally, the prolonged activation of the HPA axis can lead to increased concentrations of stress hormones harming the immune system (Aguilera, 2011; Herman et al., 2016).

The assessment of specific stress biomarkers could provide considerable advantages to future studies: such measures will allow researchers to define the outcomes of their interventions in a more systematic and precise way, taking into consideration the individual differences. It is well-known that people respond to potential stressors with great variability (McEwen, 1998). In this regard, diverse individual-related factors, such as gender, age, health status and personality characteristics, may regulate not only physiological reactivity to stress but also individuals' ability to activate their resources and cope with challenges. By capturing physiological responses, it would be possible to reveal which psychophysiological mechanisms are involved into resilience processes and how individual characteristics are interwoven in physiological traits. This may contribute, in turn, to a better understanding of human body and the implementation of effective stress management strategies based on objective indices. Moreover, concrete physiological outcomes can be directly associated with stress scales that may have implications for individual's health status, and can reduce confounding effects by response bias inherent in self-report ratings (Schnall et al.,

1992; Bosma et al., 1997; McEwen, 1998). Therefore, future studies could utilize physiological parameters as indices for assessing their effectiveness to reduce stress and overcoming certain methodological issues of self-report.

There are some other issues that have been identified by the current literature review. The majority of the studies included have been designed and conducted in US, where the surrounding conditions and needs for mental health care among nurses may slightly differ from those exist around the globe. These scientific data and knowledge deriving from research on preventive programs may be usefully applied to the case of nurses in countries other than the US. However, the fact that different countries operate very different health care systems may imply that there are limitations in generalizing and integrating the study findings (Edwards and Burnard, 2003). In line with this, most authors of the identified interventions recognized the limited generalizability of their results. In fact, it was found that most of the interventions were developed for a clinical environment and in most cases, they reported a small sample size or a homogeneous study population. Nevertheless, no interventions were identified recruiting large random samples, for example, in nursing homes, elderly care or health care facilities for homeless, where nurses may have increased needs for help and be at higher risk for chronic stress and stress-related diseases. In general, research results should be generalized with caution and future studies may adjust their methods to the local conditions of health care professionals. Another issue related to generalizability of the study findings extracted is that, in many articles, p values were reported without including the effect size, which is a standardized measure to evaluate interventions' clinical utility. Therefore, this fact rendered the comparison of the results difficult and based on this one might question their generalizability to other settings. Although previous research on stress reduction in health care providers has also identified the same methodological problem (e.g., Edwards and Burnard, 2003; Bakker et al., 2020), it still concerns. Furthermore, future research may pay more attention into different nursing specialties by developing strategies to meet the demands of non-hospital-based institutions (Bakker et al., 2020). Another major limitation of the included studies was lack of long-term follow-up data. Although the majority of the studies effectively decreased work-related stress immediately after the intervention and highlighted the benefits of such interventions for enhancing nurse's mental health, only nine programs out of the 27 identified interventions indicated a long-term change in the measured outcome. Nurses might have shown temporary improvements in stress immediately following a stress management program but might have returned later to baseline levels, especially without continued support. Hence, future interventions are needed to include longer follow-up intervals that can more reliably indicate the extent of their effect.

Strengths and Limitations of the Systematic Review

The present literature review provides the reader a thorough overview of the existing programs aimed at reducing stress in

nurses and helping them develop adequate coping resources. The benefits of these interventions examined encourage the development of clinical applications and individual-level programs toward the particular group and outcome being measured. However, there is a number of limitations of the current review that should be considered. The diversity of the interventions and their treatment characteristics hindered a comparison of the different study findings, data-pooling and meta-analysis. This limitation might be overcome by the use of a tool for the quality assessment of the extracted studies. Future authors are highly encouraged to use such appraisal instruments. For the purpose of this review, only stress programs for nurses were identified and considered for further analysis. However, other groups of health care providers, such as nurse aids, novice nurses and nursing students, suffer from significant levels of distress and mental health problems (Mackenzie et al., 2006; Pulido-Martos et al., 2012; e.g., Chatterjee et al., 2014; Rathnayake and Ekanayaka, 2016). A deeper understanding of the needs of each health professional group may explain whether and why they respond to preventive programs differently. By addressing this important issue, it may help not only to implement individually tailored interventions, but also to create a basis to allocate effectively resources for interventions that alleviate stress in health care providers at all levels. Moreover, another limitation was that literature search was restricted to articles published in English or German, which might have caused the exclusion of relevant studies. In an attempt to limit the articles identified only to those that focused on interventions for nurses, authors used the term "nurses" for conducting their literature search and as a result, they might unknowingly exclude other relevant studies. This is a limitation that should be considered.

CONCLUSION

Individual-level interventions and self-care strategies are core values for addressing the growing problem of stress among nurses. However, the question of what stress management programs would be effective to enhance nurses' personal resources to decrease stress throughout the pandemic still persists. This systematic review of the literature highlights the immediate need for evidence-based preventive interventions that may be delivered through digital technology combined with relaxation and cognitive-behavioral components to reduce stress and meet the current conditions that allow fewer human contacts. The integration of VR as a tool of stress management into mental health research has the potential to offer a radical transformation

of the traditional intervention programs, allowing their users to meet the current restrictions for human contact. Therefore, special attention should be paid to advancing technology-based interventions that develop innovative self-help strategies, and to applying standardized objective measurement tools to allow the quantification of sensitive physiological indices and transferability of scientific knowledge. Further research is needed to develop preventive programs with long-term follow-up for those nurses who work in specialized care at non-hospital institutions so as to understand and meet their needs for mental health care. Nurses play an integral role in each health care system and should be provided with all these appropriate self-help strategies to enhance their resilience and create a healing environment, where they can better exhibit their skills and commitment to patients. Having healthy staff is essential to delivering high-quality health care and preventing serious mental health disorders at the workplace.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article, further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

MV designed the study. MV, and GR performed the literature review, data extraction, and classification according to the pre-defined criteria. MV synthesized the study findings and drafted the manuscript. GR participated into the review process. Both authors contributed to the article, read and approved the submitted version.

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Effects of Experiential Learning Programmes on Adolescent Prosocial Behaviour, Empathy, and Subjective Well-being: A Systematic Review and Meta-Analysis

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Introduction: Effective adolescent learning programmes can positively influence adolescent development and curb risky behaviour. By immersing learners in an experience, experiential learning motivates learners to reflect on the experience to transform and create new skills, attitudes and ways of thinking. However, evidence of its effectiveness in learning programs facilitating positive youth development is still lacking. The objective of this study is to (a) identify the effect of adolescent learning programmes on prosocial behaviour, empathy and subjective well-being, (b) compare the effectiveness of experiential learning programmes and non-experiential learning programmes on improving these three outcomes, and (c) evaluating the effects of age on the outcomes of adolescent learning programmes.

Methods: This study was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Randomised controlled trials of learning programmes for typically developing adolescents aged 8–25 in the past 15 years were identified, and assessed for quality with the Physiotherapy Evidence Database (PEDRO) scale. One thousand ninety-six records were screened with the inclusion and exclusion criteria, and 20 studies were adopted for this meta-analysis. The standardised mean difference and 95% confidence interval (CI) of the effect of experiential learning program on empathy, prosocial behaviour, and subjective well-being were examined. Sub-group analysis based on age was conducted to examine the effects of experiential learning on adolescents in different stages of life.

Results: Experiential learning programmes were more effective than non-experiential learning programmes in improving empathy [d = 0.65 (0.07, 1.23)] and subjective well-being [d = 0.46 (0.33, 0.59)]. The effect sizes of the three outcomes in non-experiential learning programmes were non-significant. Studies conducted on older adolescents had the most significant improvements in the three outcomes.

Conclusions: Results suggest the broader application of experiential learning in adolescent learning programmes for older adolescents in the future to promote positive youth development.

Keywords: experiential learning, prosocial behaviour, empathy, well-being, positive youth development, adolescence

INTRODUCTION

Adolescence is a developmental period characterised by complex biological, psychological, social, emotional, sexual, and cognitive changes. This maturation offers an opportunity to foster a healthy and happy lifestyle as they transition to adulthood (Compas and Millstein, 1993). For example, their developing social cognition allows adolescents to grasp the complexities of social situations beyond simple rules, thus making room for new modes of prosocial behaviour with family members, peers, and the community (Fuligni, 2019). On the other hand, this period also leaves them vulnerable to developing problematic behaviours such as risky sexual behaviour, substance abuse, violence, addiction, and antisocial behaviours (Ciocanel et al., 2017). In recent years, though there is a drop in some adolescent risk behaviours, such as drug abuse, there is a worrying rise in internet and gaming addiction and risky sexual behaviour (Shek and Yu, 2011; Cheung and Cheung, 2019; Leung and Lin, 2019).

Adolescent prosociality, such as making small contributions to other members of society, promotes their personal social acceptance and integration for long-term functioning during adulthood (Fuligni, 2019). The transition of adolescents into thriving young adults raises educational and occupational prospects which enhances economic productivity (Fergusson et al., 2007). Addressing unique challenges during adolescence provides substantial personal benefits to health and well-being and also reduces economic costs for families and communities (Ciocanel et al., 2017). Positive youth development (PYD) is an ideology that aims to guide and empower youngsters by nurturing their self-efficacy, positive self-identity, psychosocial competence, and sense of belonging. Through providing adolescents with opportunities and resources to develop their strengths and form meaningful social networks, positive behaviour and the development of a prosocial and well-adjusted adult is promoted (Duncan et al., 2007). There are many examples of PYD programmes worldwide. Literature review concerning the outcomes of PYD programmes were done in the past with promising results (Catalano et al., 2004). Extensive research has been conducted by Shek and colleagues on the learning programme "Positive Adolescent Training through Holistic Social Programs" (*PATHS*) (Shek et al., 2010; Shek and Yu, 2011). Participants in *PATHS* displayed a lower level of substance abuse and delinquent behaviour than the control group (Shek and Yu, 2011) and also enabled development of positive interpersonal relationships, self-esteem, and sense of purpose (Shek et al., 2010). Other examples of PYD programmes include the Quantum Opportunities Program, Big Brother Big Sisters,

Project K and the Summer Training and Education Program (Ciocanel et al., 2017).

In recent years, experiential learning (EXL) has been gaining popularity for its ability to engage students in active learning, translate classroom learning into real-world scenarios, and address community needs (Kruger et al., 2015). Currently, there is no single unanimous definition for the term "experiential learning" among researchers, but Kolb's Theory of Experiential Learning, which views learning as a process of creating knowledge through the transformation of experience (Kolb, 2014) is one of the most renowned theory supporting EXL due to his concrete theoretical base built upon the works of others. Theory of Experiential Learning states that for learning to occur, experience must first be grasped and then transformed through reflection and application. It involves four components that occur in a cyclical process: Concrete Experience (CE) is the opportunity for an experience, Reflective Observation (RO) makes sense of, breaks down, and transforms the experience through reflection, Abstract Conceptualisation (AC) is the formation of theoretical knowledge from which new behaviours and thinking emerge, and Active Experimentation (AE) is the practical application of new concepts (Kolb and Kolb, 2005; Alkan, 2016). This theory is built on the works of John Dewy, Kurt Lewin, Kurt Hahn, Jean Piaget, and so on (Dewey, 1986; James, 1990; Schein, 1996; Miettinen, 2000). While the works of Joplin (1981), Jarvis (2006) and Dean (1993) are alternative theories developed, Kolb's definition remains more inclusive of different modes of learning. For the purpose of this review, experiential learning programmes are thereby defined as learning programmes that include all four components of Kolb's learning cycle.

EXL is an effective form of learning as it engages the whole being through connecting the senses, intellect, and feelings during the learning process, which improves retention of information (Kolb and Kolb, 2005). Literature also points to EXL's effectiveness in improving the development of critical thinking (Lisko and O'dell, 2010) and personal insight (Burch et al., 2016). Through action-reflection and experience-abstraction, experiential learning is a process that facilitates learners to transform and create knowledge, skills, attitudes, and ways of thinking; thus, accommodate to various learning styles of individual learners by integrating the experience, perception, cognition, and behaviour (Lewis and Williams, 1994; Kolb and Kolb, 2009; Kolb, 2014).There is increasing inclusion of EXL concepts in learning programmes. For example, the Youth ImpACT Award is an example of an EXL programme that aims to promote PYD. This programme fosters participants' awareness of social issues through community engagement activities, whereby participants meet with community dwellers,

explore the problems they face, and devise solutions using design thinking and innovative skills (Youth Impact Award, 2020).

Although literature asserts EXL's effectiveness in learning and skill development (Biers et al., 2006), there is a paucity of literature that specifically evaluates whether EXL programmes enhance PYD outcomes in adolescents. Moreover, what essentially constitutes an effective PYD programme is still obscure since there is no consensus about what components should be present in terms of programme design and targeted outcomes. For instance, the means of delivery, engagement methods, contexts, participants, and formats of the programmes (Brooks-Gunn and Roth, 2014; Tolan, 2016; Curran and Wexler, 2017).

Empathy, prosocial behaviour, and subjective well-being are key factors that influence healthy adolescent development and cultivate a harmonious society (Eisenberg and Miller, 1987; Silke et al., 2018). A wealth of literature suggests that empathy and prosocial behaviour play a key role in healthy social functioning and are particularly relevant in enhancing connectedness, cooperation, and understanding among people (Silke et al., 2018). For well-being, research shows that it is a reliable predictor of health and long-term positive adjustment (Gómez-López et al., 2019). As evidence suggests prosocial behaviour, empathy, and well-being are salient factors in facilitating PYD, they were chosen as the outcomes in this review. Prosocial behaviour is an umbrella term used to describe actions performed to enhance the welfare of others (Weinstein and Ryan, 2010; Spinrad and Eisenberg, 2017). It includes activities such as sharing, helping, caregiving, donating, volunteering, and acts of kindness. Empathy is the ability to apprehend others' emotional state (cognitive empathy) or the ability to share emotional experiences of others (affective empathy) (Eisenberg and Miller, 1987; Silke et al., 2018). Well-being is a multidimensional construct that includes psychological states such as positive affect or happiness, low negative affect or depression, and life-satisfaction (Curry et al., 2018). It also includes eudaimonic factors such as positive life functioning, self-actualisation, self-esteem, quality relationships, and purpose in life (Dodge et al., 2012; Moreira et al., 2015). Well-being will be referred to as "subjective well-being" in this review since all well-being outcomes were self-reported. The terminology "adolescent" traditionally refers to people under 19 years old (Curtis, 2015); however, recent literature suggests that the delayed transition to life stages such as education completion, career attainment, marriage, and parenthood expanded the length of adolescence into the mid-twenties (Mandarino, 2014; Sawyer et al., 2018). To increase the inclusiveness of this review, adolescents between the age of 8 to 25 will be explored.

The purpose of this systematic review and meta-analysis was to synthesise and categorise randomised controlled trials of adolescent learning programmes published between 2005 and 2020 into EXL programmes (those that incorporated the four elements of Kolb's Theory of Experiential Learning:) and non-experiential learning (NEXL) programmes (those that did not incorporate all four elements) and compare their effects on three PYD outcomes: prosocial behaviour, empathy, and subjective well-being. The time frame was selected as a comprehensive

review on PYD programs was done on the years before (Catalano et al., 2004). The research objectives are (a) identifying the effect of adolescent EXL and NEXL programmes on prosocial behaviour, empathy and subjective well-being, (b) comparing the effectiveness of EXL and NEXL programmes on improving these three outcomes, and (c) evaluating the effects of age on the outcomes of adolescent learning programmes.

METHODS

Guidelines

This study was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page et al., 2020). This guideline has been widely accepted and endorsed in the academic community to facilitate accurate reporting in systematic reviews (Page and Moher, 2017). It serve as a standardised method to provide transparency to the full process behind the study, thus making this review replicable and hold it up to an internationally approved standard. The PRISMA 2020 checklist is included in the **Supplementary Material**.

Identification of Studies

To identify suitable experimental studies, searches were conducted in 2020 on scientific databases: Wiley Online Library, ScienceDirect, PsycINFO, Taylor and Francis Online, SAGE Journals, and Springer LINK. A search was also conducted using Google Scholar. The search terms for interventions and outcomes were as follows.

This search identified 985 articles, screened and categorised by four reviewers working independently unless a discussion is warranted. To this, we added 111 articles by following references in journal articles and checking systematic reviews. This initial set of 1,096 articles was screened by reading the titles and abstracts, and 906 articles were excluded. These articles had unrelated interventions or did not measure target outcomes. The remaining 190 potentially eligible articles were then assessed by full-text screening. Within, 83 articles were excluded for not meeting the inclusion criteria. The remaining 107 articles were read in full and rated according to the Physiotherapy Evidence Database (PEDro) Scale. Articles with a PEDro score of less than six were excluded. Articles that did not provide data such as mean, SD, and sample size, and convertable statistics to Cohen's d were also excluded (Bird, 2014; Nelson et al., 2015; Guo et al., 2018). By the end, 20 articles were left for the final systematic review. All four reviewers reviewed the full texts to ensure its eligibility. Please see **Figure 1** for the flow diagram that summarises the literature search process.

Inclusion and Exclusion Criteria

Studies were included in the review if they met the following criteria:

(a) Articles must focus on delivering learning programmes for adolescents between 8 and 25 years of age (or a mean sample age within this range).
(b) Articles must focus on intervention outcomes of empathy, prosocial behaviour, or subjective well-being.

FIGURE 1 | Flow chart illustrating the search and selection process of studies.
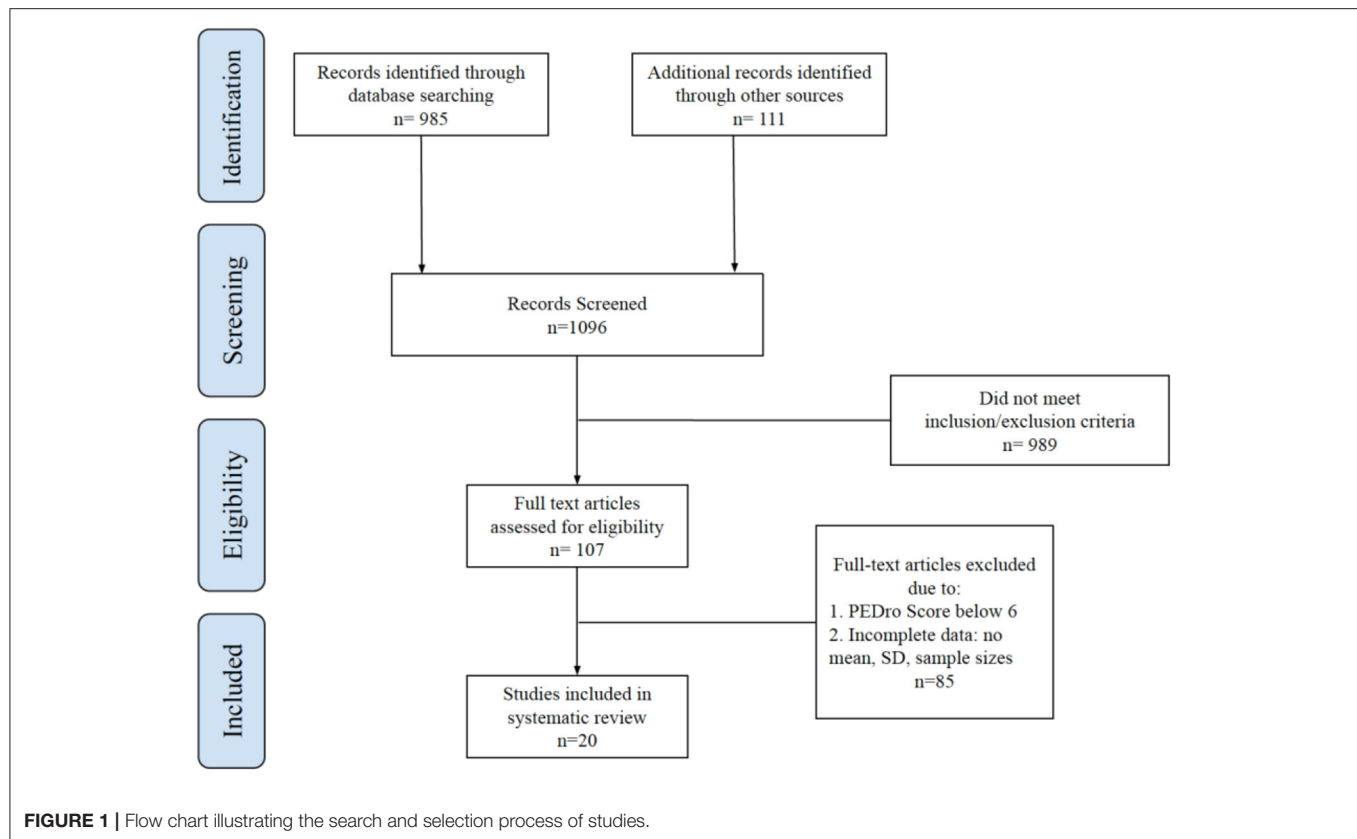
(c) Articles must focus on the assessment of typically developing adolescents from non-clinical samples.

(d) Articles must report on randomised controlled trials, be peer-reviewed, written in the English language, and published in or after 2005.

(e) Articles failing to meet the above criteria (a–d) are included if effects for relevant comparison groups or sub-sample analyses were reported separately.

Appraisal of Study Quality and Data Extraction

Potentially eligible articles were scored individually by four reviewers with the Physiotherapy Evidence Database (PEDro) Scale (Physiotherapy Evidence Database, 2020a). PEDro is designed to rate the validity of randomised controlled trials through critical appraisal (Moseley et al., 2019). The reviewers collaborated to assess and score the articles according to PEDro criteria. The items include (1) specified eligibility criteria, (2) randomisation of subjects, (3) concealed allocation, (4) similarity at baseline, blinding of subjects, (5) blinding of therapists, (6) blinding of assessors, (7) measures of at least one key outcome obtained from more than 85% of the subjects initially allocated to groups, (8) intention to treat, (9) results of between-group statistical comparisons reported for at least one key outcome, (10) and (11) point measures and measures of variability for at least one key outcome provided. Item 1 (specified eligibility criteria)

is not used to calculate the PEDro score. For items 2–11, one point is given for each item when a criterion is clearly satisfied. The possible range of score is 0–10. Only papers with a score of six or above were included in the final systematic review as the Physiotherapy Evidence Database (2020b) states that scores between six and ten are moderate to high quality. All studies were also randomised controlled trials (RCT) because this type of experiment reduces bias and allows for a better examination of cause and effect due to having a control group and random subject allocation (National Institute for Health Care Excellence, 2020).

Data Analysis

Standardised mean differences (Cohen's *d*) were computed from reported inferential or descriptive statistics using the Campbell Collaboration Standardised mean difference Calculator (Wilson, 2001) or extracted from articles when provided. Standardised mean differences were coded as positive values to suggest an increase in prosocial behaviour, empathy, or subjective well-being. Standardised mean differences were reverse coded for the well-being outcomes: depression, depressive symptoms and anxiety. The value of Cohen's *d* (later displayed as *d*) 0.20 indicates a small, 0.50 a medium, and 0.80 a large standardised mean difference (Cohen, 1988). When a study had multiple measures for the same outcome, an overall standardised mean difference was calculated by pooling the individual standardised mean differences. The pooled standardised mean differences

TABLE 1 | Main characteristics of studies included in the systematic review.

Study	Intervention mode of delivery	Intervention programme	Control	Age (mean/range)	Location	Outcome	Outcome measurement tools	N1 (I)/N2(C)	PEDro score
Experiential learning (EXL)									
Bosse et al. (2012)	University classroom (small training groups)	*Standardised/Simulated patient (SP)*: Interview with standardised patient, reflection and feedback, discuss, and debriefing	Seminar without additional training	24 (U)	Germany	E	Calgary-Cambridge Referenced Observation Guide [T]	33/34	6
						WB (self-efficacy)	(Self-created questionnaire) [S]		
Cooke et al. (2013)	University	*Goal setting intervention*: Talk on benefit and strategies to increase step count, reviewing step count and discussion, setting personal goals by writing them in a diary, and continuous recording	Same activity without review	22.2 (U)	UK	P (perceived behaviour control)	Questionnaire based on Theory of Planned Behaviour (TPB) [S]	70/66	8
						P (intention to promote physical activity)	Motivational Interviewing Treatment Integrity (MITI) scoring tool [T]		
Daeppen et al. (2012)	University (small groups)	*Motivational Interviewing (MI) Training* : Understand MI theory and mechanisms discussion, persuasion exercise, illustration (DVD), discussion/ didactics, structured ex, role plays, exercise (round robin) Recognise and reinforce change by Illustration (DVD), trainer demonstration, discussion role play, exercise (change talk jeopardy), team role plays	Training in basic communication skills	24.7 (U)	Switzerland	E	Balanced Emotional Empathy Scale (BEES) [S]	42/49	6
Deane et al. (2017)	School-based (12 people per group)	*Project K Youth Development Program*: 3-week wilderness adventure (team building and challenge-based activities), 10-day community service, workshops on topics related to youth health and well-being, and a 1-year adult mentoring	Adventure day	13–15 (S)	New Zealand	WB (academic self-efficacy) WB (social self-efficacy)	Self-Efficacy Questionnaire (SEQ) [S] Self-Efficacy Questionnaire (SEQ) [S]	482/417	6
Henry et al. (2011)	University (small groups)	*Ageing game*: instructions, briefing and transformation, the Ageing Game— Ageing Simulation period (5 stations), and debriefing of feelings and experience	Lecture with discussion	25 (U)	US	E	Empathy questions adapted from the Maxwell and Sullivan Survey [S]	62/62	7
Karasimopoulou et al. (2012)	Classroom/small groups	*Skills for Primary School Children*: Topics to develop students' personal and social skills. Each session includes introduction, 3 activities, evaluation, and homework.	Normal school curriculum	10–12 (P; grade 5–6)	Greece	WB (psychological) WB (Mood and feeling)	Psychological Well-being subscale of Kidscreen-52 Questionnaire [S] Mood and Feeling subscale of Kidscreen-52 Questionnaire [S]	128/158	6

(Continued)

TABLE 1 | Continued

Study	Intervention mode of delivery	Intervention programme	Control	Age (mean/range)	Location	Outcome	Outcome measurement tools	N1 (I)/N2(C)	PEDro score
						WB (self-perception)	Self-perception subscale of Kidscreen-52 Questionnaire [S]		
Lakin and Mahoney (2006)	School-based (small groups)	*Youth Community Service Program*: promote empowerment and sense of community. Includes skill building (6 sessions on social action, cooperation, leadership, and empathy), planning (6 sessions where participants chose a social problem they wish to address and plan action), action (community service), and regular discussion and reflection.	Normal school curriculum	10–13 (P; grade 6)	US	P (intent to be involved in future community action)	(Self-created questionnaire) [S]	29/14	6
						P (Civic responsibility/sense of responsibility)	(Self-created scale) [S]		
						E	Index of Empathy for Children and Adolescents [S]		
						WB (global self-efficacy)	Cowen, Work, Hightower, Wyman, Parker, and Lotyczewski (1991) self-efficacy scale [S]		
Li et al. (2013)	Community (6–8 children per small group)	Adventure-based Training Program: promote understanding towards the importance of psychosocial well-being and physical activities, stress and coping, and depression prevention. Includes 5 education sessions (health-related talks or workshops) and 1-day adventure-based training camp (Including warm up, briefing, group activities, team building, adventure-based games, and debriefing).	Leisure activities	11 (P; grade 5–6)	Hong Kong	WB (self-esteem)	Rosenberg's Self-Esteem Scale (RSES) [S]	56/64	8
						WB (quality of life)	Paediatric Quality of Life Inventory [S]		
						WB (anxiety)	Chinese Version of the State Anxiety Scale for Children (CSAS-C) [S]		
						WB (depressive symptoms)	The Center for Epidemiologic Studies Depression Scale for Children (CES-DC) [S]		
O'Hare et al. (2015)	After-school (15 children per group)	*"Mate-Tricks" Prosocial Behaviour After-School Program*: child, parent and family SEL sessions include snack time, opening game, review of previous session, and closing gam. The training provides theoretical framework, practical application, and sessions that include a combination of participation as well as reflection and sharing.	No treatment	9-10 (P)	Ireland	P (prosocial behaviour)	Peer Relations and Prosocial Behavior Questionnaire [S]	220/198	6

(Continued)

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TABLE 1 | Continued

Study	Intervention mode of delivery	Intervention programme	Control	Age (mean/range)	Location	Outcome	Outcome measurement tools	N1 (I)/N2(C)	PEDro score
Samuels et al. (2016)	School-based (small groups)	*Humane Education Program: Circle of Compassion*: includes experiential activities and service-learning events, student centred activities, multimedia and discussion to explore challenges faced by pets, farm animals, wildlife, the environment. The children use what they learn to plan and implement strategies to help animals, other children, and the environment with continuous discussion.	Chess club	9–10 (P; grade 4)	US	P (prosocial behaviour)	Teacher Observation of Classroom Adaptation–Checklist (TOCA-C) [T]	119/48	6
Non-experiential learning (NEXL)									
Berger et al. (2018)	Classroom	*ERSAE-Stress-Prosocial (ESPS)*: SEL, stress-reduction and prosocial program that consists of warm-up, experimental work, psycho-educational knowledge, contemplative practise, learned skill and homework assignments (sharing and practise)	Social Studies class	12.46 (S)	Tanzania	P (prosocial behaviour) WB (anxiety)	Prosocial Subscale of Strengths and Difficulties Questionnaire (SDQ) [S] Spence Anxiety Scale for Children [S]	95/88	6
Connolly et al. (2018)	Classroom	*Roots of Empathy (ROE)*: SEL, mentalization program where children are instructed to (1) label the baby's feelings, (2) describe the baby's behaviour, (3) describe the links between the two, (4) label their own feelings towards the content or discontent baby, (5) describe how the mother cares for and helps the baby feel content	Normal school curriculum	8–9 (P; grade 4–7)	Ireland	P (prosocial behaviour) E WB (quality of life)	Strength and Difficulties Questionnaire (SDQ) rated by parents and teachers [T] Interpersonal Reactivity Index (IRI) [S] Child Health Utility-9D [S]	538/424	7
Ferri et al. (2019)	University (small groups)	*Expert Patient Teaching*: 2 theoretical seminars, 2 interactive meetings with nursing teacher and expert patient, and debriefing and reflection	Same activity without expert-patient involvement	20.9 (U)	Italy	E (Emotional Empathy) E (Perspective taking) E (compassionate care) E (standing in patient's shoes)	Balanced Emotional Empathy Scale (BEES) [S] Jefferson Scale of Empathy-Health Profession Student (JSE-HPS) [S] Jefferson Scale of Empathy—Health Profession Student (JSE-HPS) [S] Jefferson Scale of Empathy—Health Profession Student (JSE-HPS) [S]	72/72	8

(Continued)

TABLE 1 | Continued

Study	Intervention mode of delivery	Intervention programme	Control	Age (mean/range)	Location	Outcome	Outcome measurement tools	N1 (I)/N2(C)	PEDro score
Herrera et al. (2011)	Community (one-on-one)	*Big Brothers Big Sisters School-based Mentoring*: creative activities (e.g., drawing, arts, and crafts), games, discussions, and academic activity	No treatment	11.23 (P)	US	WB (global self-worth)	Global Self-Worth subscale of the Self-Esteem Questionnaire [S]	565/574	7
Horowitz et al. (2007)	Classroom (small groups)	*Interpersonal Psychotherapy–Adolescent Skills Training program (IPT–AST)*: Psychoeducation, CB program that educates about the nature and risk for depression and teaches how to (a) monitor daily moods; (b) identify activating events; (c) discover, challenge, realistically evaluate, and revise negative beliefs; (d) recognise the connexions among activating events, beliefs, and consequences (e.g., affect and behaviours); and (e) problem solve and cope with stressful events. Participant workbook is provided for homework.	Normal school curriculum	14.43 (S; grade 7–10)	US	WB (depressive symptoms) WB (depressive symptoms)	Children's Depression Inventory (CDI) [S] The Center for Epidemiological Studies Depression Scale (CES-D) [S]	112/169	6
Humphrey et al. (2016)	Classroom	*Promoting Alternative Thinking Strategies (PATHS)*: SEL program with taught activities that aims to help students manage their behaviour, understand their emotions, and work well with others. Each class contains lessons and send-home activities that cover topics such as identifying and labelling feelings, controlling impulses, reducing stress and understanding other people's perspectives, in addition to associated physical resources and artefacts (e.g., posters, feelings, dictionaries).	Normal school curriculum	7–9 (P; year 3–5)	UK	P (prosocial behaviour) P (cooperation) P (responsibility) E	Prosocial Subscale of Strengths and Difficulties Questionnaire (SDQ) [T] Social Skills Improvement System subscales (SSIS) [S] Social Skills Improvement System subscales (SSIS) [S] Social Skills Improvement System subscales (SSIS) [S]	2,340/2,176	7

(Continued)

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TABLE 1 | Continued

Study	Intervention mode of delivery	Intervention programme	Control	Age (mean/range)	Location	Outcome	Outcome measurement tools	N1 (I)/N2(C)	PEDro score
Kolić-Vehovec et al. (2020)	School-based (individual)	*School of Empathy*: game including various social situations in school in which the players had to choose the reactions they find the most suitable. The player will shift from the victim role to the bystander role, then bully role once they finish the tasks at each stage.	Another game related to safe use of internet	12-14 (S)	Spain, Malta, UK, Ireland	P (appropriate assertive reaction) P (assertiveness)	(Game metrics with frequencies of correct reactions) [T] Children's Assertive Behaviour Scale (CABS) [S]	77/61	6
Morton and Montgomery (2012)	Community (group-based)	*Questscope non-formal education (QS NFE):* non-formal education program aimed to empower adolescents. It consists of educational (dialogue-based learning) and social (recreational, cultural, and vocational activities) sessions, and reflection in a prosocial environment.	Waitlist	13–15 (S)	Jordan	P WB (self-efficacy) WB (emotional symptoms)	Prosocial Subscale of Strengths and Difficulties Questionnaire (SDQ) [S] General Self-Efficacy (GSE) Scale [S] Emotional Symptoms subscale of Strengths and Difficulties Questionnaire (SDQ)[S]	67/60	7
Schonert-Reichl et al. (2015)	Classroom	*MindUP*: SEL program that consists of 12 lessons on mindfulness, self-regulation and caring for others. It also includes lessons that involve performing acts of kindness for one another and collectively engaging in community service-learning activities	Normal school curriculum (social responsibility program)	10.24 (P; grade 4–5)	Canada	P (social responsibility) E E (perspective taking) WB (optimism) WB (emotional control) WB (depressive symptoms) WB (school self-concept)	Social Goals Questionnaire [S] Interpersonal Reactivity Index [S] Interpersonal Reactivity Index [S] Optimism subscale of Resiliency Inventory [S] Emotional Control subscale of Resiliency Inventory [S] Depressive Symptoms subscale of Seattle Personality Questionnaire for Children [S] Marsh's Self-Description Questionnaire [S]	48/51	8

(Continued)

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TABLE 1 | Continued

Study	Intervention mode of delivery	Intervention programme	Control	Age (mean/range)	Location	Outcome	Outcome measurement tools	N1 (I)/N2(C)	PEDro score
Stallard et al. (2014)	Classroom	*FRIENDS:* CB, Anxiety Prevention Program that consists of teacher teaching the children how to reduce anxiety using the acronym "FRIENDS."	Normal school curriculum	9-10 (P; year 4–5)	UK	WB (anxiety and depressive symptoms) WB (worry) WB (self-esteem) WB (life satisfaction)	Revised Child Anxiety and Depression Scale [S] Penn State Worry Questionnaire for Children [S] Rosenberg Self-Esteem Scale [S] Subjective Well-being Assessment [S]	449/372	6

Standardised mean differences had been coded as positive values which suggests an increase in prosocial behaviour (P), empathy (E), or subjective well-being (WB).
Age description: P = Primary school-age (8–12 years old), S = Secondary school-age (12–18 years old), U = University-age (18–25 years old).
Outcome measure types: S = Self-reported, T = Third party measures (e.g., third-party observations, teacher-rated, parents-rated).

were calculated with the calculator *Meta Essentials* (Suurmond et al., 2017). For studies with multiple time-points, we calculated the outcome closest to the time of intervention.

RESULTS

Study Quality Assessment

The average PEDro score of articles in this review is 6.65 which reflects of moderate-to-high quality articles. The highest score of 8 was obtained in four studies, a score of 7 was obtained in five studies, and a score of 6 was obtained in eleven studies. Please refer to **Table 1** for individual scores for each article.

Study Characteristics

Design

Presented in **Table 2** are the characteristics of the 20 studies included in this review. There were ten studies on EXL and ten studies on NEXL interventions. The sample size ranged from 43 to 4,516. All ten of the EXL programmes were carried out in developed countries, such as the United States, Canada, the United Kingdom, and Greece. Eight NEXL programmes were carried out in developed western countries such as the United States, Canada, and the United Kingdom, while the remaining two were conducted in Tanzania and Jordan. Seven studies compared the intervention group with a control group using a standard school curriculum, twelve used an alternative intervention, and three used no intervention or wait-list as the control. Please see **Appendix A** for more details of the studies.

Participants

The total number of randomised participants was 10,761. There were 2,351 participants in EXL programmes (intervention $n = 1,241$; control $n = 1,110$) and 8,410 participants in NEXL programmes (intervention $n = 4,363$; control $n = 4,047$). The subjects were categorised into three age groups: primary school-age (ages 8–12), secondary school-age (ages 12–18), and university-age (ages 18–25). The EXL sample consisted of five studies with primary school-age subjects, one with secondary school-age subjects, and four with university-age subjects. The NEXL sample consisted of five studies with primary school-age subjects, four with secondary school-age subjects, and one with university-age subjects. The average proportion of male subjects included is 44.58% in EXL programmes and 49.17% in NEXL programmes. Participants from eighteen studies were recruited from educational institutions, while participants from two studies were recruited from the community.

Intervention

Programmes were categorised into EXL and NEXL programmes by reviewers based on the criteria as described in the introduction. Five of the ten EXL programmes reported they were based on the Theory of Experiential Learning, while the other five were categorised by reviewers. Both types of programmes varied in programme duration, structure, and number and demographic of participants. The activities in the EXL programmes vary widely. For example, they are based on community service (Deane et al., 2017), simulation of physical disabilities (Henry

Category	Search terms
Experiential learning	Experiential learning OR action learning OR education programme OR education program OR learning programme OR learning program OR school programme OR school program
Prosocial behaviour	Prosocial behaviour OR prosocial behaviour OR prosocial acts OR prosocial responding OR prosocial intention OR helping intention OR helping behaviour OR helping behaviour OR kindness
Empathy	Empathy OR compassion
Subjective Well-being	Subjective well-being OR well-being OR positive affect OR happiness OR life satisfaction
Randomised controlled trial	Randomised controlled trial OR randomised controlled trial OR RCT OR control

et al., 2011) and classroom games and discussion sessions about understanding one's emotions and social skills (O'Hare et al., 2015). The activities in NEXL programmes are more similar in nature, as most are classroom games and discussions (Horowitz et al., 2007; Humphrey et al., 2016; Connolly et al., 2018). Please see **Appendix A** for more information on the learning programmes.

Outcome Measures

Outcome measures related to prosocial behaviour, empathy, and subjective well-being were selected to be included in the systematic review. A majority of studies used self-reported measures while some used third-party measures, such as the Teacher Observation of Classroom Adaptation–Checklist (TOCA-C) (Samuels et al., 2016) and the Strengths and Difficulties Questionnaire (SDQ) (Prosocial Behaviour Subscale) (Humphrey et al., 2016).

Self-reported measures and third-party measures were used to measure prosocial behaviour. The Prosocial Subscale of Strengths and Difficulties Questionnaire (SDQ) was used in four studies. Self-reported and third-party measures were used to measure empathy. The Interpersonal Reactivity Index (IRI) was used in two studies, while all other measures were different in each study. All measures on subjective well-being were self-reported. There were three measures for quality of life and life satisfaction, six measures for self-esteem and self-efficacy, and ten measures for mood and affect related items. Rosenberg's Self-Esteem Scale (RSES) and the Center for Epidemiological Studies Depression Scale (CES-D) were each used in two studies. In total, 14 articles used self-reported measures only, 2 used third-party measures only, and 4 used both self-reported and third-party measures.

Intervention Effects

Six separate main effects analyses were conducted for EXL and NEXL programmes with respect to the three outcome categories. Please refer to **Figures 2**, **3** for the forest plots.

Experiential Learning Programmes
Empathy
Based on the empathy outcome measures reported in four studies, the overall standardised mean difference was $d = 0.65$, 95% CI (0.07, 1.23). This represents a moderately large effect concerning the observed increase

in empathy outcomes associated with the participation in EXL programmes.

Prosocial Behaviour
Based on the prosocial behaviour outcome measures reported in four studies, the overall standardised mean difference was $d = 0.14$, 95% CI (-0.36, 0.63). This represents a non-significant effect concerning the observed increase in prosocial behaviour outcomes associated with the participation in EXL programmes.

Subjective Well-being
Based on the subjective well-being outcome measures reported in five studies, the overall standardised mean difference was $d = 0.46$, 95% CI (0.33, 0.59). This represents a moderate effect concerning the observed increase in subjective well-being outcomes associated with the participation in EXL programmes.

Non-experiential Learning Programmes
Empathy
Based on the empathy outcome measures reported in four studies, the overall standardised mean difference was $d = 0.02$, 95% CI (-0.3, 0.34). This represents non-significant effect concerning the empathy outcomes associated with the participation in NEXL programmes.

Prosocial Behaviour
Based on the prosocial behaviour outcome measures reported in six studies, the overall standardised mean difference was $d = 0.06$, 95% CI (-0.06, 0.19). This represents a non-significant effect concerning the observed increase in prosocial behaviour outcomes associated with the participation in NEXL programmes.

Subjective Well-being
Based on the subjective well-being outcome measures reported in seven studies, the overall standardised mean difference was $d = 0.11$, 95% CI (-0.04, 0.26). This represents a non-significant effect concerning the observed increase in subjective well-being outcomes associated with the participation in NEXL programmes.

Sub-group Analysis on Age
Main effects analyses were conducted for primary school-age, secondary school-age, and university-age participants with

FIGURE 2 | Forest plot showing the standardised mean difference of experiential learning interventions.
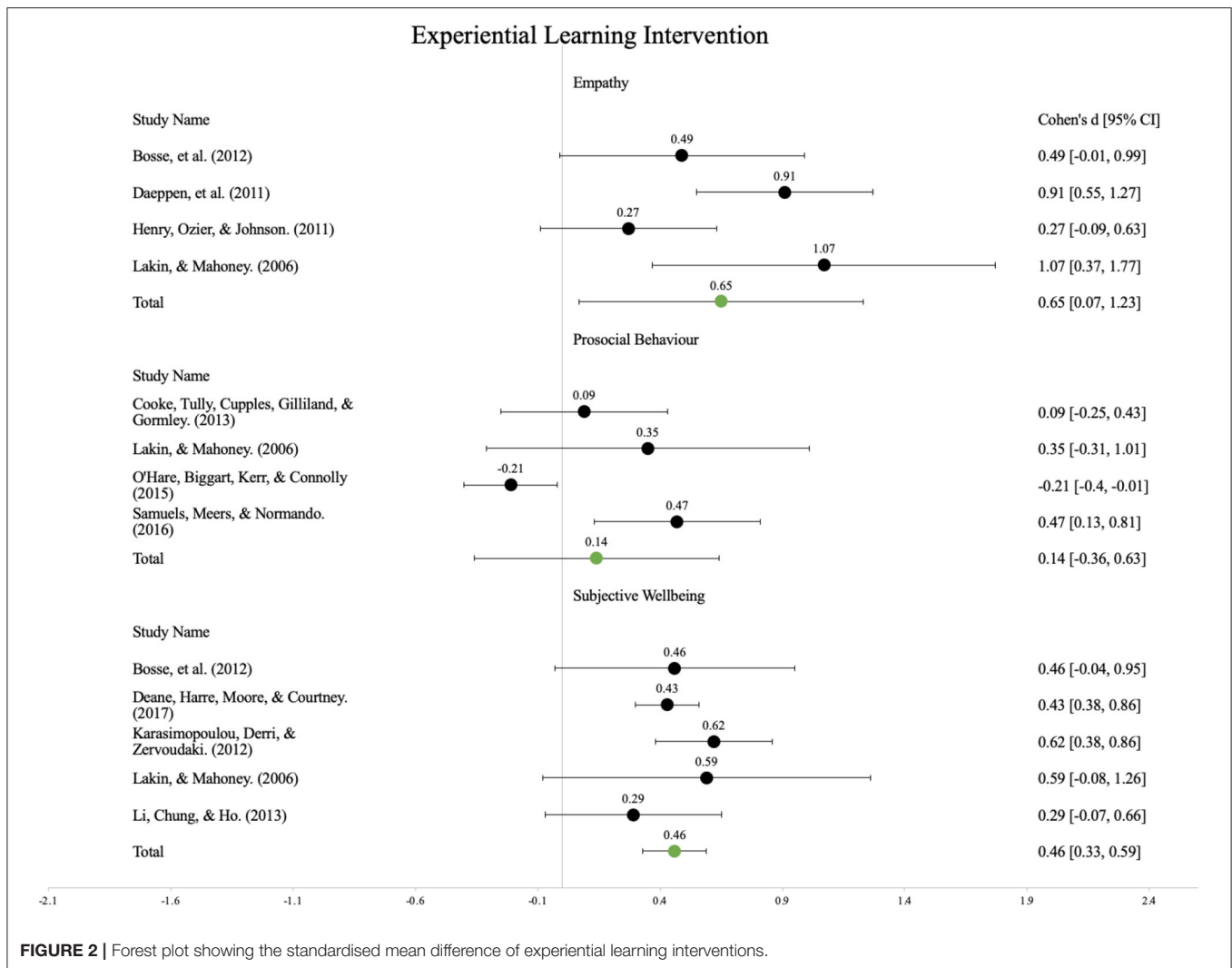
respect to the three outcome categories. Results indicate that all effects are non-significant, except for that of participants in the university-age range for empathy which $d = 0.52$, 95% CI (0.07, 0.97). Please refer to **Table 3** for the results.

Sub-group Analysis on Control

Main effects analyses were conducted for controlled conditions with respect to the three outcome categories. Please refer to **Table 4** for the results.

DISCUSSION

Effectiveness of EXL and NEXL Programmes

Results demonstrated that EXL programmes were effective in improving adolescents' empathy, prosocial behaviour, and subjective well-being. The following section suggests possible reasons for this based on information provided by the studies and literature on EXL.

Kolb's Theory of Experiential Learning is constructed based on the works of leading psychologists Kurt Lewin, William James, Jean Piaget, Lev Vygotsky, and others who shaped the field of human development and learning (Kolb, 2014). Components in the Theory of Experiential Learning are also explicitly structured to aid the transformation of experience into new ways of thinking and behaviour. This model of learning is likely a decisive factor for programme effectiveness because the four components of learning (Concrete Experience, Reflective Observation, Abstract Conceptualisation, Active Experimentation) helped participants assimilate and comprehend new knowledge. On the other hand, NEXL programmes do not fit Kolb's framework. Still, most NEXL programmes are constructed based on other well-established theories, such as Social-Emotional Learning and Cognitive-Behavioural Theory.

One major difference noted between the two types of learning programme was the amount of facilitation in reflection. With regards to the Reflective Observation component of Kolb's Theory of Experiential Learning, all EXL programmes had teachers, instructors, mentors or group members facilitating
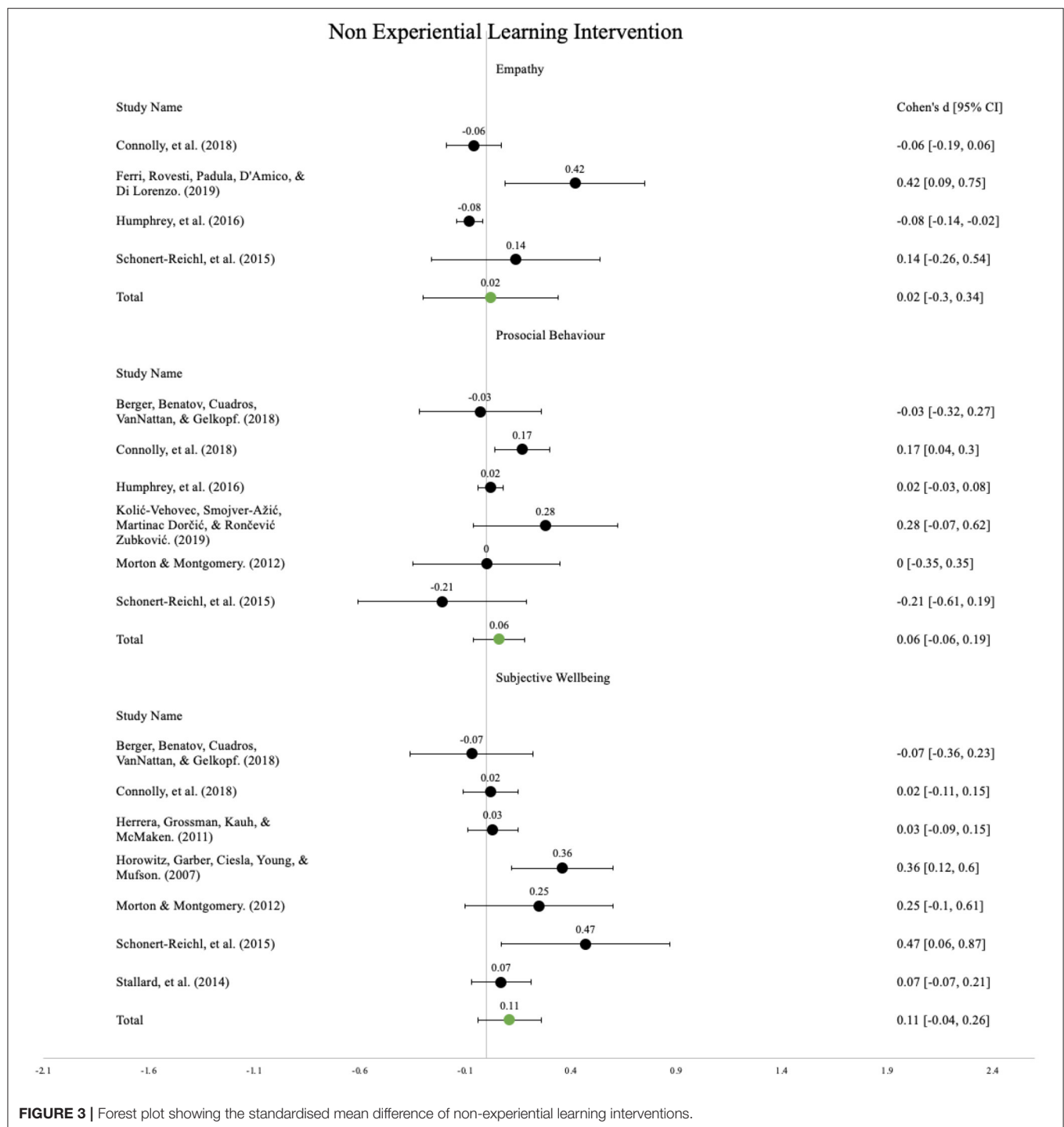
FIGURE 3 | Forest plot showing the standardised mean difference of non-experiential learning interventions.

participants' reflection of new experiences while all NEXL programmes did not. EXL programmes that had a facilitator guide members reflect on their experiences systematically produced the most significant outcomes in empathy (Lakin and Mahoney, 2006; Daeppen et al., 2012). Many EXL programmes conducted Reflective Observation through verbal discussions of

feelings, thoughts, and experiences, such as what participants learnt and how they think or felt they performed in an activity (Lakin and Mahoney, 2006; Bosse et al., 2012; Daeppen et al., 2012; Cooke et al., 2013; Li et al., 2013; O'Hare et al., 2015; Samuels et al., 2016). Some programmes crafted opportunities for self-reflection during the activity (Deane et al., 2017), two

programmes used written methods (Lakin and Mahoney, 2006; Karasimopoulou et al., 2012), and one programme used open-ended questions to guide participants' reflection (Henry et al., 2011).

In contrast, instructors in NEXL programmes did not guide their participants to reflect. Two factors, namely the mode of education and the large participant size, may have contributed to the lack of reflection. In half of the NEXL programmes, didactic lectures or classroom-based teaching was the prime mode of education (Horowitz et al., 2007; Stallard et al., 2014; Schonert-Reichl et al., 2015; Humphrey et al., 2016; Berger et al., 2018), so the participants adopted a relatively passive mode of learning. On the other hand, half of the NEXL interventions were conducted as a class, while more than half of the EXL programmes were conducted in small groups. Whole classroom interventions may pose difficulties for teachers to guide students' reflection because of limited time and resources. Overall, results suggest that reflection is essential in improving programme outcomes.

In terms of Active Experimentation, the setting in which experimentation and application of new concepts was conducted differed between the two types of programmes. Participants in EXL programmes engaged with groups and individuals in the community (Lakin and Mahoney, 2006; Henry et al., 2011; Bosse et al., 2012; Daeppen et al., 2012; Karasimopoulou et al., 2012; Deane et al., 2017). Results show that EXL programmes that used service-learning events, community service projects, simulation, role-play, or adventure programmes to apply new concepts and skills were the most effective in increasing empathy, prosocial behaviour and subjective well-being outcomes.

In contrast, most NEXL programmes either lacked the Active Experimentation component, or if they did, limited participants' experimentation to the classroom without engaging the real-world (Horowitz et al., 2007; Stallard et al., 2014; Humphrey et al., 2016; Berger et al., 2018). This may limit effective learning as it prevents newly learnt concepts from being reconstructed in a meaningful and authentic context for deeper reflections (Jeyaraj, 2019). Ultimately, participants in most NEXL programmes had no significant improvements in prosocial behaviour and empathy. Notably, two NEXL programmes that provided community-immersive activities demonstrated significant improvements in empathy (Ferri et al., 2019), prosocial behaviour (Connolly et al., 2018) and subjective well-being outcomes (Schonert-Reichl et al., 2015). Overall, these results suggest that the opportunity for participants to apply concepts beyond the classroom may yield better programme outcomes. This is consistent with existing research as interacting with others facilitates the development of empathetic attitudes and emotional sensitivity (Carlo et al., 2015; Spinrad and Eisenberg, 2017).

The flexibility of programmes for participants to take ownership of activities differed significantly between NEXL and EXL programmes. Most EXL programmes were flexible, and teachers imposed few restrictions. Emphasis was placed on the learner's self-motivation to initiate, plan and implement a course of action to achieve goals (Lakin and Mahoney, 2006; Bosse et al., 2012; Daeppen et al., 2012; Karasimopoulou et al., 2012; Li et al., 2013,?; Samuels et al., 2016; Deane et al., 2017). Participants

of these programmes had marked improvements in empathy, prosocial behaviour, and subjective well-being.

The NEXL programmes were often highly structured and teachers were required to follow programme guidelines to ensure programme fidelity (Horowitz et al., 2007; Stallard et al., 2014; Schonert-Reichl et al., 2015; Humphrey et al., 2016; Berger et al., 2018; Connolly et al., 2018). The authoritarian role of teachers and overreliance on traditional didactic teaching methods may have halted participants' self-discovery and engagement, leading to poor outcomes in NEXL programmes. Notably, an NEXL intervention that enabled participants to negotiate activities with their mentors had significant intervention effects on participants' subjective well-being (Morton and Montgomery, 2012). Hence, flexible programmes that provide opportunities for participants to take control of their learning may yield better outcomes.

It is worth noting that despite the relative ineffectiveness of NEXL programmes in improving empathy, prosocial behaviour and subjective well-being, it cannot be overlooked that out of the three outcomes, subjective well-being improved the most, albeit an less than small standardised mean difference ($d = 0.11$). One possible explanation is that most NEXL programmes aimed to teach adolescents how to regulate and understand their emotions, manage their behaviours, and reduce anxiety or depression (Horowitz et al., 2007; Stallard et al., 2014; Schonert-Reichl et al., 2015; Humphrey et al., 2016; Berger et al., 2018). These programmes were more self-oriented, focusing on understanding one's feelings and behaviours rather than helping others. Thus, improvement in subjective well-being was greater than empathy and prosocial behaviour in NEXL programmes.

Effects of Age

Results show that university-age subjects benefitted most from the learning programmes, with a higher overall standardised mean difference than that of other age groups in all three outcomes (empathy, $d = 0.52$; prosocial behaviour, $d = 0.09$; and well-being, $d = 0.46$).

One reason university-age adolescents had the most profound improvements after attending learning programmes may be that they are more cognitively developed. Major growth spurts in the brain during puberty cause the emergence of new neuronal pathways, pruning of existing neural networks, and significant development of the prefrontal cortex. Based on *Piaget's Theory of Cognitive Development,* these neuronal changes enable teens to perform formal operational skills such as abstract thinking and hypothetico-deductive reasoning, thus improving their ability to think critically about abstract concepts such as morality and free will (Weiten, 2013; Boyd and Bee, 2015). Moreover, increasingly challenging cognitive tasks demanded by higher education further develop metacognitive skills, facilitating conscious control of thought and reflective thinking (Boyd and Bee, 2015).

In contrast, primary school-age adolescents are closer to the concrete operational stage. In this stage, children can think logically, but can only apply logic to tangible objects and events (Weiten, 2013). They have difficulty thinking hypothetically and understanding things they cannot see or

TABLE 3 | Effect of age on intervention outcomes.

	Primary school-age (8–12 years old)	Secondary school-age (12–18 years old)	University-age (18–25 years old)
Empathy	0.03 (−0.48, 0.55) (*n* = 4)	–	0.52 (0.07, 0.97) (*n* = 4)
Prosocial behaviour	0.06 (−0.20, 0.32) (*n* = 6)	0.07 (−0.33, 0.48) (*n* = 3)	0.09 (−0.25, 0.43) (*n* = 1)
Subjective well-being	0.23 (−0.01, 0.47) (*n* = 7)	0.27 (−0.09, 0.62) (*n* = 4)	0.46 (−0.04, 0.95) (*n* = 1)

n, number of studies.

TABLE 4 | Effects of control conditions on outcomes.

	Alternative treatment	No treatment/waitlist
Empathy	0.31 (−0.03, 0.65) (*n* = 8)	–
Prosocial behaviour	0.11 (0.04, 0.26) (*n* = 8)	−0.16 (−1.27, 0.96) (*n* = 2)
Subjective well-being	0.29 (0.12, 0.46) (*n* = 10)	0.08 (−1.06, 1.21) (*n* = 2)

n = number of studies.

have not experienced (Boyd and Bee, 2015). The development of empathy and prosocial behaviour is highly linked to age. As children age and their theory of mind develops, their ability to self-regulate and differentiate themselves from others improves. This increases their ability to empathise with others and respond prosocially (Carlo et al., 2015). The results of this review are consistent with existing research as empathy and prosocial outcomes were the greatest for university-age, moderate for secondary school-age, and lowest for primary school-age participants.

Limitations and Implications

There are several limitations associated with this review. Firstly, as the interest of this review was to collect RCTs to ensure intervention reliability, the number of articles synthesised was limited. Only ten articles each were collated for NEXL and EXL, which may not be adequate to draw reliable conclusions on the overall effectiveness of these programmes. Secondly, the use of the PEDro scale to evaluate studies for internal validity may be too stringent. Since it is difficult to blind the administers, assessors and participants of the programs, many potential studies were screened out as a result of their low PEDro score. Thirdly, many factors contribute to the effectiveness of learning programmes beyond EXL or NEXL such as its activities, method of implementation, quality, and duration. Previous research also attests that participant characteristics such as age, gender, personality, experiences, and relationship with parents and peers also influence their empathetic responding, prosocial behaviour, and well-being (Lai et al., 2015; Silke et al., 2018). Hence, it would be inapt to attribute changes in outcomes to NEXL or EXL alone. Fourthly, this review looked at the immediate effects of learning programmes on the three outcomes, it is

not clear what the long-term effects of these interventions may be.

The results of this review suggest that EXL programmes have a higher potential to improve adolescent empathy, prosocial behaviour and well-being than NEXL programmes. This encourages the broader application of EXL in learning programmes to enhance Positive Youth Development outcomes. Future learning programmes may incorporate components such as facilitated individual or small-group reflections, active experimentation in various settings, and flexibility on the learning programme along with promotion of self-motivation to potentially increase the effectiveness of the programmes to promote PYD outcomes. However, since most EXL interventions in this review were conducted on older adolescents, further RCTs of EXL programmes for adolescents between ages 12-18 is recommended to confirm the effects of EXL programmes. Furthermore, only three studies measured all three outcomes. More RCTs of learning programmes that measure empathy, prosocial behaviour and subjective well-being is recommended.

CONCLUSION

Adolescence is a critical time for implementing learning programmes that promote PYD. Moreover, the use of such learning programmes may reduce risky behaviours in youths that lead to adverse physical and psychosocial effects that carry on into adulthood. The results of this review support the use of EXL programmes in schools and communities to develop empathy and subjective well-being. More RCTs on EXL programmes for adolescents are needed to deepen our understanding of how they can help adolescents thrive.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2021.709699/full#supplementary-material

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Effects and Moderators of Triple P on the Social, Emotional, and Behavioral Problems of Children: Systematic Review and Meta-Analysis

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Background: Social, emotional, and behavioral problems in childhood are key predictors of persistent problem behaviors throughout the life courses of individuals. Early parental intervention training, as an important preventive measure, plays a critical role in improving the social, emotional, and behavioral (SEB) development of children.

Method: We conducted a systematic review and meta-analysis to analyze the intervention effects of the latest literature on Triple P (Positive Parenting Program), which is a multilevel system that provides treatment and prevention for children at risk of social, emotional, and behavioral problems *via* parenting approaches to enhance the parenting knowledge, skills, and confidence of parents. Since the literature on Triple P from 1970 to 2012 has already been systematically reviewed, this study searched the literature from 2013 to 2020 from the Web of Science, EBSCO, ERIC, MEDLINE, CNKI, and Triple P Evidence-Base website using multiple search strategies. This study differs from the existing research by its inclusion criteria of studies that use experimental designs or quasi-experimental designs. A total of 37 studies were included in the final analysis, and STATA 16.0 was used for evaluation while RevMan 5.3 for risk of bias assessment.

Results: The results show that Triple P can promote the social competence of children ($SMD = 0.274$) and prevent their emotional ($SMD = -0.254$) and behavioral problems ($SMD = -1.38$) to a certain extent. Simultaneously, the proximal effects on parents mainly included changing negative parenting styles ($SMD = -0.46$), reducing parenting conflicts ($SMD = -0.311$), and improving parenting efficacy and self-confidence ($SMD = 0.419$). The distal effects on parents included reducing the psychological adjustment problems of parents ($SMD = -0.265$), improving parent–child relationships, and reducing parent–child conflict ($SMD = -0.714$). However, the meta-analysis results did not show a significant effect of Triple P on improving the marital relationship quality and satisfaction of parents ($SMD = 0.063$). Components of the program intervention, including intervention level, service delivery format, service method, and program implementation setting, and the age of the children were crucial moderating factors on the outcomes of Triple P.

Conclusion: This study systematically reviewed the latest Triple P intervention literature and found the significant effectiveness of Triple P on the SEB problems of children and parenting outcomes and the moderators of the effect size.

INTRODUCTION

The social, emotional, and behavioral (SEB) development of children is an essential topic to promote individual growth, family wellbeing, and social development (Sanders, 2012). This term refers to the social competence, emotional problems, and behavioral problems of children, and the definition of each part is: *social competence* is the ability of the children to use appropriate social skills in interactions with others and show pro-social and adaptive behaviors (Rantanen et al., 2012); *emotional problems* mean the negative emotions hidden inside that children fail to express or manage; *behavior problems* refer to the internalizing and externalizing behavioral issues of children, including withdrawal, refusal, and aggressive behaviors (Sanders et al., 2014). A latent transition analysis (LTA) by Basten et al. (2016) examined the stability of the behavioral problems of preschoolers and found that it had certain stability over time when children had co-occurring internalizing and externalizing problems. Thus, it would increase the risk of problem behaviors of the lives these children will have in the future. Evidence-based treatment was needed to prevent the adverse effects of the behavioral problems on the life courses of the individuals (Basten et al., 2016).

Parenting is a critical factor that affects the SEB development of children (Blader, 2006). Odgers et al. (2012) discovered that supportive parenting, especially maternal warmth, had a positively structural relationship with the social competence of children between 5 and 12 years, even under the circumstance of poverty in the United Kingdom. Maternal parenting stress would indirectly impact the social competence of children through parenting efficacy and behaviors, while positive maternal parenting behavior and a higher sense of efficacy could improve this social competence (Choi and Won, 2013). Simultaneously, negative parenting styles are risk factors that cause emotional and behavioral problems in children. Distant and excessively close parenting styles were both predictors of anxiety and depression in children aged 7–8 years old (Lindblom et al., 2017). A meta-analysis integrating 1,435 studies by Pinquart (2017) found that children showed higher externalizing problems when parents adopted negative parenting styles, such as harsh control or authoritarian, permissive, and neglectful parenting. In contrast, positive parenting styles, such as parental warmth, were protective factors that could reduce the behavioral problems of children (Hu and Jing, 2011; Li et al., 2016). The research about 10- to 13-year-old Palestinian children and their parents by Punamaki et al. (2017) proved that children who grew up in attached and warm family environments showed less internalizing, externalizing, and depressive problems.

Parenting interventions are essential for treating and preventing the problems of children and establishing a foundation to improve the wellbeing of children and families (Farrington and Welsh, 2003; McCart et al., 2006). In several countries, parenting interventions have both a rich history and an extensive evidence base. Barlow and Coren (2018) summarized six systematic reviews of parenting interventions published in the Campbell Library. These studies analyzed the effectiveness of different parenting styles in the primary and secondary prevention of the behavioral problems of children, treatment of conduct disorders in early childhood, and treatment of attention-deficit/hyperactivity disorder in children. The results showed that parenting intervention programs could not only enhance the mental health of parents but also effectively improve the emotional and behavioral adaptation of children.

Several parenting intervention programs are relatively mature, such as the meta-analysis results of two interventions, namely, the Parent–Child Interaction Therapy (PCIT) developed in the USA and the Positive Parenting Program (Triple P) developed in Australia, which have proven effective in reducing both the behavioral problems of 3- to 12-year-old children and the parenting problems of their caregivers (Thomas and Zimmer-Gembeck, 2007). Another systematic review of the Incredible Years (IY) Parenting Program has also been successful in improving disruptive behaviors and promoting the pro-social behaviors of children aged 3–9 in different families (Menting et al., 2013). These parenting intervention programs have an international influence and have the following common characteristics with other parent-focused intervention programs (Prinz, 2016): (1) they are founded in social learning theory and social interactional theory that both believe that interactions with family members are crucial factors in the development of behaviors in children, especially in preventing their misbehaviors; (2) they are action-centered behavioral parent training (BPT) interventions that focus on the specific parenting skills and strategies of parents rather than intervening directly with children; (3) they are problem-solving oriented, delivered in various content, formats, and modes, and widely spread. These interventions aim to prevent the problem behaviors of children, increase the parenting satisfaction and ability of parents, and strengthen the bond between children and parents. The vital role of parenting intervention programs in reducing and preventing the problems of children has been confirmed as they help parents reduce the internalization and externalization behaviors of children by improving parental cognition and emotional and behavioral regulation of parenting (Altafim et al., 2021).

Among these programs, Triple P has shown its distinguishing advantages because of its evidence-based features and popularity

based on public health models (Liu and Guo, 2020). Triple P is a multilevel intervention strategy with various strengths, intensities, and scopes that focus on improving parenting. It provides treatment and prevention for children aged 0–16 years at risk of SEB problems by improving their knowledge, skills, and self-efficacy parents have in parenting and promoting safe and low-conflict environments for children. The key characteristics of Triple P are as follows:

(1) The target group is the parents (or caregivers with the role of a parent) of children aged 0–16 and includes children with varying degrees of behavioral and developmental problems, children at high risk of behavioral and developmental problems, and children in general.

(2) It contains five levels of interventions. The main difference lies in the severity of the "problem" of the target groups. The low-level interventions are universal and preventative for all groups or groups with low problem severity, while the high-level interventions are targeted at and therapeutic for more severely affected groups. Simultaneously, as the intervention level increases, the intensity of the intervention gradually increases. Level 1: Universal Triple P. It is a universal prevention intervention for all populations, and program coordinators use media and communication kits as the strategy to popularize acceptable parenting advice for parents and caregivers of children. It can also foster a supportive social environment for parents. Level 2: Selected Triple P. It is a brief parenting intervention that provides parenting information with a one- or two-session program to promote healthy development for specific subgroups that are more likely to face developmental problems. The tip sheets combined with video series are used to manage one or two discrete child behaviors. Level 3: Primary Care Triple P. It is a more intensive prevention strategy that targets parents who are concerned about the discrete problem behavior of their children and provides methods and skills to address specific issues with a four-session strategy. Level 4: Standard Triple P/Group Triple P/Self-Directed Triple P. It targets at-risk populations with problematic behaviors and children who meet diagnostic criteria to provide parents with early intervention and directed prevention to prevent the emergence of problematic behaviors and the development of severe impairments with an 8- to 10-session program. Meanwhile, the deficits in parenting skills of this kind of family are clear. Level 5: Enhanced Triple P. It targets families with additional risk factors that have not changed from the lower levels of intervention, in which children usually have severe behavioral problems and family dysfunction (Sanders and Prinz, 2005). This intervention in this level is highly targeted to the problem. The level of intervention is a crucial factor in moderating the effect of the intervention (Sanders et al., 2014).

(3) Unlike other intervention programs, Triple P is based on a public health model and is not limited to providing services only to vulnerable and high-risk families. It is also a preventive intervention measure that consists of a series of streamlined, low-cost, and different intervention levels,

and has flexible delivery formats and service methods that can satisfy the fundamental needs of different parent groups across different childcare settings. The delivery formats include: face to face, online, face to face combined with telephone support, and online combined with telephone support. The service methods include: individual case, group, self-directed method, individual case combined with a group, and individual case combined with a self-directed method. They both vary according to the level of intervention correspondingly.

(4) The effectiveness of Triple P has been demonstrated by many evidence-based studies. Nowak and Heinrichs (2008) and Sanders et al. (2014) evaluated the effectiveness of Triple P in improving the parenting skills of parents and preventing SEB problems in children through systematic reviews. By comparing the information of the two studies in terms of the eligibility criteria, overall effect, and moderator effect, and by summarizing the findings, we can reveal that Triple P is a highly evidence-based parenting intervention program that can not only significantly prevent both SEB problems in children and negative parenting styles, but also effectively reduce parenting stress, enhance parenting efficacy, and improve the quality of parental relationships. At the same time, compared to other parenting intervention programs, Triple P has been widely replicated in at least 16 different countries (e.g., Australia, China, New Zealand, Turkey, Iran, and Indonesia) and diverse cultures, and has thus shown sound intervention effects and cultural adaptability (Heinrichs and Jensen-Doss, 2010; Hartung and Hahlweg, 2011). The country that implements the program does not influence the effect of the intervention, which means that the effectiveness of the intervention does not vary across countries and cultures, proving that Triple P has good cross-cultural adaptability.

In summary, many studies have shown that parenting skills are correlated with SEB problems in children, which are one of the main influencing factors and indicate that parenting intervention is a potential strategy for preventing and treating the problems of children. In recent years, a batch of increasingly mature parenting intervention programs has emerged, with such empirical studies supporting the critical role of these programs in promoting the wellbeing of parents and children. Among the many parenting intervention programs, Triple P has attracted attention owing to its good evidence-based cultural adaptability and confluence of prevention and treatment functions. Nowak and Heinrichs (2008) and Sanders et al. (2014) conducted comprehensive analyses of the literature on the effects of Triple P interventions published from 1970 to 2007 and 1980 to 2013, respectively, to demonstrate its effectiveness. In recent years, Triple P has been promoted and tested in a broader range of countries and settings, and new research results have been produced for different intervention levels and groups; thus, their effectiveness and related moderator effects need to be further evaluated and updated. Therefore, this study aims to systematically review the effectiveness of the Triple P intervention literature published

from 2013 to 2020 in terms of the SEB problems of children and parenting outcomes.

METHOD

Our study focused on the latest intervention effects of the Triple P intervention program on children and parents using a quantitative systematic review and a meta-analysis method. We collected Triple P intervention studies systematically according to specific inclusion/exclusion criteria, assessed the quality of evidence, designed information extraction forms, conducted data collection, and integrated data for analysis to summarize the effectiveness of Triple P in improving the SEB problems of children, parenting styles, parental adjustments, parental relationship satisfaction, and other aspects.

Search Strategy

We searched for intervention research articles based on Triple P from different sources: the comprehensive databases including the Web of Science, EBSCO, MEDLINE, and CNKI, and thematic databases including ERIC and the Triple P Evidence-Base website of The University of Queensland (https://pfsc.psychology.uq.edu.au/research/triple-p-evidence-base) using "Triple P" and "intervention" as the search terms. The publication period was limited between January 2013 to December 2020 and the language was limited to Chinese or English. The Endnote 20.0 software was used to manage the articles. Three researchers were responsible for the screening and two more screened the literature independently according to the inclusion and exclusion criteria. If there were any differences of opinion, the literature was resolved through discussion or a consensus was reached through discussion with a third researcher.

Inclusion/Exclusion Criteria

The inclusion and exclusion criteria in this study were formulated according to the PICOS approach; that is, (P) research population, (I) intervention measures, (C) comparison measures, (O) outcome indicators, and (S) study design. The specific standards are as follows:

(1) Population: The included studies should target the parents of the children. Regarding the definition of children, our study took the age range (0–16) of Triple P children as the same standard and included children with varying degrees of behavioral and developmental problems and children in general. Simultaneously, the included population must have parents as the primary intervention objects. Studies with "implementers" and "grandparents" as the intervention population should be excluded.

(2) Intervention: To ensure the independent effect of Triple P and eliminate interference from other interventions in the results, the included studies should include Triple P as the only intervention. Studies that combine other interventions should be excluded.

(3) Comparison: The comparison group should be a blank control group that does not receive interventions from Triple P or other parent training programs, which means that

comparative studies on the effects of interventions between different forms of Triple P and comparative studies on the effects of interventions between Triple P and other interventions should be excluded.

(4) Outcomes: The included study should report at least one data point in the outcome category to be analyzed in the current study. The outcome category consists of the social competence, emotional problems, and behavioral problems of children, parenting styles, conflict over parenting, parenting confidence, parental adjustment, marital relationship quality and satisfaction of parents, and the parent–child relationship. Meanwhile, the included study must have sufficient data, including the mean and standard deviation of each outcome of the pre- and post-tests. Studies that only report results related to parents but not children will be excluded. Studies in which the scales used to measure outcomes differ significantly from conventional ones will also be excluded.

(5) Study design: The study design should be a randomized controlled trial (RCT) design or a quasi-experimental design.

Type of Outcome

The characteristics of the outcomes were defined as follows (see the **Appendix** for specific measurement tools) to determine whether the effect value in the original study could be included in the extraction table: (1) social competence in children, which refers to the competence of children to interact and socialize with others, which includes, but is not limited to, the ability to express opinions and needs, ask for help, cooperate with the requirements of adults, get along with others, understand the feelings of others, understand the relationships between people, and to show a pro-social nature in interactions with others; (2) emotional problems in children, which may include anxiety, fear, depression, somatic complaints, shyness, and social withdrawal; (3) behavioral problems in children, which, based on the studies on the definition of the behavioral problems of children, we believe could include hyperactivity, disobedience, violation of discipline, and aggressive behavior (including problem and intensity); (4) parenting style, which refers to coping strategies used by parents to discipline their children, with parenting, according to our review of the existing literature, referring to a collection of attitudes and behaviors that parents convey to their children, and can be divided into different dimensions (including laxness, over-reactivity, and verbosity) using a conventional measurement tool; (5) conflict over parenting, which refers to disagreements and conflicts between parents in parenting, and mainly includes the problem and extent of parenting conflict; (6) parenting confidence, which refers to the self-evaluation of parents about their parenting ability, and mainly includes the sense of efficacy parents have for the behavior of their children and parenting settings; (7) parental adjustment, which refers to the pressure and adjustment of parenting and mainly includes depression, anxiety, and stress; (8) relationship quality and satisfaction of parents, which refers to the valuation and satisfaction of marital relationships between couples; (9) parent–child relationship, which evaluates the relationship between

parents and children and is mainly reflected by parent–child conflict.

Data Abstraction and Coding

Microsoft Excel was used to design the data extraction table and extract and manage the data. To ensure the accuracy of the data, two researchers extracted the information independently and then combined the data after re-checking and a consensus. Two types of data files were generated in our study: description and effect size files. The description item file included the following information: First, the basic information included the research title, publication type, publication time, name of the researchers, and data extraction date. Second, the sample characteristics included the average age and age range of children, gender ratio of children, initial symptoms/additional risks of children, severity of the initial problems of children, average age of parents, gender ratio of parents, sample characteristics at baseline (e.g., sample size of the total/intervention group/comparison group), the number of people lost to follow-up/withdrawal from the intervention and comparison groups, and the country and intervention setting. Third, the study design included extracted information on the comparison and the measures of intervention groups, such as level, version, form of service delivery, implementation time, frequency, duration, training of the intervention providers, and assessment information on the risk of bias. The effect size file concerned the extraction and sum of the relevant data for the outcomes and included nine sub-tables of the outcomes. In each sub-table, the measurement tools, reports, and intervention/control group data were recorded at the baseline and post-test time on the outcomes of each study, such as the number of participants, mean, standard deviation, and other data.

Risk of Bias Assessment

The risk of bias within studies was assessed by two researchers independently according to the Cochrane Risk of Bias assessment tool (Cochrane RoB), which mainly included the generation of random sequences, concealment of the allocation scheme, blinding of participants and intervention practitioners, blinding of the outcome evaluator, integrity of the outcome data, risk of selective reporting of study results, and other sources of bias (Higgins and Green, 2008). They were assessed as "low," "high," and "unclear" in each study. We combined the data after re-checking and used RevMan 5.3 to assess the bias within the studies through the proportion of "low risk," "high risk," and "unclear" in each kind of bias. The publication bias was assessed by Egger's test (Egger et al., 2003).

Statistical Model

The effect size was derived from the statistical standardization of initial results from different studies. It represented the quantitative results from a series of studies in a standardized form and allowed for meaningful numerical comparison and analysis between studies. In our study, the standardized mean difference (SMD) and its 95% confidence interval were used as statistics for the effect analysis (Yang et al., 2018). The random-effects model would be used unless there was only one study having the data

of the outcomes we cared about. In the circumstance of only one study, we would have chosen the fixed-effect model (Borenstein et al., 2010).

Heterogeneity tests are essential in systematic reviews of social science as the differences among studies may lead to different research results. It is believed that, if the heterogeneity between the original studies is low, then the pooled effect size has high credibility. In this study, heterogeneity was tested using the Q test, I^2 statistic (the variation in SMD attributable to heterogeneity), and the Tau^2 statistic (the estimation of the between-study variance). If the result of the Q test is not significant ($p > 0.05$), it indicates that the heterogeneity between studies is low, and vice versa. The larger the I^2 statistic, the higher the heterogeneity between the original studies is. When $I^2 < 50\%$, it means that there is a low to moderate degree of heterogeneity between the original research results, and when $I^2 \geq 50\%$, there is a high degree of heterogeneity between the original research results (Yang et al., 2018). The larger the Tau^2 statistic, the higher the heterogeneity between the original studies is (Borenstein et al., 2017). The effects were calculated and statistically analyzed using STATA 16.0.

Subgroup and Meta-Regression Analyses

We conducted subgroup and meta-regression analyses on the outcomes with high heterogeneity. The sources of heterogeneity were the characteristics of the child, which mainly referred to whether the child had a developmental problem or an initial behavioral problem, and program characteristics, which included the format of service delivery, service method, level of Triple P, and program implementation environment including country and setting. Then, we performed a meta-regression analysis with child age, boy ratio, and sample size. We need to emphasize that, first, based on the conclusions of Nowak and Heinrichs (2008) and Sanders et al. (2014), we examined whether there were differences between the effects of Triple P among countries and its cultural adaptability. Second, children with developmental problems or behavioral problems, such as intellectual disability, attention-deficit/hyperactivity disorder, anxiety disorder, autism spectrum disorder, and behavioral problems as determined by measurement tools are more likely to have SEB problems than normal children. Therefore, we investigated whether there were differences in the effectiveness of Triple P for different groups, and attempted to verify whether Triple P was more effective in interventions for children with developmental problems and initial behavioral problems.

RESULTS

Study Selection

After the retrieval, 362 articles were from the Web of Science, 249 articles from EBSCO, 14 articles from MEDLINE and ERIC, and 343 articles from the Triple P Evidence-Base website. Finally, we obtained a total of 968 articles. Endnote 20.0 was used to remove duplicated articles, and we obtained a total of 755 articles. In the initial screening stage, two researchers (the first and third authors) excluded 657 unqualified articles according to their titles and abstracts based on the inclusion and exclusion

criteria, which included duplicate articles, use of non-Chinese or English languages, combination of Triple P interventions with other programs, and non-Triple P intervention studies. Further, we re-screened the full text of 98 articles obtained after the initial screening for eligibility and excluded 61 articles. These articles included those that combined Triple P interventions with other programs, contained a non-randomized controlled experimental design or quasi-experimental design, had design and intervention objects that were not parents or caregivers with the role of a parent, had outcomes that were not directly reported, had insufficient data, had measurement tools of outcomes were too different, and had population-level changes. Finally, 37 articles were included in our meta-analysis. **Figure 1** shows the search and screening processes used in our study.

Study Characteristics

Table 1 provides basic information on the 37 studies. All the studies were conducted between 2013 and 2020, and 36 randomized controlled trials studies and one quasi-experimental study served 3,691 families (ranging from 17–355 families). The average age of children was 7.11 years (ranging from 2 to 17 years; SD = 4.62). The average proportion of boys was 61.9% (SD = 6.65). The children who received an intervention program in 28 studies had developmental or behavioral problems, including intellectual disability, attention-deficit/hyperactivity disorder, anxiety disorder, autism spectrum disorder, and behavioral problems as determined by measurement tools. In terms of the countries where programs were implemented, 16 were in Australia, 4 were in China, 3 were in New Zealand, 1 was in Australia and New Zealand simultaneously, and 13 were in other countries. Communities (n = 10) consisted of the main implementation setting. The other settings were healthcare centers, hospitals and clinics, schools, university health research centers, universities combined with communities, and online. In terms of the Triple P intervention levels, level 4 was the most common (n = 23), followed by levels 3, 5, and 2, in that order. There was no related research on the level 1 intervention in the included articles. The delivery formats of the interventions were "face-to-face," "online," "face-to-face combined with telephone support," and "online combined with telephone support." The service methods included the individual case, group, self-directed method, individual case combined with a group (n = 19), and individual case combined with a self-directed method. The average duration of the program intervention was 6.61 sessions.

Overall Effect Size

Table 2 summarizes the effects of Triple P on the nine outcomes and other statistics, and includes the number of articles that reported the outcomes (k), pooled SMD, 95% confidence interval (CI), I^2, Tau^2, and Tau.

SEB Problem Outcomes in Children

Six intervention studies reported results relating to the social competence of children and 13 reported results relating to the emotional problems of children. We found significant differences in the outcomes of the social competence [$SMD = 0.274$, 95% CI (0.025, 0.523)] and emotional problems [$SMD = -0.254$,

95% CI (−0.476, −0.031)] of children between the experimental and control groups, showing that Triple P can significantly improve the social competence of children while reducing their emotional problems. Seventeen intervention studies reported results relating to the behavioral problems of children. The pooled SMD of the behavioral problems of children was −1.38 and its 95% confidence interval ranged from −2.161 to −0.599. Therefore, we can conclude that the Triple P intervention can significantly reduce the behavioral problems of children.

Fifteen studies reported the effects of Triple P on the number of behavioral problems of children. The pooled SMD was −0.467 and its 95% confidence interval ranged from −0.631 to −0.303, showing that the experimental and control groups had significant differences in the number of the behavioral problems of children, which indicates that Triple P can significantly reduce this number. Seventeen studies reported the effect of Triple P on the intensity of behavioral problems. The pooled SMD was −0.378 with a 95% confidence interval that ranged −0.501 to −0.255, indicating that there was a significant difference between the experimental and control groups. Therefore, Triple P can significantly reduce the intensity of behavioral problems in children.

Parental Outcomes: Proximal Effects

The proximal effects mainly included *parenting style*, *conflict over parenting*, and *parenting confidence*. For parenting style, the outcomes reported in the original research consisted of four types: total score of *parenting styles* [$SMD = -0.46$, 95% CI (−0.717, −0.203)] and the score of the sub-dimensions of *laxness* [$SMD = -0.482$, 95% CI (−0.653, −0.31)], *over-reactivity* [$SMD = -0.48$, 95% CI (−0.645, −0.315)], and *verbosity* [$SMD = -0.639$, 95% CI (−0.878, −0.399)]. The results showed that the experimental and control groups had significant differences in these four dimensions, indicating that Triple P can significantly prevent negative parenting styles in parents. The analysis of *conflict over parenting* included three aspects: *total score* [$SMD = -0.311$, 95% CI (−0.515, −0.106)], *problem* [$SMD = -0.333$, 95% CI (−0.638, −0.029)], and *extent* [$SMD = -0.268$, 95% CI (−0.511, −0.025)]. The meta-analysis results showed significant differences between the experimental and control groups in these dimensions, indicating that Triple P can significantly reduce conflict over parenting. The analysis of parenting efficacy also included three aspects: *total score* [$SMD = 0.419$, 95% CI (0.309, 0.53)] and the sub-dimensions of *behavior self-efficacy* [$SMD = 0.491$, 95% CI (0.339, 0.643)] and *setting self-efficacy* [$SMD = 0.304$, 95% CI (0.111, 0.497)]. The meta-analysis results showed that there were significant differences between the experimental and control groups regarding the changes in the above data, showing that Triple P can significantly improve parenting efficacy.

Parental Outcomes: Distal Effects

The distal effects mainly included *parental adjustment*, *parent–child relationship*, and *marital relationship quality and satisfaction of parents*. For *parental adjustment*, in addition to the *parental adjustment* total score, the original studies also reported the scores of the three sub-dimensions of *depression*,

FIGURE 1 | The process of the exclusion and the selection of studies in meta-analysis.
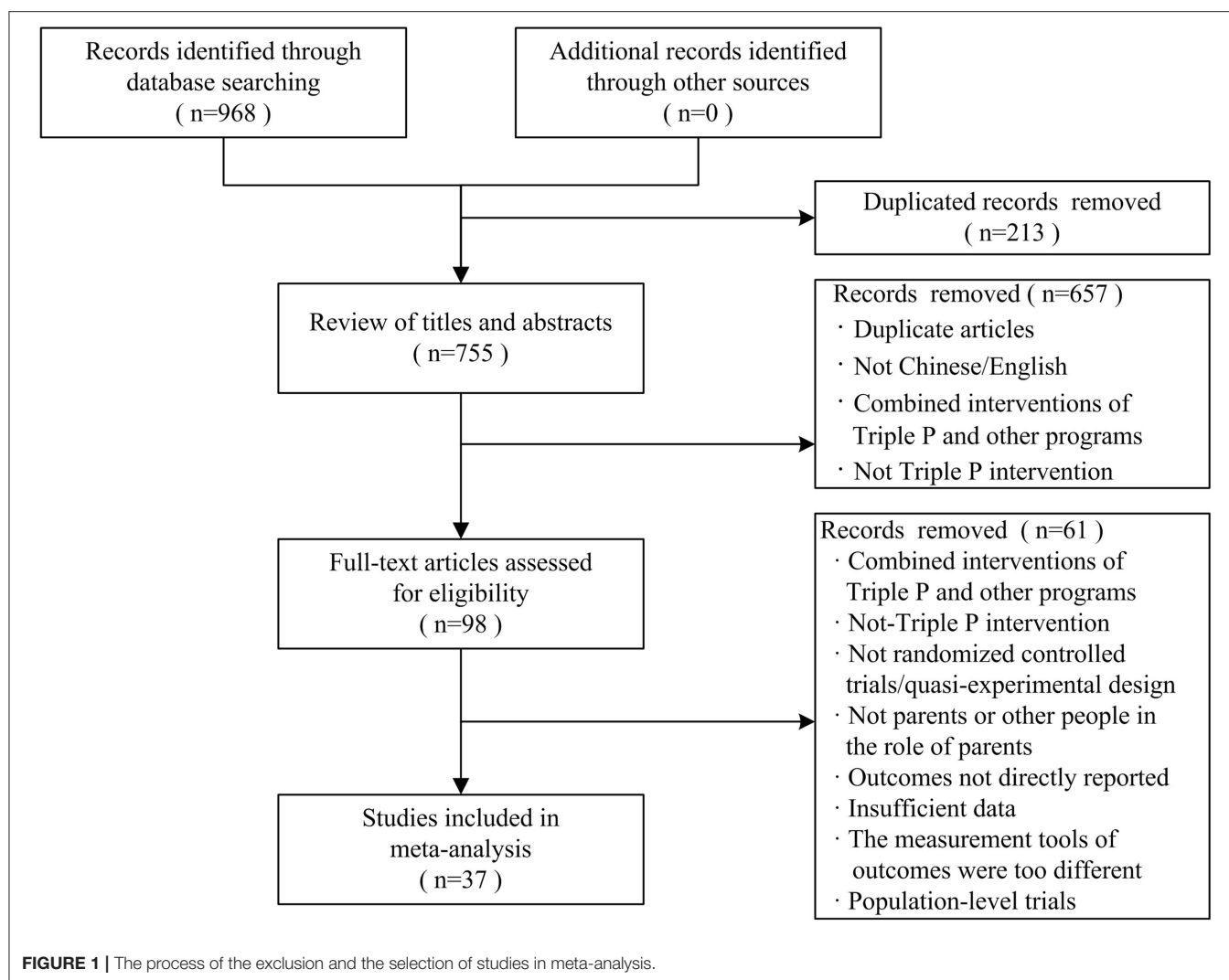
anxiety, and *stress*. The results showed that the experimental and control groups had different total scores for *parental adjustment* [$SMD = -0.265$, *95% CI* (-0.402, -0.128)], *depression* [$SMD = -0.571$, *95% CI* (-1.003, -0.139)], *anxiety* [$SMD = -0.278$, *95% CI* (-0.427, -0.128)], and *stress* [$SMD = -0.582$, *95% CI* (-1.055, -0.108)], indicating that Triple P can significantly improve the level of psychological adjustment of parents. In addition, the meta-analysis results showed that Triple P had a significant effect on reducing parent–child conflict [$SMD = -0.714$, *95% CI* (-1.292, -0.135)], but we did not find a significant effect of Triple P on the marital relationship quality and satisfaction of parents [$SMD = 0.063$, *95% CI* (-0.228, 0.354)].

Heterogeneity Sources and Moderating Effects

Table 3 shows the results of subgroup analysis. **Table 4** shows the results of meta-regression analysis.

Subgroup and Meta-Regression Analyses of Emotional Problems in Children

According to the subgroup analysis results of emotional problems in children, we could first conclude that the presence of a developmental/behavioral problem, the level of Triple P, service delivery format, service method, and country of the intervention implementation were all heterogeneity sources of the emotional problems of children. The differences of the pooled effect sizes between the subgroups were all statistically significant (most $p < 0.001$). First, in terms of the sample characteristics, the effect of Triple P on reducing the emotional problems in children without developmental or behavioral problems was significant [$SMD = -0.314$, *95% CI* (-0.565, -0.062)], which was contrary to our expectations. Second, interventions in other countries [$SMD = -0.529$, *95% CI* (-1.019, -0.04)] had a stronger effect on the outcomes of emotional problems in children than interventions in Australia [$SMD = -0.221$, *95% CI* (-0.563, 0.121)]. Third, regarding the components of the intervention, level 4 [$SMD = -0.612$, *95% CI* (-0.946, -0.278)]

Sample characteristics	Sample size (N)	Sample characteristics	Sample size (N)	Other values
Country		Face to face	14	
Australia	16	Online + telephone	3	
China	4	Online	3	
New Zealand	3	**Developmental/**		
Turkey	3	**Behavioral problems**		
Netherlands	3	Yes	28	
Iran	2	No	9	
Australia and New Zealand	1	**Level of Triple P**		
Indonesia	1	First level	0	
Ireland	1	Second level	1	
Panama	1	Third level	11	
Sweden	1	Fourth level	23	
the UK	1	Fifth level	2	
Setting		**Service methods**		
Community	10	Case	4	
Hospital and clinic	6	Group	9	
School	5	Self-directed	3	
University	5	Case + group	19	
Online	5	Case + self-directed	2	
Health care center	4	**Child age**		7.11 (year)
University and community	2	**Average % of boy**		61.9 (%)
Delivery format		**Average session**		6.61 (session)
Face to face+telephone	17	**Total sample size**		3691 (family)

Bold value indicate dimensions of study characteristics.

showed significant effects in reducing the emotional problems of children. Correspondingly, the "face-to-face combined with telephone support" format [$SMD = -0.761$, 95% CI (-1.04, -0.481)] and the "group activities combined with individual case counseling" methods [$SMD = -0.761$, 95% CI (-1.04, -0.481)] were both significant. We also conducted a meta-regression analysis with child age, boy ratio, and sample size as the moderating variables. The results showed that child age ($\beta = -0.121$, $p < 0.05$) was negatively correlated with emotional problems, while the effects of boy ratio ($\beta = -0.774$, $p > 0.05$) and sample size ($\beta = 0.006$, $p > 0.05$) on emotional outcomes were not significant. This indicates that, the older the child, the stronger the effect in the reduction of emotional problems in children. The boy ratio and the sample size of the intervention did not have significant effects on the emotional problems of the children.

Subgroup Analysis of Behavioral Problems in Children (Total Score)

We conducted a subgroup analysis of behavioral problems in children and found that the presence of a developmental/behavioral problem, country, age of the children, boy ratio, and sample size did not significantly moderate the outcomes and were not sources of heterogeneity. These contrast with the findings of Sanders et al. (2014), who found that country, presence of a developmental/behavioral problem, and child age were significant moderators of SEB in children. The heterogeneity of behavioral problems in children came

from four sources, namely, Triple P level, service delivery format, service method, and intervention implementation setting, and the differences of the pooled effect sizes between the subgroups were all statistically significant ($p < 0.001$). First, in terms of the intervention levels of Triple P, level 4 [$SMD = -0.758$, 95% CI (-1.184, -0.332)] could significantly reduce behavioral problems in children, while the effect of level 3 was not significant [$SMD = 0.143$, 95% CI (-0.304, 0.59)]. Second, regarding the format of service delivery, "face-to-face activities combined with telephone support" [$SMD = -3.004$, 95% CI (-4.721, -1.288)] showed a significant effect, while "face-to-face activities" [$SMD = -0.408$, 95% CI (-1.022, 0.206)] and "online combined with telephone support" [$SMD = -0.015$, 95% CI (-0.4, 0.37)] had no significant effects. In terms of the service methods, "group activities combined with case counseling" [$SMD = -2.676$, 95% CI (-4.267, -1.086)] showed strong effect, while group [$SMD = -0.695$, 95% CI (-1.618, 0.228)] and case counseling [$SMD = -0.017$, 95% CI (-0.603, 0.569)] methods did not explain the heterogeneity between the effect sizes significantly. Interventions in hospitals and clinics [$SMD = -3.928$, 95% CI (-6.437, -1.419)] and universities [$SMD = -1.055$, 95% CI (-1.751, -0.359)] were significantly effective, in addition to when implemented in both universities and communities simultaneously. The effect of the intervention implemented in community [$SMD = -0.377$, 95% CI (-0.931, 0.178)] alone was non-significant, while the effects of online [$SMD = -0.015$, 95% CI (-0.4, 0.37)] and healthcare centers [$SMD = 0.203$, 95% CI (-0.536, 0.941)] were not significant.

TABLE 2 | The overall effect size of Triple P on the outcomes.

	k	Pooled SMD	Lower 95% CI	Upper 95% CI	I^2	Tau^2	Tau
1. Social competence in child	6	0.274	0.025	0.523	0.0%	0.000	0.000
2. Emotional problems in child	13	−0.254	−0.476	−0.031	65.0%	0.102	0.319
3. Behavioral problems in child-Total	17	−1.380	−2.161	−0.599	97.3%	2.508	1.584
3.1 Problem	15	−0.467	−0.631	−0.303	42.5%	0.042	0.205
3.2 Intensity	17	−0.378	−0.501	−0.255	15.6%	0.010	0.100
4. Parenting Style-Total	18	−0.460	−0.717	−0.203	83.3%	0.249	0.499
4.1 Laxness	15	−0.482	−0.653	−0.310	50.9%	0.056	0.237
4.2 Overreactivity	15	−0.480	−0.645	−0.315	47.3%	0.048	0.219
4.3 Verbosity	10	−0.639	−0.878	−0.399	59.6%	0.084	0.290
5. Conflict over Parenting-Total	6	−0.311	−0.515	−0.106	11.4%	0.008	0.089
5.1 Problem	8	−0.333	−0.638	−0.029	69.0%	0.127	0.356
5.2 Extent	9	−0.268	−0.511	−0.025	57.8%	0.076	0.276
6. Parenting Confidence-Total	28	0.419	0.309	0.530	32.1%	0.027	0.164
6.1 Behavior	14	0.491	0.339	0.643	34.3%	0.028	0.167
6.2 Setting	9	0.304	0.111	0.497	32.1%	0.028	0.167
7. Parental Adjustment-Total	15	−0.265	−0.402	−0.128	19.3%	0.014	0.118
7.1 Depression	15	−0.571	−1.003	−0.139	94.3%	0.660	0.812
7.2 Anxiety	14	−0.278	−0.427	−0.128	48.7%	0.034	0.184
7.3 Stress	14	−0.582	−1.055	−0.108	95.0%	0.748	0.865
8. Parent-Child relationships	5	−0.714	−1.292	−0.135	85.2%	0.368	0.607
9. Relationship Satisfaction of parents	9	0.063	−0.228	0.354	64.4%	0.126	0.355

k, number of studies; SMD, standard mean difference; CI, confidence interval; I^2, the variation in SMD attributable to heterogeneity; Tau^2, the estimation of the between-study variance.

Subgroup Analysis of Parenting Styles

Consistent with the subgroup analysis results of problem behaviors in children, the subgroup analysis results of parenting styles showed that the presence of a development/behavioral problem, country, age of children, boy ratio, and sample size did not explain the heterogeneity between the effect sizes significantly. Heterogeneity came from four sources: Triple P level, service delivery format, service method, and implementation setting. The differences of the pooled effect sizes between the subgroups were all statistically significant ($p < 0.001$). In terms of the intervention levels of the Triple P, level 4 [$SMD = −0.615$, 95% CI (−0.855, −0.376)] could significantly improve parenting style, while the effect of level 3 [$SMD = 0.013$, 95% CI (−0.381, 0.407)] was not significant. In the service delivery format, only "face-to-face activities" [$SMD = −0.088$, 95% CI (−0.404, 0.227)] was non-significant. "Face-to-face activities combined with telephone support" [$SMD = −0.917$, 95% CI (−1.208, −0.626)] and "online combined telephone support" [$SMD = −0.443$, 95% CI (−0.737, −0.15)] were both effective. "Face-to-face case counseling" [$SMD = 0.468$, 95% CI (−0.611, 1.547)] was non-significant, but "face-to-face group activities" [$SMD = −0.287$, 95% CI (−0.503, −0.072)], "group activities combined with case counseling" [$SMD = −0.917$, 95% CI (−1.208, −0.626)], and "self-directed combined case counseling" [$SMD = −0.443$, 95% CI (−0.737, −0.15)] were all effective. Interventions in hospitals [$SMD = −0.703$, 95% CI (−1.344,

−0.061)], communities [$SMD = −0.322$, 95% CI (−0.554, −0.09)], universities [$SMD = −0.609$, 95% CI (−0.907, −0.312)], and online [$SMD = −0.528$, 95% CI (−0.775, −0.281)] were all effective. It did not show significant effects when interventions were implemented in healthcare centers [$SMD = 0.468$, 95% CI (−0.611, 1.547)] and universities in combination with communities [$SMD = −0.515$, 95% CI (−1.419, 0.388)].

Subgroup Analysis of Conflict Over Parenting

In the subgroup analysis of conflict over parenting, the level of Triple P and implementation setting were sources of heterogeneity. The subgroup analysis results showed that level 4 of the Triple P [$SMD = −0.349$, 95% CI (−0.645, −0.052)] had a significant effect on reducing the conflict over parenting of parents. The community [$SMD = −0.478$, 95% CI (−0.947, −0.009)] was the only setting showing a significant effect on reducing the conflict over parenting of parents. However, neither of the differences of the pooled effect sizes between the subgroups were significant ($p = 0.13$ and $p = 0.08$). Further research based on more studies is needed.

Subgroup Analysis of Parent–Child Relationship

The heterogeneity of the parent–child relationship came from the level of Triple P. The level 4 intervention [$SMD = −0.904$, 95% CI (−1.528, −0.280)] had a significant effect in reducing the parent–child relationship. As the other subgroups included

TABLE 3 | The results of the subgroup analysis.

Outcomes	Sources of heterogeneity	Subgroup differences	Categories	k	pooled SMD	lower 95% CI	upper 95% CI	z	P
Emotional problems in children	Developmental/ Behavioral problems	P = 0.02	Yes	9	−0.355	−0.733	0.023	1.84	0.066
			No	4	−0.314	−0.565	−0.062	2.45	0.014*
	Level of Triple P	P < 0.001	Third level	4	0.088	−0.129	0.304	0.79	0.427
			Fourth level	8	−0.612	−0.946	−0.278	3.59	0.000***
	Delivery format	P < 0.001	Face to face + telephone	4	−0.761	−1.040	−0.481	5.34	0.000***
			Face to face	6	−0.234	−0.654	0.186	1.09	0.274
			Online	2	−0.151	−0.714	0.411	0.53	0.598
	Service method	P < 0.001	Group	5	−0.230	−0.722	0.262	0.92	0.359
			Self-directed	2	−0.151	−0.714	0.411	0.53	0.598
			Group + case	4	−0.761	−1.040	−0.481	5.34	0.000***
	Country	P < 0.001	Australia	8	−0.221	−0.563	0.121	1.27	0.205
			Other countries	4	−0.529	−1.019	−0.040	2.12	0.034*
Behavioral Problems in Children	Level of Triple P	P < 0.001	Third level	3	0.143	−0.304	0.590	0.63	0.531
			Fourth level	12	−0.758	−1.184	−0.332	3.49	0.000***
	Delivery format	P < 0.001	Face to face + telephone	8	−3.004	−4.721	−1.288	3.43	0.001***
			Face to face	7	−0.408	−1.022	0.206	1.30	0.193
			Online + telephone	2	−0.015	−0.400	0.370	0.08	0.938
	Service method	P < 0.001	Case	3	−0.017	−0.603	0.569	0.06	0.956
			Group	4	−0.695	−1.618	0.228	1.48	0.14
			Group + case	9	−2.676	−4.267	−1.086	3.3	0.001***
	Setting	P < 0.001	Community	2	−0.377	−0.931	0.178	1.33	0.183
			Hospital and clinic	6	−3.928	−6.437	−1.419	3.07	0.002**
			University	4	−1.055	−1.751	−0.359	2.97	0.003**
			Online	2	−0.015	−0.400	0.370	0.08	0.938
			Health care center	2	0.203	−0.536	0.941	0.54	0.590
Parenting Style	Level of Triple P	P < 0.001	Third level	6	0.013	−0.381	0.407	0.06	0.949
			Fourth level	10	−0.615	−0.855	−0.376	5.04	0.000***
	Delivery format	P < 0.001	Face to face + telephone	7	−0.917	−1.208	−0.626	6.18	0.000***
			Face to face	8	−0.088	−0.404	0.227	0.55	0.584
			Online + telephone	2	−0.443	−0.737	−0.150	2.96	0.003**
	Service method	P < 0.001	Case	2	0.468	−0.611	1.547	0.85	0.395
			Group	6	−0.287	−0.503	−0.072	2.62	0.009**
			Group + case	7	−0.917	−1.208	−0.626	6.18	0.000***
			Self-directed + case	2	−0.443	−0.737	−0.150	2.96	0.003**
	Setting	P < 0.001	Community	4	−0.322	−0.554	−0.090	2.72	0.007**
			Hospital and clinic	4	−0.703	−1.344	−0.061	2.15	0.032*
			University	2	−0.609	−0.907	−0.312	4.01	0.000***
			Online	3	−0.528	−0.775	−0.281	4.19	0.000***
			Health care center	2	0.468	−0.611	1.547	0.85	0.395
			University and community	2	−0.515	−1.419	0.388	1.12	0.264
Conflict over Parenting	Level of Triple P	p = 0.13	Third level	3	−0.363	−1.085	0.358	0.99	0.324
			Fourth level	5	−0.349	−0.645	−0.052	2.31	0.021*
	Setting	P = 0.08	Community	4	−0.478	−0.947	−0.009	2.00	0.046*
Parent-Child Relationship			Online	2	−0.205	−0.854	0.444	0.62	0.535
	Level	–	Fourth level	4	−0.904	−1.528	−0.280	2.84	0.005**

*We conducted a subgroup analysis of the outcomes with high heterogeneity (Q test is significant, p <0.05 and I² ≥ 50%). The results of subgroup analysis of only one study were not presented in this Table. k, number of studies; SMD, standard mean difference; CI, confidence interval; * p < 0.05 **p < 0.01. ***p < 0.001.*

TABLE 4 | The results of the meta-regression analysis.

Outcomes	Moderators	k	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
Emotional problems	Child age	13	−0.121	0.043	2.80	0.017[*]	−0.216	−0.026
in children	Boy ratio	13	−0.774	1.688	−0.46	0.655	−4.488	2.940
	Sample size	13	0.006	0.003	2.08	0.062	−0.000	0.012
Behavioral problems in	Child age	17	0.009	0.322	0.03	0.978	−0.687	0.705
Children	Boy ratio	17	2.693	9.692	0.28	0.785	−18.245	23.631
	Sample size	17	−0.013	0.015	−0.88	0.396	−0.046	0.019
Parenting style	Child age	18	0.034	0.047	0.73	0.476	−0.066	0.135
	Boy ratio	18	−0.174	1.338	−0.13	0.898	−3.042	2.695
	Sample size	18	−0.002	0.002	−0.73	0.478	−0.006	0.003
Conflict over parenting	Child age	8	0.068	0.039	1.77	0.151	−0.039	0.176
	Boy ratio	8	2.510	0.963	2.60	0.060	−0.165	5.184
	Sample size	8	0.004	0.003	1.14	0.300	−0.004	0.012
Parent-child relationship	Child age	5	−0.138	0.314	−0.44	0.736	−4.123	3.847
	Boy ratio	5	−4.915	7.626	−0.64	0.636	−101.819	91.988
	Sample size	5	0.030	0.037	0.83	0.558	−0.423	0.482

k, number of studies; Coef., coefficient; Std. Err., standard error; 95% Conf. Interval, 95% confidence interval; *p < 0.05.

only one study, this conclusion was not accurate. We need more studies for further research.

Risk of Bias
Risk of Bias Within Studies
Figure 2 shows the results of the risk of bias within studies. In terms of the selection bias, the high-risk sequence generation accounted for a relatively small proportion. The generation of the random sequence had a low risk. None of the allocation concealments of the studies were unclear. There were a small number of studies that had not concealed its random allocation, with most of the studies carried out allocation concealment. The highest risk of bias was performance bias. Attrition bias in all studies was low risk, while the reporting bias was relatively low. Only one study reported incomplete results that differed from the data expected to be reported in the study design. To summarize, the risk bias within studies is low, except for the performance bias.

Publication Bias
We used Egger's test to assess the publication bias (see **Table 5**). The results showed that most of the outcomes of the children and parents were not significantly affected by the publication bias, except for the emotional problems of children and parental parenting confidence. Due to the limited number of included studies, the small sample size may lead to a certain degree of bias.

DISCUSSION

This study searched and screened Triple P intervention studies published from 2013 to 2020 and synthesized the results using a meta-analysis and a systematic review. We searched a total of 968 studies and included 37 articles for meta-analysis. These studies all published high-quality and rigorously designed RCT

studies. Thus, our research conclusions could rigorously evaluate the effectiveness of Triple P.

In terms of the overall effect of Triple P, the meta-analysis results showed that Triple P could provide a series of differences between children and parents, including the significant prevention of SEB problems in children. The proximal effects on parents mainly included changing negative parenting style, reducing parenting conflict, and improving parenting efficacy and self-confidence. The distal effects on parents included reducing psychological adjustment problems in parents, improving parent–child relationships, and reducing parent–child conflict. However, the meta-analysis results did not show the significant effects of Triple P on improving the marital relationship quality and satisfaction of parents.

Regarding the moderator variables, we conducted subgroup and meta-regression analyses of the effect sizes with high heterogeneity. The five groups of analysis results showed that components of the intervention, including intervention level, service delivery format, service method, and program implementation setting, explained the heterogeneity between the effect sizes of Triple P significantly, as follows: First, the sessions and intensities were different for the different Triple P levels, so their outcomes varied. Combined with previous research, we believe that the higher the intervention level, the better the effect. In our results, the level 3 intervention did not show significant effectiveness in the subgroup analysis, while the level 4 intervention had significant effectiveness in improving emotional problems in children, behavioral problems in children, parenting styles, parental conflict, and the parent–child conflict, which is consistent with the research conclusion of De Graaf et al. (2008). This finding contrasts with Sanders et al. (2014), who found that all Triple P levels had significant amounts of heterogeneity for all outcomes. In addition, since the Triple P levels generally corresponded to the program variants, the number of articles included in our study was limited as there were many variants of
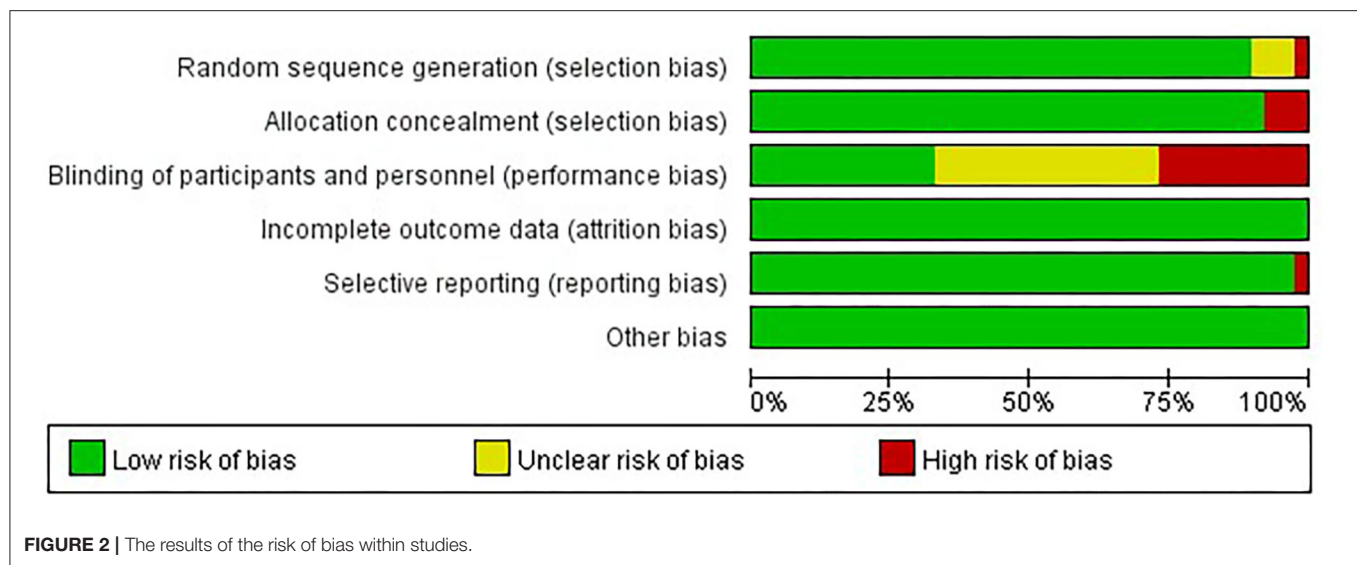
FIGURE 2 | The results of the risk of bias within studies.

TABLE 5 | Publication bias.

	k	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
Publication bias of social competence	6	−1.402	1.698	−0.83	0.455	−6.116	3.311
Publication bias of emotional problems	13	−3.238	1.385	−2.34	0.039[*]	−6.288	−0.189
Publication bias of behavioral problems	17	−8.938	4.281	−2.09	0.054	−18.063	0.188
Publication bias of parenting styles	18	2.513	2.193	1.15	0.269	−2.135	7.161
Publication bias of conflict over parenting	6	−3.224	1.471	−2.19	0.094	−7.309	0.861
Publication bias of parenting confidence	14	3.158	1.169	2.70	0.019[*]	0.611	5.706
Publication bias of parental adjustment	15	−2.328	1.127	−2.07	0.059	−4.762	0.105
Publication bias of parent-child relationship	5	−12.162	5.540	−2.20	0.116	−29.793	5.469
Publication bias of relationship quality and satisfaction of parents	9	3.427	3.722	0.92	0.388	−5.373	12.228

*k, number of studies; Coef., coefficient; Std. Err., standard error; 95% Conf. Interval, 95% confidence interval; *p < 0.05.*

Triple P, and the specific analysis of the program variants might lead to deviations in the results. This differed from Sanders et al. (2014) in that we did not analyze the moderating effect of the program variants.

Second, regarding the service delivery formats and service methods, based on the five different delivery formats of Triple P classified by Sanders (2012), we distinguished the service delivery formats and service methods and conducted further in-depth analysis. Different service delivery formats and corresponding service methods led to different outcomes. Although our research did not discover consistent and effective service delivery formats and service methods for all outcomes, we can still conclude that we can achieve excellent parent-related outcomes through various formats and methods (especially in the improvement of parenting styles). However, to achieve good children-related outcomes, although the different intervention levels have a significant impact, we still need to adopt specific formats and methods, such as face-to-face group activities combined with telephone support for individual cases. This is because Triple P intervenes directly with parents. To further reduce SEB problems in children by improving parenting styles, more intensive service

delivery formats and service methods are needed. Meanwhile, in contrast with Sanders et al. (2014), we found that the online format only showed significant effect on the improvement of parenting styles, but we did not verify the overall higher effect sizes for online Triple P as Sanders et al. (2014) did. We must be extra cautious when choosing an online method.

Third, regarding the countries where Triple P interventions were implemented, the results proved the significant effectiveness of Triple P in other countries in terms of the emotional problems in children. However, considering that there were only four interventions in other countries, this result needs to be further verified in future studies. More interventions and more evidence of Triple P in countries that have fewer studies available than Australia are needed. In addition, the meta-analysis results did not reveal country-to-country differences in the effects of Triple P on most outcomes of parents and children, which further proves the cultural adaptability of Triple P. In terms of the implementation settings of Triple P, the university was a vital setting which had a significant impact on the results in all subgroup analyses. In addition, interventions implemented in the

community alone had no significant effect on the outcomes, but when implemented in both universities and communities simultaneously, the effectiveness of the outcomes became significant. This may be because the scientific research and professional specialties in universities can implement and standardize the program more rigorously, thereby improving the effectiveness of the interventions. In addition, hospitals, communities, and online were also settings with high significance, but the interventions implemented in healthcare centers had no significant effect. In terms of the other sample characteristics, we found the moderating effect of the age of children on emotional problems in children but did not discover the significant moderating role of the initial developmental/behavioral problems or boy ratio on the outcomes of children and parents, which differed from Sanders et al. (2014) who found higher effect sizes in children with initial developmental/behavioral problems.

Fourth, in terms of the risk of bias within studies, all RCT studies could not make participants blind to the intervention they received, which is consistent with other psychological intervention studies. Therefore, performance bias may have a certain impact on the results of data analysis.

CONCLUSION

This study systematically reviewed the Triple P intervention literature published from 2013 to 2020 and found the significant effectiveness of Triple P in terms of preventing SEB problems in children and improving parenting outcomes, as well as the moderators of the effect size. We can conclude that: first, level 4 Triple P is widespread and the most effective on the SEB problems in children and parenting skills of parents; second, Triple P intervenes directly with parents, thus, to further prevent SEB problems in children, more intensive service delivery formats and service methods are needed; third, universities are good intervention settings for scientific research and professional specialties to implement and standardize the program more rigorously, thereby improving the effectiveness of interventions.

While Sanders et al. (2014) and Nowak and Heinrichs (2008) conducted comprehensive systematic reviews of Triple P literature, our research differs *via* the following aspects. First, the inclusion and exclusion criteria were different. By strictly adhering to the PICOS approach, our research had stricter requirements for the included studies, which were limited to RCTs and quasi-experimental studies with higher research quality, and, because of the focus of research design, we did not use *the study approach* as a moderating variable to analyze its impact on outcomes. Second, our research analyzed SEB problems in children separately, supported by the evidence that Triple P is effective in reducing emotional problems in children. Simultaneously, our research reported the different dimensions of parent outcomes separately to describe their

specific connotations and manifestations more clearly. Third, in terms of the research purpose, our research was not limited to a comprehensive review of the effects of Triple P but also attempted to provide an analytical reference for more interventions of Triple P in other countries that have fewer studies available than Australia based on the results of the systematic review.

There are some limitations to our study. First, we should counteract the file drawer problem by simultaneously analyzing published and unpublished studies. However, we included only published studies in this research. Second, in terms of database retrieval, we only searched the journal databases and did not search for articles and dissertations related to Triple P in other ways. We will continue to expand the database in this area in future. Third, we only included new research but did not include past research, so we cannot give the full picture very well, particularly in terms of the moderator effects, with a low number of studies. We will conduct another meta-analysis including all previous research in the future. Last, there are still some potential risks of bias in-depth that need to be assessed and eliminated using Cochrane RoB 2.0 in the future, including the risk of bias within and across studies.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

AUTHOR CONTRIBUTIONS

FUNDING

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg. 2021.709851/full#supplementary-material

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A Systematic Review of the Contribution of Dance Movement Psychotherapy Towards the Well-Being of Children With Autism Spectrum Disorders

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Background: The present review provides an original examination of published literature on the use of Dance Movement Psychotherapy (DMP) as an intervention for children with an Autism Spectrum Disorder (ASD).

Method: The review was systematically conducted using the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guidelines. A protocol consisting of four phases: identification; screening and selection; data extraction and synthesis; quality assurance was developed and registered with the PROSPERO. A search strategy was developed using population and intervention as the key concepts and ten databases were searched between 6.1.2018 to 4.4.2018 and 10.07.2021 to 20.07.2021. The intervention characteristics were extracted based on the TIDieR template for intervention description and replication checklist. Quality assessment and level of evidence of all the included studies were evaluated using the Mixed Methods Appraisal Tool (MMAT) and the Centre for Evidence-Based Medicine (CEBM) for treatment criteria.

Results: Nine research studies with a total of 133 participants were identified through a systematic search process. There was only one mixed-methods study with the component of randomisation found during the literature search. Collected information was synthesised in relation to (a) ways in which dance movement psychotherapists work with children; (b) data collection methods and findings. Results from the reviewed literature suggest that DMP can potentially promote various aspects of well-being in children with ASD. Eight out of nine studies mentioned the effects of DMP on improving different social and communication skills. However, results from quality assessments and synthesised outcomes indicate that research in DMP is still in its infancy.

Conclusions: We conclude that further large-scale, high-quality studies are required to generate further evidence that explains the processes involved in DMP, the effectiveness of DMP, the relationship between therapeutic factors of DMP, and research findings for children on the autism spectrum.

Systematic Review Protocol Registration: PROSPERO, identifier: CRD42018087912.

INTRODUCTION

The number of individuals diagnosed with ASD have increased in the last decade with 1 in 160 individuals being diagnosed with Autism Spectrum Disorders (ASD) worldwide (Elsabbagh et al., 2012). This figure is found to be even higher in some areas of the developed world reaching 1 in 100 in the United Kingdom (National Autistic Society, 2020) and 1 in 59 children in the United States of America (USA) according to estimates from Centres for Disease Control and Prevention (Christensen et al., 2018). The well-being of such individuals is often challenged due to persistent difficulties in social interactions, communication, as well as restricted and repetitive behaviours and interests (Irwin et al., 2011). The impact these issues have on family members and carers is often major: having a child with ASD in the family can be demanding, time-consuming and expensive (Jordan and Jones, 1999; Green et al., 2006). It therefore comes as no surprise that caregivers reportedly seek alternate interventions to support their children. Effective treatments, however, remain elusive (Canitano and Bozzi, 2015) despite a clear need for them. Most often, available interventions focus on teaching socially acceptable norms or imposing socially acceptable communication modes on children rather than value inherent differences (Nind, 1999; Desforges and Abouchaar, 2003; National Autistic Society, 2020). In addition, most of the available interventions for children with ASD follow behavioural approaches which rely on drill-like activities that encourage repetition of specific skills with constant instructions or teacher direction. These interventions do not typically involve structured reflection or intuitive retorting (Silberman, 2015; Baron-Cohen, 2017; Mottron, 2017). It is therefore less common for available interventions to focus on strengths and attempt to reach children where they are at, listening and responding to children's specific needs (Mottron, 2017).

Multi-dimensionality in the concept of well-being plays a role in understanding the well-being of children with ASD. Acknowledging the complexity, plentiful dimensions and viewpoints, the present study bases its definition of wellbeing on the publication of Dodge et al. (2012). Here well-being is viewed as the balance point between an individual's resource pool and the challenges faced. Dodge et al.'s (2012) definition is based on the principles of equilibrium/homeostasis and the fluctuating state between challenges and resources. Therefore, the way children with ASD dynamically utilise their resources to address the numerous emotional, social and communication challenges they encounter in life to maintain the balance is viewed as well-being in this context.

In the UK, National Institute for Health and Care Excellence (NICE, 2016) guidelines for ASD in under 19s recommends that children and young people with ASD must have access to multidisciplinary health and social care services including mental health. The general principles of care and specific interventions for the core features of ASD consider play-based strategies, behavioural and developmental models. For mental health challenges, group/individual cognitive behavioural therapy (CBT), group non-directive supportive therapy (NDST), group/family-based interpersonal psychotherapy (IPT), psychodynamic psychotherapy are recommended depending on the severity of the issue. As the guidelines are from 2016, there might have been new studies on the effectiveness of arts-based interventions that need to be aknowledged. Thus, a new systematic review on these studies is warranted.

Description of the Intervention

Dance/Movement Therapy, or Dance Movement Psychotherapy[1] (DMP) as it is known in the UK, is a psychotherapeutic approach that aims to support the integration of mind and body through the use of creative movement expression (American Dance Therapy Association, 2018; Association for Dance Movement Psychotherapy UK, 2020). Within DMP, the body is viewed as a container of experiences which can be communicated through movements. DMP is used with a wide range of client populations in several settings and is offered by qualified practitioners who, in the UK, undergo Master's level training for a minimum of 2 years (Association for Dance Movement Psychotherapy UK, 2020). Methods such as rhythmic circle dance formations, group or dyadic improvisation and expressive movement processes are tailored to the needs of the individual or group (Levy, 1988; Meekums, 2002; Payne, 2003). In DMP, movement is viewed as symbolic representation and as evidence for both conscious and unconscious processes (Meekums, 2002; Karkou and Sanderson, 2006). The interdependence between movement and emotion (Bernstein, 1975; Rossberg-Gempton and Poole, 1992) is thought to enable the unconscious to unfold (Levy, 1988; Fischman, 2001)

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[1]Other titles known for the discipline internationally: dance movement therapy, dance-movement therapy, dance therapy, dance psychotherapy, movement therapy, and movement psychotherapy.

thereby promoting health and growth toward personal well-being (Fischman, 2001). Some of these ideas are also relevant to working with children with ASD (Karkou, 2010).

DMP interventions for children with ASD focus on body-informed and non-verbal interpersonal exchanges that attempt to meet the children empathetically (Adler, 1968; Siegel, 1973; Kalish, 1977; Erfer, 1995; Loman, 1995; Parteli, 1995; Torrance, 2003; Tortora, 2005; Scharoun et al., 2014). Mirroring and other techniques that enable kinaesthetic empathy in ASD populations are commonly stated in clinical practice reports as ways of supporting non-verbal relationships (Tortora, 2010; Wengrower, 2010; Devereaux, 2012; Martin, 2014). This technique is similar to those used in the autism field such as intensive interaction (Nind and Hewett, 1988), where the value of meeting the child non-verbally is acknowledged. However, mirroring within the context of DMP practise does not refer to simply copying one's actions but also involves an affective attunement to the non-verbal presentation and movement preferences of the child (Meekums, 2002). Whilst mirroring and similar techniques are used extensively in DMP practise, the value of working in this way with children with ASD remains largely anecdotal with limited systematic evaluation.

Rationale for Systematic Review

Although research in the field of DMP has shown an upward trend in the past two decades (Meekums, 2010), DMP remains a young profession that relies heavily on creative, subjective and clinical reports (Rova, 2017). When research methodologies are adopted, they use small samples, qualitative designs, and descriptive, phenomenological, experience-based approaches or case studies (Serlin, 1996; Behrends et al., 2012; Hervey, 2012), resulting in insufficient empirical evidence for the wider use of DMP. Indeed, compared to other practices, DMP has not been used widely with children on the autism spectrum. Green et al. (2006) reported that in the USA only 2.4 % of children on the autism spectrum participated in DMP in comparison to other interventions, while DMP stood in 55th position on a list of treatments used by parents. To make DMP interventions more widely available, further research is needed to empirically validate the effectiveness of the DMP as an intervention and to identify the most appropriate ways of working with ASD client populations. Such research will bridge the gap between evidence-based practise and practise-based evidence (Barkham and Mellor-Clark, 2003).

Earlier reviews in DMP and ASD have either been too generic (Takahashi et al., 2019) or have focused only on adults with ASD and their needs (Marchant et al., 2018; Shuper Engelhard and Vulcan, 2021). Information such as dosage (frequency and duration of DMP sessions), theoretical frameworks, therapeutic techniques and overall process used in DMP for children with ASD are yet to be synthesised. To our knowledge, no existing studies have documented explicitly the changes and outcomes during and/or after DMP intervention in children with ASD. Further research is required to systematically report on how DMP is practised and to evaluate the quality of the existing evidence on the contributions of DMP interventions for children with ASD. Therefore, this review aims to examine how the processes involved in DMP could support the development of a wellness

toolbox to cope with the situation, and implement the tools when necessary.

Research Questions

The present systematic review explores the following research questions:

1. How do dance movement psychotherapists work with children with ASD in terms of, theoretical frameworks, techniques, overall process and dosage in published research?
2. How do different studies examine the effectiveness and processes involved in DMP interventions? What are their findings?

METHODS

This integrative systematic review was based on the processes used in meta-analyses and qualitative evidence synthesis of Cochrane Reviews (Higgins and Green, 2011). Unlike Cochrane Reviews, however, the exclusive reliance on Randomised Control Trials (RCTs) was changed in this review to include other quantitative, qualitative and arts-based research studies on DMP for children with ASD. We also extended the meta-synthesis approach by including not only qualitative findings in the briefs but also quantitative studies. In order to combine both approaches, we adopted the principles of pragmatism (Haack and Lane, 2006), according to which all evidence available at the time is collected. The review was implemented using the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guidelines (Page et al., 2021) to ensure that the review was conducted systematically and that results were replicable.

Firstly, a protocol was developed and registered with an open access online database PROSPERO (https://www.crd.york.ac.uk/PROSPERO; Registration Number CRD42018087912). The protocol included the following stages:

a) **Identification:**

The following electronic databases were searched during two time periods (6.1.2018 to 4.4.2018 and 10.7.2021 to 20.7.2021) to present the updated studies: Academic search primer; CORE; PsyARTICLES; Emerald Health and Social Care Journals; PsycINFO; Proquest Health Research Premium Collection; Wiley; PubMed; BioMed Central Journals; and Cinahl Complete. Additional hand searches in relevant journal databases and different universities' catalogues were also conducted.

Search Formula

1. Step 1: Autis* OR Asperger* OR Rett* OR "Pervasive Developmental Disorder*" OR "Neurodevelopmental Disorder*" OR "Childhood Disintegrative Disorder*" AND

2. Step 2: "Dance movement therapy" OR "Dance/Movement therapy" OR "Dance Movement Psychotherapy" OR "Movement Therapy" OR "Movement Psychotherapy" OR "Authentic movement" OR "Primitive expression"

b) **Study Screening and Selection Process**

Framework	Criteria
Types of participants	Studies with participants of 16 years of age or below; diagnosed with ASD of any severity were considered for this review. Furthermore, studies in which the majority (>75%) of the participants were younger than 16 years or had a diagnosis of ASD were included
Types of interventions	Studies where DMP was delivered as an intervention by a qualified therapist (in the countries where training is available) with clear goals and therapeutic process were considered. All DMP approaches were considered even if they were delivered alongside other arts therapies or as a combination with other arts therapies. However, studies where dance training or other types of recreational dance programmes without a psychotherapeutic process were not included in this review
Types of outcome measures and processes	Outcomes of DMP on social, cognitive, emotional, behavioural, physical, academic measured through standardised measures were considered. Methods that captured the perspectives of children, parents, therapists, and teachers on both the process and the outcomes were included. Video analysis methods that looked at therapeutic process were also considered. Studies that neither investigated the therapeutic process nor its outcomes were excluded
Types of studies	Any type of empirical research (quantitative, qualitative, mixed, or arts-based methods) were included. Studies not included were: non-empirical research studies (e.g., secondary sources, opinion-based, editorials, policy reviews and statements, commentaries), studies not published in English, unpublished Master level dissertations, unpublished conference presentations, conference proceedings where full-length articles are not available, clinical case examples without rigorous research methodology and narrative articles and reviews without rigorous research methodology

The first author as part of the doctoral study ran the searches in various databases, identified relevant studies and removed duplicate titles using Zotero software 2018. Another PhD student (ZM) and the first author independently screened at the level of title and abstract based on the predetermined inclusion/exclusion criteria. Inclusion and exclusion criteria were also applied for full texts. In cases of missing data, the authors were contacted to provide original reports. Any cases that remained unclear were discussed with the director of studies (VK).

With regards to eligibility (**Table 1**) to target studies that are relevant to DMP for children with ASD, we used a modified version of PICOS method (Bowling and Ebrahim, 2005). In particular, we decided eligibility based on four components: Participant Population-P, Intervention-I, Outcomes-O and Study design-S; but did not consider Comparison (C) as the review does not aim to compare DMP intervention with other types of interventions or groups without any intervention. The outcome component included studies oriented toward outcomes as well as studies describing the therapeutic processes to further understand the contribution of DMP for children with ASD.

c) **Data Extraction and Management**

Microsoft Excel and the specialised software package Covidence (2018) were used to organise and manage all

relevant information from the studies. The data extraction focused on answering the research questions and included two main categories:

- *Ways in which dance movement psychotherapists* work with children with ASD. This category looked at theoretical frameworks, therapeutic techniques, overall process and intervention dosage. Theoretical frameworks referred to the wider concepts that informed the approach of DMP were documented. Therapeutic techniques considered the methods that therapists practically used during the session. The overall process recorded the DMP session structures. Finally, dosage referred to frequency, duration and intensity of DMP sessions. These intervention characteristics were extracted based on the TIDieR template for intervention description and replication checklist (Hoffmann et al., 2014).

- *Data-collection methods and findings* captured what type of assessments were administered, how the assessment took place and the changes noticed in the participants after attending DMP.
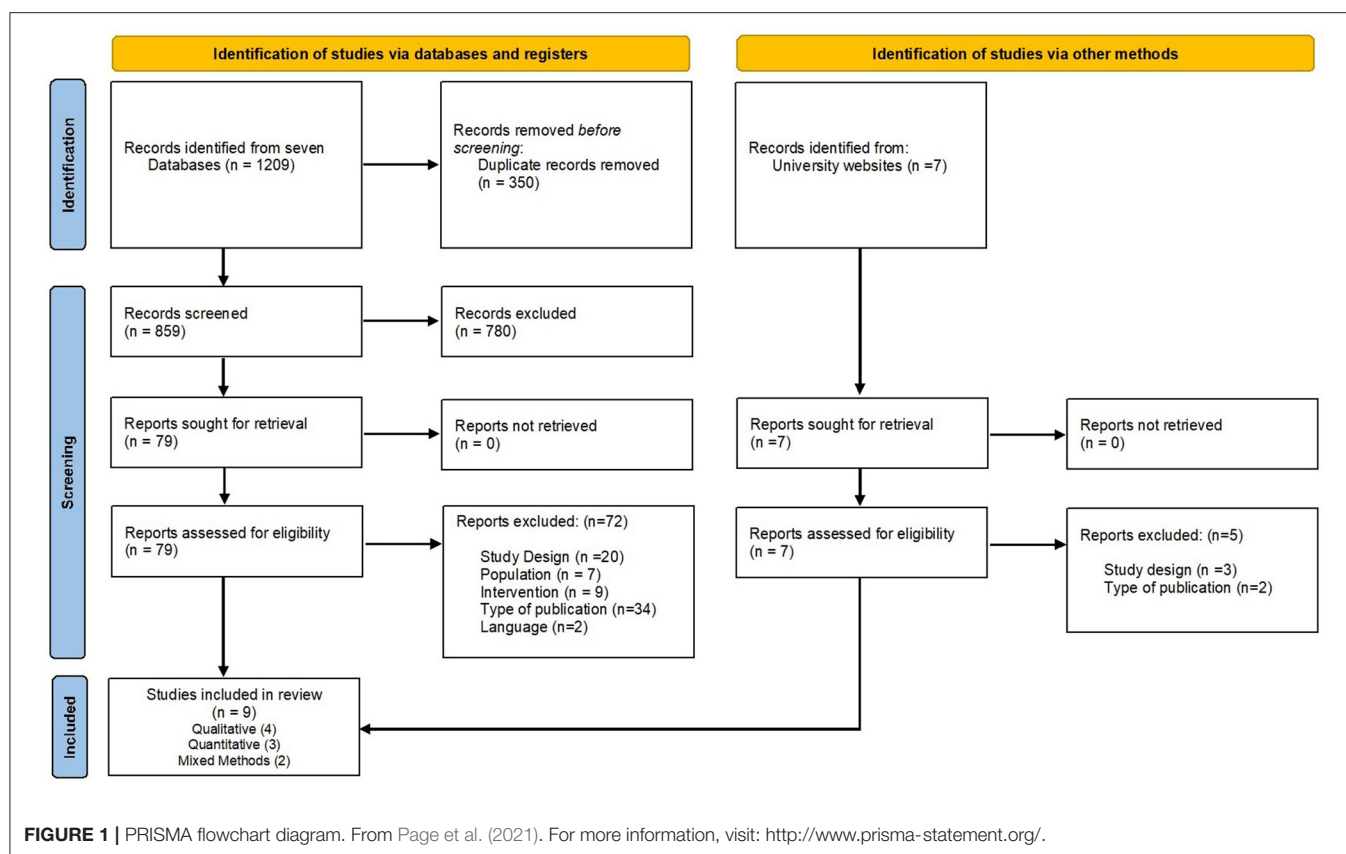
d) **Quality Assessment**

The Mixed Methods Appraisal Tool (MMAT) (Hong et al., 2018) was used to critically evaluate the quality and risks of bias in the reviewed studies and also to ensure that the studies were reviewed with equal rigour. The MMAT was chosen because it is specifically designed for the appraisal stage of systematic mixed studies reviews, and the five sub-sections cover the methodological quality appraisal of: qualitative research, randomised controlled trials, non-randomised studies, quantitative descriptive studies, and mixed methods studies. Further, the studies were evaluated as per the levels of evidence for therapeutic studies based on the criteria developed by the Centre for Evidence Based Medicine (CEBM) for treatment (March, 2009).

RESULTS

As shown in the PRISMA flow chart (**Figure 1**), 1,209 records were identified from searching across seven databases, out of which 780 were irrelevant and were treated as noise. Eight hundred and fifty nine articles were screened at the title and abstract level. Handpicked searches from various universities' repositories and correspondence with researchers generated 7 relevant records which were considered for the full-text screening. Eighty eight records (79 from the databases and 7 from handpicked searches) were evaluated for the full-text eligibility. In total, nine studies met the inclusion criteria for the data extraction process. One of the doctoral studies included in the review contained four sub-sections (Samaritter, 2015) which involved different participants. However, only those three sub-sections which met the inclusion criteria were counted as one study during data extraction and synthesis.

Overview of Included Studies

The nine studies included in the review are summarised in **Table 2**. With regards to the research questions that are addressed, some studies (Samaritter, 2015; Athanasiadou and Karkou, 2017) focused on the process of DMP while others

FIGURE 1 | PRISMA flowchart diagram. From Page et al. (2021). For more information, visit: http://www.prisma-statement.org/.

described either the intervention techniques (Wengrower, 2010) or ways of evaluating practice (Houghton and Beebe, 2016); the remaining studies focused on outcomes (Hartshorn et al., 2001; Chiang et al., 2016; Aithal, 2020; Sengupta and Banerjee, 2020).

The most recent of the nine studies included in this review was published in 2020 and the oldest in 2001. The majority were from the West (USA, UK, and EU); one study was from Taiwan and one from India. Special education schools were the most common environments for DMP sessions to take place followed by clinical or hospital-based settings. In total, there were 133 participants across these nine studies. Sample sizes were small ranging from one to thirty-eight participants. Hartshorn et al. (2001), with an experimental research design, had the largest sample size: 38 participants and the second largest sample was in the Taiwan-based study (Chiang et al., 2016) which included 34 participants (18 in the experimental condition). Houghton and Beebe's (2016) video micro-analysis study involved an individual case that used small videoclips of the therapist and participant interaction from a session.

In eight out of the nine studies, the participants were children with a formal diagnosis of ASD, albeit the severity of ASD presented remained unclear. Studies with more than 75% children or adolescents of 16 years of age or below were included for the review. From the studies included, the average age of the participants was 9.48 years (age range = 2–17.2

years). An exception to these studies was the one by Devereaux's (2017), which involved 13 special educators reporting on their observations of DMP sessions for children with ASD. This study was included in the review because it described the contribution of DMP for children on the autism spectrum from the educators' perspective and answered one of the review research questions exploring the findings of DMP intervention for children with ASD.

The nine studies included in the review followed different methodological approaches; four were qualitative (Wengrower, 2010; Houghton and Beebe, 2016; Athanasiadou and Karkou, 2017; Devereaux, 2017) and specifically, one of which followed an arts-based research design (Athanasiadou and Karkou, 2017). There were three quantitative (Hartshorn et al., 2001; Chiang et al., 2016; Sengupta and Banerjee, 2020) studies. The doctoral studies of Samaritter (2015) and Aithal (2020) were conducted using a mixed-methods design.

Research Question 1- Ways in Which Dance Movement Psychotherapists Work With Children on the Autism Spectrum

To address the first research question, we extracted information on therapeutic frameworks, techniques, overall processes that informed DMP intervention and the dosage in which the sessions were delivered (**Table 3**).

TABLE 2 | Study characteristics.

Author and year	Country	Participants (sampling size, diagnosis, age)	Study design	Methods of data collection	Findings	Level of evidence [CEBM, March 2009]
Aithal (2020)	UK	$N = 26$, all with ASD; Age range = 8–13 yrs Mean Age = 10.65 yrs	Mixed methods cross over design	• Questionnaire • Semi structured interview • Arts based methods	• Significant improvements in social communication questionnaire (SCQ) • Minimally clinically important differences in strengths and difficulties questionnaire and SCQ • Three qualitative themes and 18 sub themes reflecting therapeutic process of change • Artistic inquiry identified six key moments of change	2B
Sengupta and Banerjee (2020)	India	$N = 3$, all with ASD, Age range = 3–11 yrs	Multiple case studies	Pre-post design case study	• Improvement in body attitude checklist and communication • Effects of DMP were sustained in three cases during post interventions assessments (3 and 6 months) • The effects of DMP declined after 9 months of intervention	4
Athanasiadou and Karkou (2017)	UK	$N = 3$; all with ASD; Age range = 6–7 yrs	Series of case studies (Arts-based)	• Video Recordings • Somatic responses (including drawings of a body figure, and written and video recordings) • Written reflections	• Enhanced social bonding and relationships • Increased expressive and receptive vocabulary • Improved self-regulation and empathy • Reduced stereotypical behaviours	4
Devereaux (2017)	USA	$N = 17$; 15 children with ASD, one child with down syndrome and one child with cerebral palsy; Age range = not mentioned	Interpretive qualitative approach	Person to person Semi-Structured Interviews	• Building connexion, awareness with self and others • Improved regulatory behaviour, coping skills • Enhanced capacity to focus, regulate energy levels and relax	4
Houghton and Beebe (2016)	USA	$N = 1$; ASD; Age = 6 yrs	Video micro analysis	• Video Microanalysis • Narrative of the first 80 s based on real time and slow motion	Micro disruptions of the connexions, missed opportunities for connexions, critical points in interactions were identified	4
Chiang et al. (2016)	Taiwan	$N = 34$; all with ASD; Age range = 2–4 yrs	Quasi-experiment research design	• Pre- and post-intervention and 3 month follow-up • Semi-structured observations	• No significant change in joint attention and engagement immediately after the intervention • Improvement during 3 months follow up in engagement state, supported joint engagement (child initiated) and co-ordinated joint engagement (child initiated)	2C
Samaritter (2015)	UK and Netherlands	$N = 4$; All with ASD; Age range = 6.3–17.2 yrs Mean Age = 12.02 yrs	Study (1) Mixed-methods design: Retrospective video analysis	Retrospective movement annotation and analysis of video vignettes of interpersonal relating in dyadic DMP	• Development of Social Engagement and Attunement Movement (SEAM) scale, with overarching themes (space, time, weight) and specific movement categories • Individual profiles of all four cases showed an increase within SEAM categories and an overall increase of the number of SEAM markers that could be recognised in the interpersonal movement actions	4

(Continued)

TABLE 2 | Continued

Author and year	Country	Participants (sampling size, diagnosis, age)	Study design	Methods of data collection	Findings	Level of evidence [CEBM, March 2009]
			Study (2) Mixed-methods design: Retrospective video analysis	Contents analysis of the therapist's actions	• Four basic themes were identified for structuring DMP sessions for ASD and illustrated with examples a. Procedural structure of the therapy process b. Structure of the sessions c. Relational modes d. Movement actions	4
		N = 4, all with ASD Age range = 11.9–17.1 yrs Mean Age = 14.9 yrs	Study (3) Mixed-methods design	Replication of Shared Movement Approach (SMA) intervention and outcome evaluation with SEAM scale	Average pre-post-intervention outcomes for group of four showed a positive trend on youth self-report scale, social responsiveness scale, and child behaviour checklist	4
Wengrower (2010)	Spain	N = 3 (2 children with ASD and one child with PDD); Age range = 3–8 yrs; Mean Age = 6.3 yrs	Multiple case study design	Narratives of three DM therapists as they wrote then in their case study, therapy journals, treatment reports	• Enhanced therapeutic relationship that implies a sense of mutuality, attraction and interest to know each other better • Created a shared and translation playing space where bonding evolved	4
Hartshorn et al. (2001)	USA	N = 38, all with ASD; Age range = 3–7 yrs; Mean Age = 5 yrs	Experimental design	• Video recording • Behaviours were coded and observed during the first and last movement sessions.	• Statistically significant reduction in resistance to teacher, negative response to touch and wandering behaviours • Significant improvement in on-task passive behaviour • No difference in eye contact, social relatedness, on–task active behaviours and stereotypical behaviours	2C
Summary						
Year range: 2001–2020	Countries: EU, UK, USA, Taiwan and India	N = 133; Mean age= 9.1 yrs (age not mentioned in one study)	QUAL-4 QUAN-3 MIXED-2	Observing video recordings of the sessions is the most common method-5 studies, followed by semi-structured interviews and questionnaires −2 studies	Improvements were observed in • Group connexions • Relationship with the therapist • Awareness of self and others • Emotional regulation • Coping mechanisms • On-task behaviours	

EU, Europe; UK, United Kingdom; USA, United States of America; N, Number of Participants; QUAL, Qualitative; QUAN, Quantitative.

TABLE 3 | Intervention characteristics.

Author and year	Why	What	How	Who	How much, when, and where			Tailoring and modifications	How well
	Therapeutic frameworks	Techniques	Overall process	Therapist qualification	No. of participants in the group & therapist to client ratio	Dosage	Settings		Fidelity assessment
Aithal (2020)	Integrative therapeutic framework consisting of 8 principles informed by humanistic, psychodynamic and developmental theories	• Mirroring • Sensorimotor-based activities (Scharoun et al., 2014) • Sherborne developmental movement (Weston, 2012) • Imaginative role play (Westby, 2013)	4 modules, 10 semi structured sessions starting with a ritual followed by warm up, theme exploration and closing ritual	A licenced DMP practitioner	3 to 6 children, one therapist and one co-facilitator	DMP, 10 group sessions, 40 min twice a week	Two special educational needs setting	Yes. Depending on the needs of the group	Three evaluators rated video recordings of sessions (3, 6, and 9). Results indicated 75% and above adherence to the protocol
Sengupta and Banerjee (2020)	Not reported	• Mirroring • Bartenieff fundamentals • Comfort touch • Improvisation	24 sessions (45 min/per session) over a 3-month period	Researcher trained in DMP	One to one	DMP, 24 sessions (45 min/per session) over a 3-month period	Special School	Not reported	NA
Athanasiadou and Karkou (2017)	• Persons centred (Rogers, 1967) • Chace interactive model of DMP (Chaiklin and Schmais, 1986) • Intersubjectivity theory (Stern, 2005; Trevarthen, 2005; Meltzoff and Brooks, 2007) • Kinaesthetic empathy (Berger, 1972) • Sherborne Developmental Movement (Sherborne, 2001) • Embodiment-Projection-Role model (Jennings, 1999)	• Sensorimotor-based activities (Scharoun et al., 2014). • Mirroring (Wengrower, 2010) • Moving in Synchrony • Purposeful Misattunement (Stern, 1985) • Use of props • Use of metaphors • Rhythmic movement explorations • Embodied play, symbolic play activities • Shaping circle and moving in or away • Relaxation play • Goodbye movements	**Intervention programme structure**: Four modules- with eight sessions divided unevenly (module 1- one session, module 2- three sessions, module 3 and 4- two each) **Session structure:** Loosely structured around warm up mid-face and closure.	A licenced DMP practitioner	3 children and 1 adult	DMP, 8 group sessions, 50 min once a week	Special School	• **Case 1:** • Therapeutic Holding Environment (Winnicott and Rodnam, 2005) • Sensorimotor-based activities (Scharoun et al., 2014). • **Case 2:** • Mirroring (Wengrower, 2010) • **Case 3:** • Purposeful Misattunement (Stern, 1985)	NA
Devereaux (2017)	• Child-centred approach (Rogers, 1967) • Social engagement theories (Greenspan and Wieder, 1999) • Relational interaction (Ogden et al., 2006)	• Synchronistic rhythmic action • Self-expression movements • Building connexion on movement level • by moving closer, reaching • Circle formation • Tapping, stretching movements • Expansive movements • Understanding, reflecting, expanding non-verbal expressions • Attuned improvisation • Use of music • Use of props • Relaxation techniques	**Session structure:** Warm-up • Theme development • Closure portion	Registered or Board certified DMP	5–7 children and 1 or 2 adults	DMP, 30 Min, Once a Week	Special Education	1 child with Down's syndrome, 1 child with Cerebral palsy	NA
Houghton and Beebe (2016)	Literature review refers to • Disruption and repair (Beebe and Lachmann, 1994) • Dyadic systems view (Beebe and Stern, 1977) • Laban Movement Analysis (Laban, 1956; Bartenieff and Lewis, 1980)	• Interpersonal coordination • Imitation • Mirroring or Attunement • Synchrony • Use of kinesphere, different planes • Following the child's lead in the movement patterns, energy level,	**Session structure:** Unstructured movement exploration	Final year master's DMP training at a program approved by ADTA	One child and one adult	DMP, 30 Min, one session	Multipurpose special school	Beginning- Movements directed as he was not able to follow and imitate later turned into mirroring	NA

(Continued)

TABLE 3 | Continued

Author and year	Why	What	How	Who	How much, when, and where			Tailoring and modifications	How well
	Therapeutic frameworks	Techniques	Overall process	Therapist qualification	No. of participants in the group & therapist to client ratio	Dosage	Settings		Fidelity assessment
	• Kestenberg Movement Profile (Amighi et al., 2018)	• amount of connexion, direction • Intuitive and improvisational exploration							
Chiang et al. (2016)	Creative movement play approach was developed using: • Joint Engagement (Kasari et al., 2010) • Body informed intersubjectivity (Samaritter and Payne, 2013; Lee, 2014) • Child-centred approach (Rogers, 1967)	• Imitation • Mirroring • Toy play • Movement play • Meaningful play routine • Facilitating sharing communication • Encouraging child's initiating communication • Managing child's emotional regulation	**Intervention programmes structure:** 10 modules with different objectives and overall process **Session structure:** • Reviewing the dyad homework • coaching effective caregiver-child interaction • Discussing handout on objectives, goals of the homework	Two licenced clinical psychologists and one licenced dance/movement intervention	Parent child dyad and each interventionist worked with 4 to 7 dyads separately	DMP, 20 sessions, 60 min, Twice a Week across 2 months	Clinical & research setting	Movement play routine Affective attunement Facilitate Joint Engagement State	2 independent evaluators for videotapes of pre, post 3 months follow up- Therapists-high internal reliability Cronbach's α =0.96 Parents-moderate internal reliability
Samaritter (2015)	Literature review referred to-Interpersonal engagement theories from social cognition, social neuroscience, developmental perspectives • Theory of Mind (Baron-Cohen et al., 1985) • The weak central coherence theory (Frith, 1989) • Executive functioning theory (Ozonoff et al., 1991)	• Open-ended movement explorations • Use of props and variation of movement actions as starting point of improvisation • Structured games for example martial arts forms, baseball, dodge ball actions of synchronisation, attunement and dyadic engagement • Witnessing Mode- Space for individual movement experience • Joint movement- creating sameness • Movement Dialogue—Sharing sameness and otherness • Other relational modes-stillness, short oral evaluations	**Session structure:** Opening • Warming up • Structured games and dance/movement activities • Open movement activities • Closure	Researcher as Therapist (Qualified DMP Therapist)	One child and one adult	Shared Movement Approach (SMA) Intervention; 12 sessions,	Dutch Mental Health Care Centre (Clinical Outpatient Therapy)	**NA**	**NA**
Wengrower (2010)	Literature review referred to • Psychodynamic-Developmental (Alvarez, 1996) • Developmental individual difference relationship-based model (DIR) (Greenspan and Wieder, 2006) • Laban Movement Analysis (Laban, 1956; Bartenieff and Lewis, 1980) • Kestenberg Movement Profile (Amighi et al., 2018)	• Imitation (Stern, 1985) • Mirroring (Loman, 1998) • Attunement (Loman, 1998) • Empathic reflection (Sandel, 1993) • Use of transitional objects (Winnicott, 1971) • Exploratory movements and play • Sharing rhythm • Ritualistic actions	**Session structure:** Details not described explicitly • Warm up and movement dialogue are mentioned in fifth session	Qualified DMP Practioner	One child one adult	NA	Special education settings	**NA**	**NA**

(Continued)

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TABLE 3 | Continued

Author and year	Why — Therapeutic frameworks	What — Techniques	How — Overall process	Who — Therapist qualification	How much, when, and where — No. of participants in the group & therapist to client ratio	Dosage	Settings	Tailoring and modifications	How well — Fidelity assessment
Hartshorn et al. (2001)	Literature review referred to • Physiology of stress reduction and enhancing attentiveness (Field, 1998)	• Hello song • Clapping the syllables • Use of props- hoops, gym mats, tambourine, stickers • Jumping in and out of hoops, obstacle course, making different shapes, start and stop games • Behavioural class management techniques	**Session structure:** Warm up activity • Intermediary activities structured with task, role and space • Cool down	Trained movement Therapists.	3 to 8 children and 2 adults	DMP, 16 sessions, 30 min, Twice a Week	School for children with Autism	NA	NA
Summary	• Not all studies have mentioned the intervention approach explicitly. • Person-centred approach, • Social engagement and intersubjectivity related theories are most common	• Mirroring-most common • Sensorimotor explorations creatively merged alongside the use of play techniques, rhythm and props	• Overall structure described by only two studies • Session structure: • Semi-structured most common	• Qualified DMP • Experience of the therapist mentioned in only one study • Three studies with researcher as therapist	• Four studies with one to one DMP • Three studies group sessions DMP • One study with caregiver-mediation	• Frequency: Once or twice a week • Total: 8 to 20 sessions across-One and a half to 2 months • Duration-30 to 60 min	7 studies in special educational needs settings	No clear pattern- driven by the needs of each child	Mentioned by two studies

Therapeutic Frameworks

This section considered the theories, principles and approaches that conceptually informed the DMP intervention. It was noticed that reporting the type of therapeutic approach adopted was not a widespread practice among DMP researchers as only four studies specifically described their approach and lens in which the therapy sessions were delivered (Chiang et al., 2016; Athanasiadou and Karkou, 2017; Devereaux, 2017; Aithal, 2020). The rest of the studies only reported either the structure of the session or the activities conducted during the DMP sessions. Although all nine studies included in the review have referred to various theories in their literature review section, it is unclear if those theories have really influenced the development and delivery of the DMP sessions or if they were referred to from a research perspective. However, for better understanding of the subject, the data extraction process of the present review considered all important theories mentioned in the studies' literature review as well as in their methods sections, distinguishing between the two.

As shown in **Table 3**, the four studies that were explicit about their therapeutic approach referred to person-centred or humanistic principles[2] (Chiang et al., 2016; Athanasiadou and Karkou, 2017; Devereaux, 2017) and integrative approach (Aithal, 2020). In a humanistic approach of DMP, the focus is generally on strengthening clients' resources in the here-and-now (Karkou and Sanderson, 2006). For the rest of the studies, details provided within the description of sessions and the literature review appear to have influences from the humanistic approach. For instance, in studies Wengrower (2010), Samaritter (2015), Houghton and Beebe (2016) references are made to kinaesthetic empathy, Chace interactive model of DMP (Chaiklin and Schmais, 1986), initiating the movements following the child's lead in the movement patterns and energy level resonate with the humanistic principles.

Apart from the humanistic approach, elements of developmental ideas[3], psychodynamic[4], and behavioural[5] thinking were also found in some of these studies. Four studies (Wengrower, 2010; Samaritter, 2015; Athanasiadou and Karkou, 2017; Aithal, 2020) have referred to the relevance of developmental models such as Developmental Individual difference Relationship-based model (DIR) (Greenspan and Wieder, 2006) and Sherborne Developmental Movement

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[2]"Humanistic" is an umbrella term used to refer to a number of different approaches to therapy (client/person-centred therapy is one such example–Rogers, 1942), all of which focus on strengthening clients' resources in the here-and-now, value I-thou relationships, empathy and consider the client as leading the process of the work (Karkou and Sanderson, 2006).

[3]Developmental perspectives focus on providing interventions that are developmentally suitable to the skills and capacities of participants (Karkou and Sanderson, 2006).

[4]"Psychodynamic" is a broad term which includes Freudian and meta-Freudian schools of thought, all of which believe in the existence of the unconscious, assume one's first years of life shape one's emotional life and attempt to make links with past experiences (Karkou and Sanderson, 2006).

[5]A behavioural approach believes that all behaviours are learned through interaction with the environment and focuses on establishing observable stimulus-response behaviours with clear expectations of behaviours to specific stimuli (Barbera and Rasmussen, 2007).

(Sherborne, 2001) as relevant to DMP sessions. These developmental approaches allowed the therapists to determine movements, to engage with sensorimotor explorations, to support fundamental capacities for joint attention, to achieve regulation, and encourage children's development of a wide range of emotional, social and communicative skills appropriate to the stages of development and age. Traces of psychodynamic perspectives were found in three studies (Wengrower, 2010; Houghton and Beebe, 2016; Aithal, 2020). A dyadic system view of communication (Beebe and Stern, 1977) and the psychodynamic-developmental model (Alvarez, 1996) mentioned in the latter two studies elucidate the nature of interpersonal process and interactive regulation in the dyad. Wengrower (2010), Houghton and Beebe (2016) have brought in psychodynamic thinking by viewing the movement interaction from mother-child lens and attachment patterns. Influences from behavioural approaches were also found in two quantitative studies (Hartshorn et al., 2001; Chiang et al., 2016). These studies focused on how behaviours and skills change, the way learning takes place and also stressed the role the environment plays in enabling new learning within the context of DMP sessions.

The most common trend prevalent in seven out of the nine studies was the allusion to theories focusing on social engagement and interpersonal relationships. As shown in **Table 3**, eleven different theories have been reported to describe processes that are often associated with achieving: shared understanding, relating one situation to another, broad range of social roles and relationships, interaction between individuals and their environments from social cognition, social neuroscience and also from a developmental perspective. Among those eleven theories, the intersubjectivity theory (Stern, 2005; Trevarthen, 2005; Meltzoff and Brooks, 2007) used for describing relations between people, has influenced the development of three DMP intervention models called Shared Movement Approach (SMA) by Samaritter (2015); Creative Movement Play approach by Chiang et al. (2016) and See-Saw by Aithal (2020). Intersubjectivity theory was also used to explain a core concept used in DMP called Kinaesthetic empathy (Jerak et al., 2018). Further, the same theory has encouraged Houghton and Beebe (2016) to look more deeply at disruption and repair within a dyadic system.

Within these different relational theories, four studies (Wengrower, 2010; Samaritter, 2015; Houghton and Beebe, 2016; Sengupta and Banerjee, 2020) have incorporated movement-based systems such as Laban Movement Analysis (Laban, 1956; Bartenieff and Lewis, 1980) and Kestenberg Movement Profile (Amighi et al., 1999) to analyze as well as to create movement-based activities. DMP sessions widely incorporate play within movement activities. Three studies have explicitly mentioned the application of theories related to play in general (Chiang et al., 2016; Aithal, 2020) and specifically; Athanasiadou and Karkou (2017) refer to a dramatherapy model called Embodiment-Projection-Role (Jennings, 1999). Overall, person-centred and developmental approaches with suffuse and overlap of social engagement, intersubjectivity theories and play theories were found to be most prevailing in DMP intervention for children with ASD.

Techniques

The focus here was on what practically happened during DMP sessions. The studies have consistently mentioned mirroring as one of the basic techniques. Many different terms referring to similar concepts have been used across these studies as a way of improving interaction: attunement; understanding, reflecting, imitation, expanding non-verbal expressions leading to attuned improvisations, affective synchrony, movement synchrony, movement coordination, relational knowing, shared movement, reciprocal responsiveness/interaction, and many more. In some instances, these terms have been used synonymously while some authors have distinguished between them. Wengrower's (2010) study investigated the difference between imitation and mirroring and found that the major difference between the two was in the quality of interaction. Unlike imitation, Wengrower (2010) argued that mirroring involves the therapist making similar (and not identical) body movements reflecting the essence of the movement of the client which are either coordinated in time or with a slight echo (Fitzpatrick, 2018). The assumption is that the moving partners experience in their own body the qualities of each other's movements to experience motor resonance and perceive better emotional understanding of each other leading to somatic relationship by connecting with attunement. In the past, the term attunement has been described as a component of mirroring that often goes beyond empathy and can be seen as a product of mirroring (Erskine and Trautmann, 1997; Trevarthen and Fresquez, 2015). The process of attunement is reported to have two levels (Jerak et al., 2018). At first, the moving partners are fully aware of the other person's sensations, needs, or feelings and the next step is the communication of that awareness (Jerak et al., 2018). Tortora (2010) identifies three subcategories in mirroring: modified mirroring, mirroring exaggerated, and mirroring diminished. In addition, misattunement, disruptions and purposeful misattunement have also been reported as part of the process and occasionally as useful techniques for regulating and introducing new movement vocabulary to children with ASD (Houghton and Beebe, 2016; Athanasiadou and Karkou, 2017).

The next set of most popular techniques as mentioned in all seven studies were related to sensorimotor explorations creatively merged alongside the use of play techniques, rhythm and props. Sensorimotor-based activities (Scharoun et al., 2014) involved open-ended movement explorations and structured games. Importance was given to spontaneous movement interactions and expanding the children's movement vocabulary. Across the studies opportunities were offered for body part identification and awareness through stretching, tapping, movements from martial art, baseball, dodgeball actions, jumping in and out of hoops, obstacle course, making different shapes, start and stop games and many more (Hartshorn et al., 2001; Athanasiadou and Karkou, 2017; Devereaux, 2017; Aithal, 2020). All these movement explorations were reported to be used playfully and to be linked to different types of play such as embodied play, symbolic play, imaginative play, movement and rhythmic play, structured, and unstructured play activities across all seven reviewed studies.

In addition, the reviewed studies made use of props such as hoops, gym mats, tambourines, stickers, elastic bands, many other toys, and music. These props were used for different purposes such as self-expression, sensory stimulation, sensory integration and relaxation; they were also used as starting points in movement improvisation, as transitional objects and as concrete ways of connecting. Some of the studies reported incorporation of relaxation techniques (Hartshorn et al., 2001; Athanasiadou and Karkou, 2017; Devereaux, 2017) while the rest of the studies have merged relaxation techniques with the use of props and music. Laban movement vocabulary such as body, efforts, shape and space were used, along with body orientation, engagement and regulation. These elements were reported as important by many authors (Samaritter, 2015; Chiang et al., 2016; Houghton and Beebe, 2016; Athanasiadou and Karkou, 2017; Sengupta and Banerjee, 2020). Behavioural class management techniques appeared to be least popular as only one study mentioned them as part of the intervention (Hartshorn et al., 2001).

To sum up, particular attention was given to intuitive and improvisational exploration of movements with mirroring as the key technique in DMP sessions across all the studies.

Overall Process

This section explored the DMP intervention programme structures spreading across research projects and the structure within each session. Chiang et al. (2016), Aithal (2020) and Athanasiadou and Karkou (2017) were the only three studies to describe the overall structure. Chiang et al. (2016), included ten modules and each module consisted of two sessions targeting various objectives. Athanasiadou and Karkou (2017) described four modules with eight sessions divided unevenly (module 1: one session; module 2: three sessions; module 3 and 4: two each). Aithal (2020) described eight principles that informed four modules containing ten sessions. Houghton and Beebe (2016) reported that the intervention consisted of twenty sessions while Sengupta and Banerjee (2020) mentioned 24 sessions. However, further description of the course was not offered in those two studies.

With regards to the structure of each session, Hartshorn et al. (2001), Samaritter (2015), Athanasiadou and Karkou (2017), Devereaux (2017), and Aithal (2020), had similar session structures. The sessions began with a warm-up, moved to theme development and/or structured/unstructured play activities and closed with cooldown activities. Unlike these five studies, the session structure in Chiang et al. (2016), Houghton and Beebe (2016) studies appeared different. Chiang et al. (2016) showed traces of a behaviourist approach where each session consisted of reviewing the dyad homework film-taped by the parent, followed by effective caregiver-child interaction with guided practise, demonstration, modelling, and feedback. The one-to-one session described by Houghton and Beebe (2016) was completely unstructured. The session began with child-directed movements usually leading to mirroring and improvisational

exploration. Wengrower's (2010) study did not mention anything about the session structure.

Dosage

As shown in **Table 3**, four studies involved individual therapy sessions while another four studies held group therapy sessions, all delivered by qualified dance movement therapists. Teaching assistants and care givers were also involved when groups were large (Hartshorn et al., 2001) and licenced psychologists were involved in the Taiwanese study (Chiang et al., 2016). In the latter study (Chiang et al., 2016) there was also parental involvement with parents receiving training in caregiver-child interaction. The number of participants in a group session varied from three to eight with an average of five children per group. Studies with group therapy were delivered over one and a half to 2 months and sessions ranged from 30 min (Hartshorn et al., 2001; Houghton and Beebe, 2016; Devereaux, 2017) to 60 min (Chiang et al., 2016). Sessions were delivered once or twice a week totalling from 8 (Athanasiadou and Karkou, 2017) to 24 sessions (Sengupta and Banerjee, 2020) as shown in **Table 3**. There was lack of clarity on the dose and intensity of the therapy in the studies where the focus was on specific sections of the process of therapy against the outcome (Wengrower, 2010; Houghton and Beebe, 2016). Moreover, there was no clear trend or pattern that was noted to indicate the relationship between length of therapy and the benefits gained by the client group. In general, DMP dosage was not always theoretically grounded or in accordance with the aims of the intervention. Rather it appeared to be driven by logistics and availability of funding.

Research Question 2- Data-Collection Methods and Findings

This section synthesised information on how data were gathered and the results that were reported in the studies.

Data-Collection Methods

Qualitative, quantitative and artistic enquiry research methodology studies were considered. As shown in **Table 2**, video recording methods were used by the majority of the reviewed studies as it enabled particular sections of the session to be reviewed at a later point. For instance, Houghton and Beebe (2016) carried out a video micro analysis in real-time and in slow-motion to develop an extensive narration of the video clip, exploring key changes of the interpersonal movement sequences. Samaritter (2015) also used a retrospective video analysis where movement markers of interpersonal relating were coded based on Laban Movement Analysis (LMA) using ELAN software to develop an observation scale. Studies that used artistic inquiry as a research methodology, somatic responses and written reflections were complemented with video recordings of the sessions (Athanasiadou and Karkou, 2017; Aithal, 2020). The next popular approach after video recordings in these studies was collecting narratives and therapists' diaries (Wengrower, 2010; Houghton and Beebe, 2016; Athanasiadou and Karkou, 2017). Semi-structured interviews of the parents and educators have also been utilised in the qualitative studies included in this review (Devereaux, 2017).

Quantitative studies have relied upon movement or behavioural observations by trained movement observers with parameters such as duration and frequency of occurrence of target movements or behaviours; these observations produced numerical data (Hartshorn et al., 2001; Chiang et al., 2016). Standardised questionnaires and test batteries were employed in four studies (Samaritter, 2015; Chiang et al., 2016; Aithal, 2020; Sengupta and Banerjee, 2020). Samaritter (2015) was the only study to use self-reporting method as they had adolescent participants in their study. No tool was used more than once and hence the quantitative results were not suitable for meta-analysis. Overall, the preferred methods of data collection were through video observations and semi-structured interviews from clinicians, parents or educators' perspectives.

The reviewed studies addressed the contribution of DMP for children with ASD. Outcomes were grouped under the following domains based on literature themes:

- Social and communication: skills used to interact, both verbally and non-verbally to communicate messages, thoughts and feelings with others.
- Psychological (cognitive, emotional, & behavioural): skills necessary for bonding, self-regulatory behaviour, displaying emotions, empathy and to cope with challenges; combination of several critical brain functions related to memory, judgment, intuition, attention, concentration, ability to learn and process information.
- Physical and sensory: abilities related to the whole body in terms of endurance, stamina, flexibility, speed, coordination, balance, sensory inputs, and integration.

Social and Communication

Eight out of nine studies mentioned the effects of DMP on improving different social skills. Positive impact on awareness of personal boundaries, relationship with the therapist, entering group relationship, understanding of social dynamics and social relatedness were noted in many studies (Samaritter, 2015; Houghton and Beebe, 2016; Athanasiadou and Karkou, 2017; Devereaux, 2017). Significant improvement in Social Engagement and Attunement Movement (SEAM) observation scale and scores obtained on a social questionnaire administered pre-post therapy in Samaritter (2015) thesis. In Aithal (2020) study, a statistically significant result on the social communication questionnaire was observed in the intervention group irrespective of whether they preferred verbal or non-verbal mode of communication. The measurement of social behaviours through questionnaires and self-report indicated that improvement was not limited just to the therapeutic setting; instead, the participants were able to generalise it to their real life as well.

All qualitative and arts-based studies reported progress in overall communication (verbal and non-verbal). As non-verbal communication is predominantly used in DMP sessions, therapists have observed improvement in expressive and receptive oral vocabulary (Houghton and Beebe, 2016; Athanasiadou and Karkou, 2017; Aithal, 2020). It was cited that DMP provided opportunities for an increase in movement vocabulary (Samaritter, 2015; Athanasiadou and Karkou, 2017; Sengupta and Banerjee, 2020). In turn it provided scope for experiencing group dynamics and different levels of communication (Athanasiadou and Karkou, 2017). Case studies have reported that the children who did not show communicative intent in the beginning of the therapy improved to such a level where they initiated conversation by greeting the therapist (Houghton and Beebe, 2016). As a whole, qualitative, quantitative and arts-based studies suggest that DMP can play a significant role in improving different aspects under the social domain in children with ASD.

Psychological (Emotional, Behavioural, and Cognitive)

Parents, educators and therapists have noted progress in emotional regulation (Athanasiadou and Karkou, 2017; Devereaux, 2017; Aithal, 2020). Children improved in their ability to modify their emotional reactions. The coping mechanisms were enhanced as they had better control over their movements to increase or decrease the intensity of the movement. It was evident that there was improvement in awareness (self and others). It has also been reported that participants presented a better mood for the rest of the day after sessions (Athanasiadou and Karkou, 2017; Devereaux, 2017). Studies report that the participants improved in attention, concentration, on task passive behaviour and also on transition from one activity to another (Hartshorn et al., 2001; Devereaux, 2017). Statistical tests in Hartshorn et al.'s (2001) study revealed a reduction in the time that the children wandered in the room, showing that they had developed better abilities to focus. On task active behaviour and joint attention did not show any significant enhancement after therapy. In Chiang et al.'s (2016) study, the different types of joint engagement (JE) states between parent and child were studied. Improvements were seen only at the 3 months follow up stage in unengaged JE, child initiated supported JE and child initiated co-ordinated JE. No statistically significant difference was seen in parent initiated JE states at post treatment and follow up assessments. Only in Devereaux's (2017) study academic engagement has been reported. The teachers interviewed in this study reported that the DMP sessions facilitated transition into academic activities. It was also reported that children performed better in class after the session as their energy had been channelled. This helped them to sit and focus during the lessons.

Physical and Sensory

Qualitative and arts-based studies (Athanasiadou and Karkou, 2017; Devereaux, 2017) described reductions in the self-stimulatory and stereotypical behaviours. The children appeared more relaxed and calmer. However, Hartshorn et al.'s (2001) study did not find any statistically significant reduction in stereotypical behaviours.

In summary, various tools have been used to examine the contribution of DMP for children with ASD. Most frequently occurring outcomes fell under the social domain followed by cognitive, emotional and physical. There was only one study

which mentioned academic engagement which again overlaps with cognitive, physical and sensory domains.

Results of Quality Assessment

The methodological quality of the studies are heterogenous as per the MMAT (Hong et al., 2018) appraisal tool as shown in **Table 4**. Six studies were assessed as level 4 evidence and there was one study at level 2B and two studies at 2C levels as per the criteria from the Centre for Evidence Based Medicine (March, 2009). Two qualitative studies, one quantitative study and two mixed methods study have addressed at least four out of five questions on the MMAT quality assessment (Samaritter, 2015; Chiang et al., 2016; Athanasiadou and Karkou, 2017; Devereaux, 2017; Aithal, 2020). However, limitations were observed in most of the studies. For the below research aspects were inadequately addressed: intervention characteristics, methodological pitfalls, challenges at the stage of recruitment and implementation of interventions, attrition rates, sufficient correlation between theory and outcomes. One of the major drawbacks identified in Wengrower (2010) and Sengupta and Banerjee (2020) was the lack of a clear link between data sources, collection, analysis and interpretation. Further, there were some observations in the narration of the case studies that were not always substantiated with adequate data (Wengrower, 2010; Houghton and Beebe, 2016; Athanasiadou and Karkou, 2017; Sengupta and Banerjee, 2020).

The lack of clarity in reporting methodological procedures have affected the trustworthiness of many studies (Hartshorn et al., 2001; Wengrower, 2010; Houghton and Beebe, 2016; Sengupta and Banerjee, 2020). As a result of insufficient reporting of children's demographic characteristics and contextual background information, it was unclear whether the findings are transferable (Wengrower, 2010; Samaritter, 2015; Houghton and Beebe, 2016; Sengupta and Banerjee, 2020). Poor reporting of DMP intervention in three studies made it difficult to extract clear patterns of evidence (Hartshorn et al., 2001; Wengrower, 2010; Houghton and Beebe, 2016).

The two non-RCT quantitative studies (Hartshorn et al., 2001; Chiang et al., 2016) used age and level matched controlled groups and statistical testing of variables. They were identified with a high risk of bias as the recruitment process lacked randomisation. In Hartshorn et al.'s (2001) study the attrition rate and dropping out of participants were not mentioned and this might have skewed the outcomes to some extent. Aithal (2020) a mixed methods, study, was the only one to include randomisation of the participants, report attrition, use intention-to-treat analysis and report all the measured outcomes. However, the study did not include blinding of the researchers and participants and therefore it has a high risk for detection bias. Whilst as for all types of psychotherapy, it is difficult to blind participants to the type of intervention, it appeared that in Chiang et al. (2016) and Hartshorn et al. (2001) there were opportunities to blind for the outcome assessment. Hartshorn et al.'s (2001) study mentions that psychology graduate students rated the video. However, the description did not mention if they were blinded on the group information. Similarly, in Chiang et al.'s (2016) study, it is unclear if the clinicians administering the interviews and tests were aware

of whether the participants were allocated to the control or the experimental group. This study introduced blinding while testing the fidelity of the interventionist to the treatment protocol, but there was incomplete information and reporting of the findings from other assessment tools used in the study.

DISCUSSION OF THE SYSTEMATIC REVIEW FINDINGS

This review gathered clinical procedures and research findings from nine studies on DMP with children with ASD involving a total of 133 participants. The number of studies included remained small with heterogeneous outcome measures and compromised quality. There was only one mixed methods study (Aithal, 2020) with a randomisation component found during the literature search and only nine studies met the inclusion criteria that was very broad. It is frequently argued in DMP that RCTs alone cannot capture therapeutic processes as the creative arts therapies emphasise creativity and subjective ways of knowing (Junge and Linesch, 1993). However, there were only two studies with artistic inquiry (Athanasiadou and Karkou, 2017; Aithal, 2020) which met the inclusion criteria. The small number of studies meeting the inclusion criteria reflects the dearth of research work in the field.

The synthesis of data relating to the first research question (how do dance movement psychotherapists work with children with ASD?) revealed that humanistic and developmental approaches delivered through semi-structured sessions using play-based sensorimotor activities and mirroring techniques are the most common ways of working with children with ASD. These approaches are in agreement with Nind (1999) who supported the need for interventions with minimal instructions or teacher direction, and more dependent on intuitive responses. The approaches and techniques are on a par with case reports, documentaries and reports by pioneers in DMP such as Adler (1968), Siegel (1973), Kalish (1977), Erfer (1995), and Loman (1995) in propounding the body-informed and non-verbal interpersonal approaches that attempt to meet the children at the level they are and to facilitate expressive relationship with the environment. Behavioural theories are minimally referred to in DMP which is noteworthy especially given the client population and the prevalence of behavioural thinking in existing literature (Pierce and Cheney, 2017). It is possible that DMP is indeed offering a new approach that complements existing interventions.

There are similarities in the DMP approaches across the age range of ASD population. Marchant et al. (2018) in their systematic review on DMP with adults with ASD, synthesised that person-centred approach with techniques such as mirroring, Baum Circles, sensory integration, synchronisation, six-part storey making, dyadic leading and following, as well as moving together, breath work and relaxation exercises, props and verbal processing. The differences in the approaches for the younger population with ASD were the use of developmentally appropriate play-based activities alongside other DMP techniques with the focus on joint attention and

TABLE 4 | Quality appraisal of the studies using the mixed methods appraisal tool (MMAT).

MMAT category of study designs	Study	Responses					MMAT methodological quality criteria (Hong et al., 2018)
Qualitative		**1.1**	**1.2**	**1.3**	**1.4**	**1.5**	1.1. Is the qualitative approach appropriate to answer the research question?
	Athanasiadou and Karkou (2017)	Y	Y	Y	C	Y	1.2. Are the qualitative data collection methods adequate to address the research question?
	Devereaux (2017)	Y	Y	Y	Y	Y	1.3. Are the findings adequately derived from the data?
	Houghton and Beebe (2016)	Y	C	Y	C	Y	1.4. Is the interpretation of results sufficiently substantiated by data?
	Wengrower (2010)	Y	N	N	N	N	1.5. Is there coherence between qualitative data sources, collection, analysis and interpretation?
Quantitative non-randomised		**3.1**	**3.2**	**3.3**	**3.4**	**3.5**	3.1. Are the participants representative of the target population?
	Hartshorn et al. (2001)	Y	C	N	N	C	3.2. Are measurements appropriate regarding both the outcome and intervention (or exposure)?
	Chiang et al. (2016)	Y	Y	Y	Y	Y	3.3. Are there complete outcome data?
							3.4. Are the confounders accounted for in the design and analysis?
							3.5. During the study period, is the intervention administered (or exposure occurred) as intended?
Quantitative descriptive		**4.1**	**4.2**	**4.3**	**4.4**	**4.5**	4.1. Is the sampling strategy relevant to address the research question?
	Sengupta and Banerjee (2020)	N	Y	N	Y	N	4.2. Is the sample representative of the target population?
							4.3. Are the measurements appropriate?
							4.4. Is the risk of non-response bias low?
							4.5. Is the statistical analysis appropriate to answer the research question?
Mixed methods		**5.1**	**5.2**	**5.3**	**5.4**	**5.5**	5.1. Is there an adequate rationale for using a mixed methods design to address the research question?
	Samaritter (2015)	C	Y	Y	Y	Y	5.2. Are the different components of the study effectively integrated to answer the research question?
	Aithal (2020)	Y	Y	Y	Y	Y	5.3. Are the outputs of the integration of qualitative and quantitative components adequately interpreted?
							5.4. Are divergences and inconsistencies between quantitative and qualitative results adequately addressed?
							5.5. Do the different components of the study adhere to the quality criteria of each tradition of the methods involved?

Y, Yes; N, No; C, Can't tell.

other cognitive prerequisites for communication. Marchant et al. (2018) also reports that the studies reviewed were predominately structured with the exception of Mateos-Moreno and Atencia-Doña (2013) and Edwards (2015) who pertained to a semi- or un-structured framework. While in this review, the majority of studies have preferred semi-structured DMP sessions over fully structured or unstructured sessions. It can be deduced that DMP group sessions for children are most likely to be semi-structured for children with ASD and unstructured sessions are feasible while working on one-to-one. Both group and individual sessions appeared to be popular while working with children on the autism spectrum. However, there was no clarity and correlation between the severity of ASD and the type of session nor there was a clear trend between duration, frequency, intensity and progress made by children. One of the most relevant result of this review is that only three studies have reported on complete DMP intervention programme structure. Poor research reporting of the sessions has created several gaps in interpretation of the findings.

In terms of settings, special education settings were the most common settings across the studies. Advantages of conducting studies within special education settings could be that attrition is minimised and there are more opportunities for consistent observations from different perspectives. Similar advantages have been reported in studies involving adults with ASD conducted in education institutions or specialist centres (Marchant et al., 2018).

With regards to the second research question (How do different studies examine the effectiveness and processes involved in DMP interventions? What are their findings?), the search results were in accordance with Vulcan's (2016) claim that the research available in relation to children with ASD often leans toward case studies. Although the studies included in the current systematic review revealed some positive outcomes, these results cannot be generalised since included studies were placed at the lower and intermediate level of evidence with varying methodological quality. This led to high heterogeneity of the results, unconvincing evidence, and exertion in recognising key results. Since the studies did not have consensus in terms of the parameters measured, tools used and the output, there was a risk of *mixing apples and oranges* (Higgins and Green, 2008) leading to meaningless results if meta-analysis was

performed. Hence, the outcomes were synthesised and mapped under broader domains, namely social and communication, psychological and physical/sensory.

Improving social skill was a major area of interest in the reviewed studies; a substantial evidence reports that DMP is potentially able to enable the development of relationships. This extensive interest stands as per the NICE guidelines (NICE, 2016) that value interventions that address the social-communication core features of ASD. Despite considerable extent of importance given to the core features of ASD in the reviewed articles, some of the claims were not fully substantiated with data. For example, serotonin levels, EEG activity, sensory motor mirroring and many others were proposed as probable reasons for change in social skills without linking them with data and appropriate tools for measurement. Hence, further explorations are required to look at the underlying factors bringing changes in the client group.

NICE guidelines (NICE, 2016) for children with ASD also highlight the importance of managing co-existing emotional issues leading to anxiety and depression in addition to cognitive areas such as increasing joint attention, joint engagement, and on-task behaviours through play-based strategies. The findings from the present review on the role of DMP in improving emotional regulation, awareness and anxiety coping strategies as perceived by parents, educators and therapists are promising. In contrast, findings relating to the development of cognitive skills and physical/sensory outcomes remained inconsistent, calling for further clarification. For instance, the findings on task behaviour and joint attention did not show any significant enhancement after therapy in quantitative studies while qualitative studies did observe progress. In addition, Chiang et al.'s (2016) study found improvements stage in unengaged joint engagement, child initiated supported JE and child initiated co-ordinated JE only at 3 months follow up and not immediately after the intervention. But the reasons for these inconsistencies are not clear.

Similar issues where findings from qualitative and quantitative findings contradicted each other were noticed in other domains as well. For example, improvements from brief moments of eye contact to sustained and meaningful eye contacts with the therapist (Houghton and Beebe, 2016; Athanasiadou and Karkou, 2017) and with the group members (Athanasiadou and Karkou, 2017) have been reported. By contrast, Hartshorn et al.'s (2001) quantitative observation on eye contact does not report statistically significant improvement. This could possibly be because of the nature of assessment and methodology of the research studies. In a natural context, eye contact varies within the content and meaning of the situation. Probably, quantifying the progress in terms of duration of the behaviours or actions sustained may not always reflect as the correct measurement of change. As a result, gaps in understanding the appropriate dosage, follow up findings and type of assessment tools that are valid and sensitive to pick up changes will need to be addressed for better clarity.

To compare the results of the present review with the other studies on the same topic, not many reviews were found in DMP and there was no review on this topic specifically focusing on children below 16 years. The current results were compared with

findings of the reviews by Koch et al. (2014) and Scharoun et al. (2014). Koch et al. (2014) studied health-related psychological outcomes of DMP and reported DMP was as effective evidence-based intervention for children and adults with ASD. Similarly, the study by Scharoun et al. (2014) identified the success of DMP interventions in both individual and group settings for people with ASD. Unlike these two reviews, the present study does not share the confidence that DMP is an effective intervention for this client population due to the high risk of bias of the reviewed studies, extensive variability in methodology, limited and inconsistent usage of valid, standard tools for assessments and dearth of replicable outcomes. However, this study does acknowledge the *potential* in DMP to be an effective intervention for children with ASD.

To sum up the key contributions of DMP, social and emotional domains stand out among different parameters while communication and sensory domains are interwoven with the other domains. Improvements in core issues of ASD and comorbid problems such as making connexions, awareness of self and others, emotional regulation, joint engagement, repetitive movements have been frequently reported. There is lack of clarity in the underlying factors that might have brought these changes. Furthermore, these findings are inconclusive due to the small sample sizes of the studies included in the review. Generalising the outcomes to the population is not, therefore, possible leading to limited evidence on the contribution of DMP to children with ASD. Overall, there were issues with the quality for the studies reviewed. It is necessary for the authors to adhere to the reporting guidelines to enhance transparency and the impact of the interventions (Hoffmann et al., 2014). Although the findings of this review are inconclusive, they clearly highlight gaps in existing literature which need to be dealt with in depth for future developments in research, policy and practise.

Potential Bias in the Review Process

This review includes the doctoral thesis of the first author (Aithal, 2020) and the co-authors who were part of the supervisory team. This potential source of bias has been addressed by involving an external researcher who was not part of the doctoral research team. In addition, the members in the research team are from diverse backgrounds which could potentially reduce bias by bringing in different perspectives and expertise.

Some of the limitations of the review were that unpublished studies and research articles in languages other than English were not included due to time and resource restraints. This could have led to a potential risk of bias. Furthermore, a funnel plot analysis designed to check for the existence of publication bias in systematic reviews was not possible due to low number of published studies included (Higgins and Green, 2011). One more issue influencing the external validity of this review could be the PICOS inclusion criteria set to identify studies. The way DMP was defined for the purposed review i.e., with a clear psychotherapeutic process and intent has limited the included studies. For example, the study by Ramachandran and Seckel (2011, p. 151), which outlined the basis of "synchronised DMP to simulate mirror neurons" was excluded because the authors described a DMP practise that parted from a conventional

approach: children with ASD were invited to look into a room of mirrors, all located at varying angles to facilitate numerous allocentric views (Fidalgo and Martin, 2016).

SUMMARY OF THE REVIEW

The systematic review suggests that DMP can potentially promote various aspects of well-being in children with ASD; however, evidence for its effectiveness remains inconclusive. There is a need for large sample 1B level studies (Burns et al., 2011) that use standardised and validated tools for evaluation which are appropriate for the population. The review also identifies limited evidence on long-term effects of DMP. Therefore, follow-up studies which assess outcomes at regular intervals after terminating the intervention are needed. Researchers should also consider including economic analyses and acceptability measures as they can provide a more realistic picture for practise implications and can connect research with policy, training and advocacy (Uttley et al., 2015). Additional needs to be given to setting the inclusion criteria on severity and comorbidity of ASD. Future studies could also consider exploring the relationship between particular approaches of DMP and diverse severity of ASD. Individual v/s group interventions for children with ASD also need to be researched so as to support clinical guidelines that take these issues into account. Overall quality and quantity of studies must grow markedly in this topic to make a substantial shift in what we know so far. Well-designed, detailed studies on the impact of DMP for children with ASD are warranted. Before well-designed RCTs are conducted and given the limited explanations of the key therapeutic factors that bring change, attention should be given to further understanding the therapeutic process. It was inferred from the review that qualitative and arts-based research designs that focus on the therapeutic process could be useful with regards to this issue.

DATA AVAILABILITY STATEMENT

The secondary data supporting the conclusions of this article will be made available by the authors without undue reservations upon request.

AUTHOR CONTRIBUTIONS

SA was responsible for organising, analysing, and writing up the current paper. ZM completed the systematic search with SA and VK. She also contributed to the editing of the text. VK guided and provided corrections for review. She also acted as a referee during the searches. SM, JP, and TK contributed to the development of protocol, revisions, and edits of the paper. All authors contributed to the article and approved the submitted version.

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*Indicate the references of the articles included in this review.

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Impacts of Internet-Based Interventions for Veterans With PTSD: A Systematic Review and Meta-Analysis

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Background: Veterans who did not seek and complete treatment as intended have been shown to have an elevated risk of experiencing and being exposed to post-traumatic stress disorder (PTSD). Internet-based interventions (IBIs) provide more confidentiality and fewer treatment barriers, and they are regarded as potential treatments to reduce PTSD in veterans. However, the effects of IBI for veterans with PTSD are inconclusive.

Objectives: IBI is defined as any internet-based series of psychosocial interventions, of which the internet works as a way of delivery. Psychosocial content and reduction of PTSD symptoms in veterans have been recognized as two core elements of this intervention. This study aimed to (1) examine the effects of IBI on veterans' PTSD outcomes and (2) distinguish between the elements of IBI that play an important role for veterans with PTSD.

Methods: Web of Science, PubMed, EMBASE, PsycINFO, Cochrane, Wanfang Data, CNKI, and CQVIP databases were searched for randomized controlled trials (RCT) in IBI programs for veterans with PTSD, covering all studies in English and Chinese published from January 1990 to November 2020. Also, related studies tracking citations were identified. Studies met the following inclusion criteria of (1) being RCTs; (2) containing IBI in the full text; (3) having IBI conducted on veterans as participants; and (4) being on PTSD. All processes followed PRISMA. The risk of bias of the studies was assessed by the Cochrane Systematic Review Handbook. The confidence of outcomes of this review was valued according to the GRADE (Grading of Recommendations Assessment, Development, and Evaluation). The meta-analysis was done by RevMan 5.13. Two teams of reviewers independently searched the literature, made the assessment, and extracted the data.

Results: A total of 1,493 citations were identified after initial searching, of which the full texts of 66 studies were screened. Eventually, six RCT studies met the inclusion criteria. Beneficial effects of IBI were found on the overall PTSD outcome (-0.29; 95% CI-0.48 to -0.11, $p < 0.01$). Particularly, IBI based on cognitive behavioral therapy (CBT) with peer support was found to be effective for PTSD outcomes (-0.36; 95% CI-0.61 to -0.11, $p < 0.01$). The subgroup analysis demonstrated that scores of PTSD outcome measured by a PCL (PTSD Checklist) decreased to an average score of 0.38 (95% CI -0.60 to

−0.15, $p = 0.001$). The intervention had a positive effect on the PTSD outcome on veterans with comorbid psychological disorders (−0.30; 95% CI −0.61 to −0.11, $p < 0.01$). Overall, the six studies included were evaluated with a low risk of bias, and the outcomes of the meta-analysis were proven with high confidence.

Conclusion: On the whole, IBIs have a positive effect on the overall PTSD outcome of veterans. The results encouraged us to focus on IBI with CBT with peer support for veterans, on specific instruments for veterans with PTSD, and on veterans with comorbid psychological disorders. This study, however, has limits. Only six studies with a Western population were included, which might result in cultural bias on IBI effects. In future, more high-qualified research and diverse cultural background of RCTs is needed to prove the effectiveness of IBI on veterans with PTSD.

INTRODUCTION

Post-traumatic stress disorder (PTSD) is a prevalent, chronic, and disabling psychiatric disorder often diagnosed among military personnel in relation to combat trauma (Possemato et al., 2011; McLean and Foa, 2013). A combination of childhood abuse, combat traumas, and/or sexual assault was suggested as the reason for veterans' PTSD (Morland et al., 2015). The study by Niemeyer et al. (2020) proved that PTSD had a 12-month prevalence rate of 3.7% among the United States population and 2.3% in the German population and other European countries. Among veterans of the wars in Iraq and Afghanistan, PTSD prevalence was estimated to be 10–20%, and female military personnel were more likely than male veterans to experience higher PTSD prevalence rates (Morland et al., 2015).

PTSD is related to many negative effects on patients, such as significant adverse health and life consequences (Morland et al., 2015). PTSD can cause severe distress, chronic suffering, and impairments, of which the core symptoms include persistent avoidance of traumatic content, re-experiencing traumatic content, and negative alterations in cognition, arousal, and reactivity (Haagen et al., 2015). Firstly, PTSD results in altered cognition that includes hypersensitivity to physical sensations or mislabeling these symptoms as common physical health problems (Possemato et al., 2011). Individuals with PTSD report poorer general health and bodily pain (Stevens et al., 2016; Hamblen et al., 2019). Also, veterans with PTSD often have high rates of comorbid mental health disorders (Engel et al., 2015). When patients do not receive timely and effective treatment, PTSD often becomes a chronic and disabling disorder that is often comorbid with substance abuse disorders, major depression, psychological distress, and other anxiety disorders (McLean and Foa, 2013; Niemeyer et al., 2020). What is worse, PTSD is associated with impairment in social/occupational functioning (Hamblen et al., 2019). Veterans with PTSD are believed to be less able to engage in physical activities or fulfill previously held roles (Stevens et al., 2016). They are reported to have increasing impairments in performing life roles (e.g., work and family responsibilities) and daily tasks

(e.g., household chores; Stevens et al., 2016). PTSD is also related to violent behavior (e.g., aggression; Morland et al., 2015).

Traditionally, several evidence-based psychotherapeutic approaches to treat PTSD have been recommended, including CBT, cognitive processing therapy (CPT), prolonged exposure therapy (PE), stress management skills training, eye movement desensitization reprocessing (EMDR), and other innovative interventions (Kearney et al., 2012; Rodriguez et al., 2020). Cognitive-behavioral conjoint therapy (CBCT) and integrative behavioral couple therapy (IBCT) were designed to combine acceptance strategies and IBCT techniques to ameliorate the symptoms of PTSD, relationship conflicts, and experiential avoidance (Monson et al., 2009). Structured approach therapy (SAT) as an approach in a stress inoculation therapy (SIT) framework consists of psycho-education, skills training, and coping skills (Sautter et al., 2015). PE has also been shown effective in lessening PTSD symptoms and maintaining treatment gains over time (McLean and Foa, 2013). EMDR produced significant enhancements in decreasing anxiety, anger, depression, isolation, and other symptoms (Koven, 2018). Mindfulness-based stress reduction (MBSR) is a standardized class series to teach mindfulness to reduce stress by a combination of meditation, body awareness, and mindful breathing, which have been shown to have significant improvements in PTSD symptoms (Kearney et al., 2012; Colgan et al., 2016; Koven, 2018). Mindfulness-based cognitive therapy (MBCT) also belongs to stress-reduction groups involved psychotherapies incorporating mindfulness techniques (King et al., 2013). Yoga has also been used to manage stress *via* adjusting the cognitive perspective and focusing on inner peace (Reddy et al., 2014). Building spiritual strength (BSS) is an inter-faith, manualized, spiritually integrated intervention to support the participants in their choice of religious affiliation or non-affiliation (Harris et al., 2011). Logotherapy has also been applied as an innovative adjunctive treatment for PTSD by healing through meaning (Koven, 2018). Another complementary intervention is a specially trained psychiatric service dog, offering emotional and therapeutic value (Rodriguez et al., 2020).

Traditional intervention sessions are usually conducted by therapists with the veteran and the veteran's partner (Sautter

et al., 2015). While, compared with non-military groups, veterans have a higher need for services addressing PTSD. Perceived stigma of treatment seeking was proven to be negatively related to treatment utilization in a study with a sample of 812 veterans (Kulesza et al., 2015). And for some veterans, logistics and confidentiality concerns also posed problems with treatment utilization (Engel et al., 2015; Krupnick et al., 2017; Niemeyer et al., 2020) Nontraditional online health care pathways have been proposed as possible solutions to cope with the disadvantages of stigma, confidentiality concerns and treatment inefficacy (Parish et al., 2014). It was found that web-based interventions for PTSD were a feasible and helpful intervention for veterans (Belsher et al., 2015). The feasibility, acceptability, and usability of IBI have been well documented (Bush et al., 2011).

According to Barack and Klein, IBIs are defined as therapeutic programs with various health objectives mainly delivered *via* the internet, described with respect to four major components: content, multimedia, interactive online activities, and guidance and supportive feedback (Barak et al., 2009; Guay et al., 2017). The U.S. Defense Department's National Center for Telehealth & Technology has developed a web through which to provide a set of information on resources, tools, and aids for military personnel, veterans, and their families (Bush et al., 2011). Web-based self-management has been proved an effective online tool for the military (Bush et al., 2011). A web-based video gallery has been provided to share personal stories about PTSD and treatments (Hamblen et al., 2019).

In a systematic review and meta-analysis, e-Mental health interventions revealed a significant improvement in PTSD symptoms in the active intervention group among a general population (Simblett et al., 2017). Yet, to our knowledge, there is limited literature on meta-analysis and systematic review of IBI on veterans with PTSD. One review analyzed the prevalence of eight disorders among elderly veterans and found that PTSD prevalence was not markedly high (Williamson et al., 2018). To reduce PTSD symptoms, a meta-analysis suggested that iCBT for PTSD was efficacious, and only one study was analyzed based on a military sample (Niemeyer et al., 2020). One review included 12 studies to access the interventions for supporting partners of military veterans with PTSD, among which only one was based on IBI (Turgoose and Murphy, 2019). However, IBIs in other groups were tested as effective in supporting informal caregivers (Sherifali et al., 2018), which helped us to see the potential of IBI on veterans with PTSD in our study. Therefore, the primary aim of this research was to conduct a systematic review and meta-analysis to examine the effects of IBI on veterans diagnosed with PTSD who were living in a community or absent from military life. The secondary objective was to distinguish the contents of IBI that played an important role for veterans to decrease levels of PTSD.

MATERIALS AND METHODS

Population

A total of 622 participants in all six studies included veterans, members of the active military on leave with PTSD, and a small number of civilians diagnosed with PTSD (see **Table 1**). The average age of the participants in the studies was 38.88.

Interventions

In the definition of IBI, the internet works as a method of delivery assisted by therapists, mental health providers, counselors or specialists, and nurses. The platform aims at conducting PTSD care and relief for veterans by stress-management skills, cognitive reframing techniques, treatment sessions, and CBT lessons with peer support.

Inclusion and Exclusion Criteria

Two teams of researchers screened the literature independently. Research studies must meet the following inclusion criteria: be RCTs; contain IBI in the full text; have IBI conducted on veterans in trial groups; have no intervention, a delayed intervention, or another psychosocial intervention or usual care but not online conducted on participants in the control group; have PTSD as the outcome; be studies published between January 1990 and November 2020; and be studies published in English or Chinese.

Interventions conducted in closed settings (e.g., medical institutions) or those including the use of drugs were excluded. To ensure the quality of the study, research not published in a peer-reviewed journal, without data extraction or of detailed information for meta-analysis was also excluded.

Search Strategy

We conducted a detailed automated search and screened relevant literature in the Web of Science, PubMed, EMBASE, PsycINFO, Cochrane, Wanfang Data, CNKI, and CQVIP databases for articles that were RCT in IBI programs for veterans with PTSD. Also, reference lists of related studies were manually tracked. Our search term consisted of three subsets: participant ("veteran" and "military"), intervention ("internet" and "web"), and outcomes ("PTSD" and "mental health"). We connected them with two Boolean operators (AND and OR) to search for relevant research in English and in Chinese published from January 1990 to November 2020 from the databases.

Selection Results

We followed the PRISMA statement to select studies (Moher, 2010). As shown in **Figure 1**, a total of 1,493 studies in the literature related to the topic were identified from eight databases ($n = 1,488$) and other resources ($n = 5$). After the removal of duplicate literature, 1,222 articles remained. Based on the inclusion and exclusion criteria, two teams of reviewers independently screened and excluded a total of 1,153 articles as non-related. The remaining 69 articles were further screened after reading the full-text articles. Considering that there might be topic-related articles or the titles and abstracts were insufficient to judge whether articles were useful. In the remaining 69 studies, we identified six eligible RCTs for our meta-analysis.

TABLE 1 | Key characteristics of participants and RCTs in the studies.

Study	Participants	Country	Comorbidity	Treatment type		N1	Experimental group			N2	Control group			Outcome measure
				Control group	Experimental group		Mean age	Age range	Sex (M/F)		Mean age	Age range	Sex (M/F)	
Engel et al., 2015	Service members and veterans	United States	Depression and anxiety	OUC[e]	DESTRESS-PC[e]	43	36.2	28.45–43.95	34/9	37	36.7	26.95–46.45	31/6	PCL[d]
Morland et al., 2015	Female civilian and military	United States	Depression, anxiety and substance use disorder	NP[e]	VTC[e]	63	46.9	35.1–58.7	0/63	63	46.0	33.9–58.1	0/63	CAPS[d]
Niemeyer et al., 2020	Male veterans and military	Germany	Depression, anxiety and dysthymia	-	iCBT[e]	21	37.7	30.84–44.56	21/0	17	37.8	25–50.6	17/0	CAPS
Litz et al., 2007	Service members	United States	Depression and anxiety	Internet-based supportive counseling	Internet-based, self-management cognitive behavior therapy	24	38.63	29.22–48.04	18/6	21	39.86	32.14–47.58	17/4	PCL
Stevens et al., 2016	Veterans	United States	Depression and perceived physical health impairment	AAU[e]	VP[e]	209	34.36 ± 8.01[a]	20–63[b]	170/30	94	-	-	77/17	PCL-M[d]
Possemato et al., 2019	Veterans	United States	Hazardous alcohol use	Self-management thinking forward	Peer-supported thinking forward	15	39 ± 9[a]	NA[c]	14/1	15	-	-	14/1	CAPS

[a]Mean age of population in both experimental group and control group.
[b]Age range of population in both experimental group and control group.
[c]Not reported in included study.
[d]PCL: PTSD Checklist; CAPS: Clinician-Administered PTSD Scale; PCL-M: Checklist – Military Version.
[e]OUC: optimized usual primary care PTSD Treatment; DESTRESS-PC: Delivery of self-training and education for stressful situations online; NP: in person VTC: videotele conferencing; iCBT: online cognitive behavior therapy; AAU: Adjustment as Usual; VP: Vets Prevail.
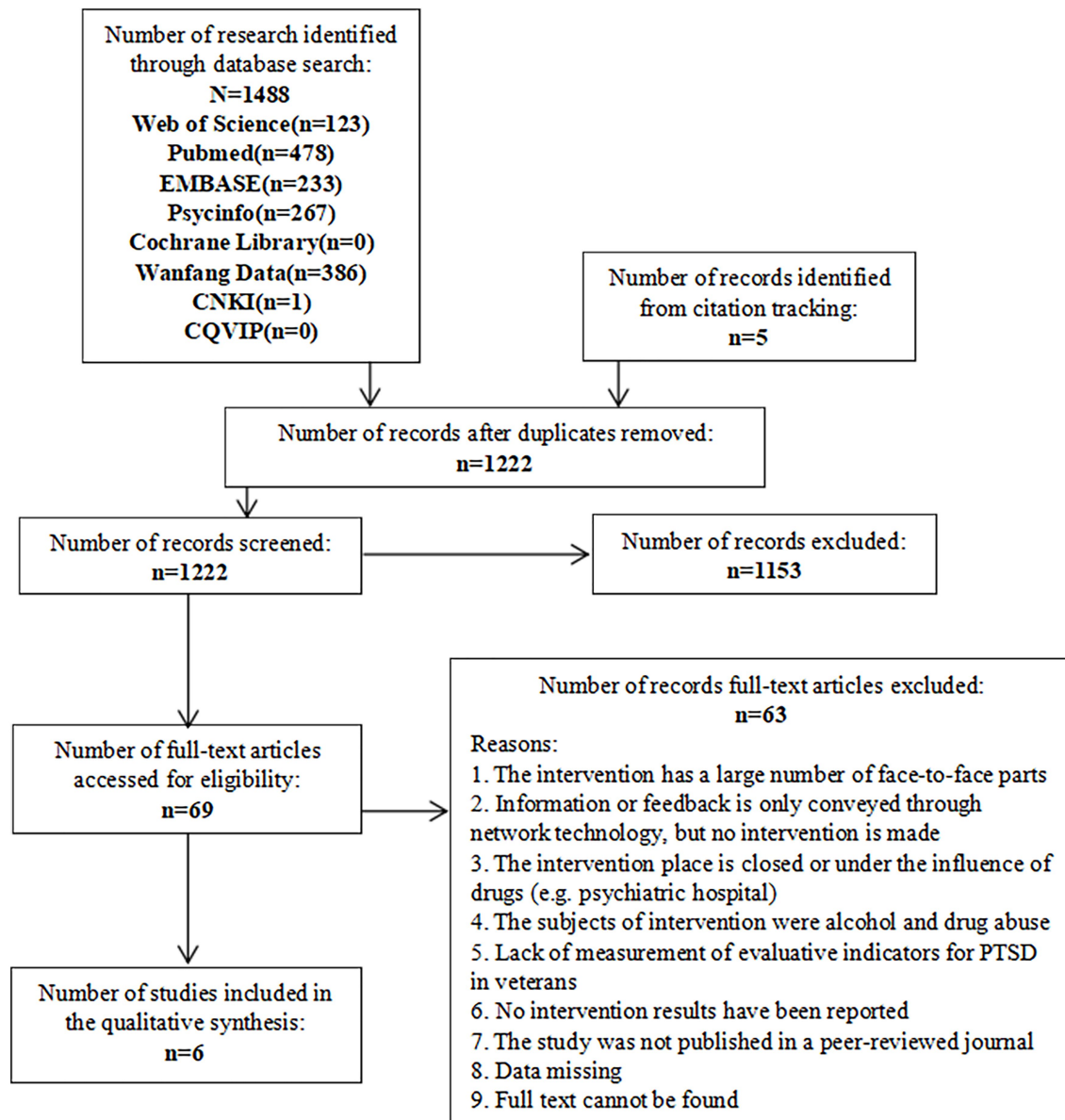
FIGURE 1 | PRISMA diagram of included studies in the meta-analysis.

Date Extractions

To answer the research questions, we generated a data extraction table. The coding scheme mainly extracted the contents, including participants' characteristics, intervention design, outcome, measurement tool, and the duration of follow-ups. Basic information was extracted, including title, authors, country of authors, publication year, abstract, objective, and the journal. We also addressed the quantitative data: mean and standard deviation (SD). Some literature did not report these data, and we calculated the mean and SD of these studies according to the standard error (SE), d effect size, values of p, 95% confidence intervals (CIs), and other information given in the papers. The detailed information of these studies is reported in **Tables 1–4.**

All data extraction was completed by two independent reviewers and verified by another reviewer, to ensure the reliability of data extraction. The third reviewer was also responsible for the reconfirmation of inconsistent data that the two reviewers extracted. All reviewers agreed upon the content of the final data extraction table after discussion.

Quality Assessment

Two independent reviewers assessed the risk of bias of each eligible study by the Cochrane Systematic Review Handbook. This quality assessment evaluates the levels of bias in the following content: selection, performance, detection, attrition, reporting, and other biases (Higgins et al., 2011). The confidence

TABLE 2 | Summary of overall effectiveness of IBI on veterans with PTSD.

Author (year)	Intervention/Control	Estimate standard mean difference (95%CI)	I^2 (%)	p	GRADE quality assessment
Engel et al., 2015	30/25	−0.20[−0.73, 0.34]	–	–	–
Litz et al., 2007	8/10	−0.89[−1.88, 0.09]	–	–	–
Morland et al., 2015	38/45	−0.14[−0.57, 0.30]	–	–	–
Niemeyer et al., 2020	21/17	−0.07[−0.71, 0.57]	–	–	–
Possemato et al., 2019	9/11	−0.10[−0.99, 0.78]	–	–	–
Stevens et al., 2016	166/90	−0.38[−0.64, −0.12]	–	–	–
Total	272/198	−0.29[−0.48, −0.11]	0	0.002	High

TABLE 3 | Summary of subgroup analysis on intervention contents, outcome instruments, and comorbidity of participants.

Group	Subgroup	Number of studies	Intervention/ Control	Estimate standard mean difference (95%CI)	I^2 (%)	p	GRADE quality assessment
Intervention contents	Psycho-education	2	38/35	−0.35(−0.82 to 0.12)	33	0.14	High
	psychotherapy	2	59/62	−0.12(−0.47 to 0.24)	0	0.53	High
	CBT with peer support	2	175/101	−0.36(−0.61 to −0.11)	0	0.004	High
Outcome instruments	CAPS	3	68/73	−0.11(−0.45 to 0.22)	0	0.50	High
	PCL	3	204/125	−0.38(−0.60 to −0.15)	0	0.001	High
Comorbidity of participants	Depression and anxiety	5	263/187	−0.30(−0.49 to −0.11)	0	0.002	High
	Hazardous alcohol use	1	9/11	−0.10(−0.99 to 0.78)	/	0.82	High

TABLE 4 | Summary of sensitivity analysis on sample size, gender and culture.

Subgroup	Number of studies	Intervention/Control	Estimate standard mean difference (95%CI)	I^2 (%)	p	GRADE quality assessment
Exclude large sample size	5	106/108	−0.19[−0.46, 0.08]	0	0.16	High
Exclude female civilians and military	5	234/153	−0.33[−0.54, −0.12]	0	0.002	High
Exclude male veterans and military	5	251/181	−0.31[−0.51, −0.12]	0	0.002	High

of outcomes of this review was also evaluated by two reviewers and rechecked by the third reviewer according to GRADE, which includes the risk of bias, inconsistency, indirectness, inaccuracy, and publication bias (Grade Working Group, 2004; Moher, 2010). All disagreements on risk bias and quality assessment were discussed to reach a conclusion among the reviewers.

Data Analysis

We used the data (mean, SD) to perform the meta-analysis on the effectiveness of the IBI. I^2 was used to demonstrate the heterogeneity among the studies in quantitative statistics and when the heterogeneity test $I^2 < 50\%$, a fixed-effects model, was used for meta-analysis (Higgins et al., 2003). Accordingly, this study used a fixed-effect model to explore the relationship between the studies. According to the differences in intervention content, measurement tools, and status of comorbidity,

we grouped the studies and conducted a subgroup analysis to determine which components were playing key roles in mitigating PTSD symptoms in veterans. We also conducted a sensitivity analysis to test the stability of outcomes. The meta-analysis was done by RevMan 5.3.

RESULTS

Description of Studies

As shown in **Table 1**, one of the studies was conducted in Germany (Niemeyer et al., 2020) and the other five in the United States. The mean age of the participants was under 50 (range 36.2–48). Two studies did not report the mean age of the experimental group and the control group (Stevens et al., 2016; Possemato et al., 2019). More than half the veterans were male in the majority of the studies (range 81.25–100%),
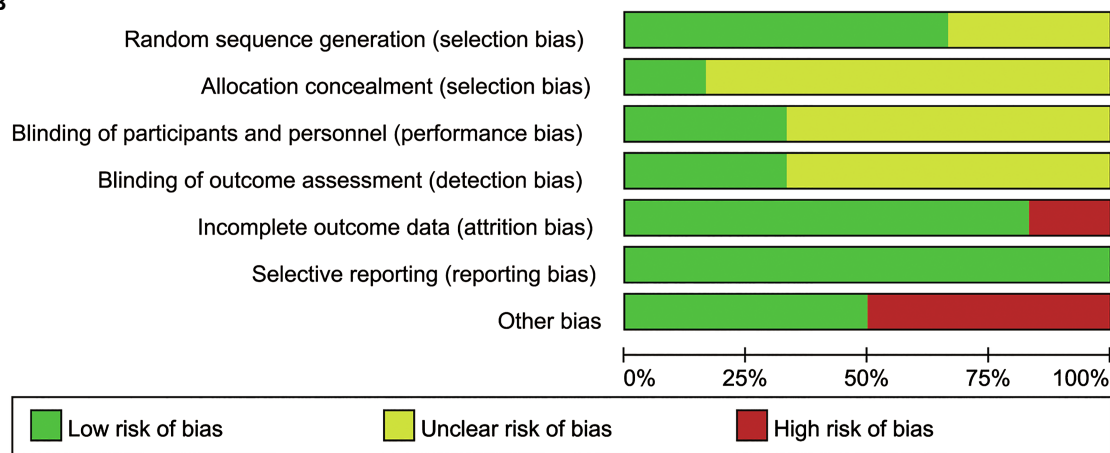
A

B

FIGURE 2 | **(A)** Summary of Risk of Bias for all the included studies. **(B)** Graph of Risk of Bias for all the included studies.

except for one study in which all participants were female (Morland et al., 2015).

All six studies had experimental groups defined as veterans receiving IBI, and five studies had control groups with veterans having optimized usual primary care (OUC; Engel et al., 2015), treatment in person (NP; Morland et al., 2015),

web-based supportive treatment (Litz et al., 2007; Possemato et al., 2019) and no treatment (Stevens et al., 2016; Niemeyer et al., 2020). One study had civilian women as participants in the control group (Morland et al., 2015). In all six studies, there were three types of intervention contents as branches of IBI. Two of these studies (33.33%) were categorized as

using IBI in psycho-education, which contained self-training and education for stressful situations and self-management treatment (Litz et al., 2007; Engel et al., 2015). Two studies (33.33%) were regarded as using IBI in psychotherapy, which included two kinds of trauma-focused psychotherapy (Morland et al., 2015; Niemeyer et al., 2020). Two studies (33.33%) used IBI on CBT with peer support, which provided a platform for veterans to build social connections (Stevens et al., 2016; Possemato et al., 2019). PTSD outcomes were examined by three subgroups of the IBI, as shown in **Table 3**. Outcome assessment tools used for the outcome were categorized as CAPS and PCL. Three studies were assessed by CAPS (Morland et al., 2015; Possemato et al., 2019; Niemeyer et al., 2020), and the others were measured by PCL (Litz et al., 2007; Engel et al., 2015; Stevens et al., 2016). In total, five of the six studies were judged as small in sample size ($\leq$100; Litz et al., 2007; Engel et al., 2015; Morland et al., 2015; Possemato et al., 2019; Niemeyer et al., 2020), and one study contained a large sample with 209 recipients in the experimental group and 94 recipients in the control group (Stevens et al., 2016). The length of follow-up in all studies was short ($\leq$6 months). Regarding the recipients' mental health condition, six studies included veterans with PTSD (Litz et al., 2007; Engel et al., 2015; Morland et al., 2015; Stevens et al., 2016; Possemato et al., 2019; Niemeyer et al., 2020). Varying degrees of psychological disorders (depression, anxiety, dysthymia, substance use disorder, and perceived physical health impairment) were represented as comorbidities in five studies (Litz et al., 2007; Engel et al., 2015; Morland et al., 2015; Stevens et al., 2016; Niemeyer et al., 2020). In one study, veterans struggled with hazardous alcohol use in addition to PTSD (Possemato et al., 2019).

Descriptions of Risk of Bias

The Cochrane Risk of Bias reported the quality of study methodology. The results of the critical assessments of the studies for the risk of bias on aspects of Allocation Assignment Methods, Allocation Concealment, Blinding of Participants Providers, Blinding of Outcome Assessment, Completeness of Outcome Data, Selective Reporting, and Other Bias are

shown in **Figures 2A,B**. In Allocation Assignment Methods, four studies (66.67%) were low-risk (e.g., Engel et al., 2015), and two studies were unclear (33.33%; e.g., Litz et al., 2007). In regard to Allocation Concealment, one study (16.67%) was low-risk (Niemeyer et al., 2020), and five studies (83.33%) were unclear (e.g., Engel et al., 2015). For Blinding of Participants Providers, two studies (33.33%) were low-risk (e.g., Engel et al., 2015), and four studies (66.67%) were unclear (e.g., Stevens et al., 2016). For Blinding of Outcome Assessment, two studies (33.33%) were low-risk (e.g., Engel et al., 2015), and four (66.67%) were unclear (e.g., Stevens et al., 2016). With respect to Completeness of Outcome Data, five studies (83.33%) were low-risk (e.g., Engel et al., 2015), and only one study (16.67%) was high-risk (Morland et al., 2015). On Selective Reporting, all six studies (100%) were low-risk. In Other Bias, three studies (50%) were low-risk (e.g., Engel et al., 2015), and three studies (50%) were high-risk (e.g., Niemeyer et al., 2020).

Results of Overall Effectiveness

This systematic review and meta-analysis examined the overall effects of IBI on veterans' PTSD outcomes. As shown in **Table 2** and **Figure 3**, the scores dropped an average of 0.29 (95% CI −0.48 to −0.11, $p < 0.01$). It was also found that there was no heterogeneity between the studies ($p < 0.01$; $I^2 = 0\%$). The assessment was evaluated as having high quality.

Results of Subgroup Analysis

For the subgroup of intervention measures, three kinds of IBI content have been distinguished. All six studies applied mature IBI training platforms or treatments: online self-management training (Engel et al., 2015), psycho-education *via* the internet (Litz et al., 2007), online therapy (iCBT; Niemeyer et al., 2020), videotele conferencing (VTC; Morland et al., 2015), CBT with a forum (Stevens et al., 2016), and CBT with peer support (Possemato et al., 2019). Considering the content and targets of treatments, we identified three subgroups of these interventions, which focused on providing psycho-education (Litz et al., 2007; Engel et al., 2015), psychotherapy (Morland et al., 2015; Niemeyer et al., 2020),
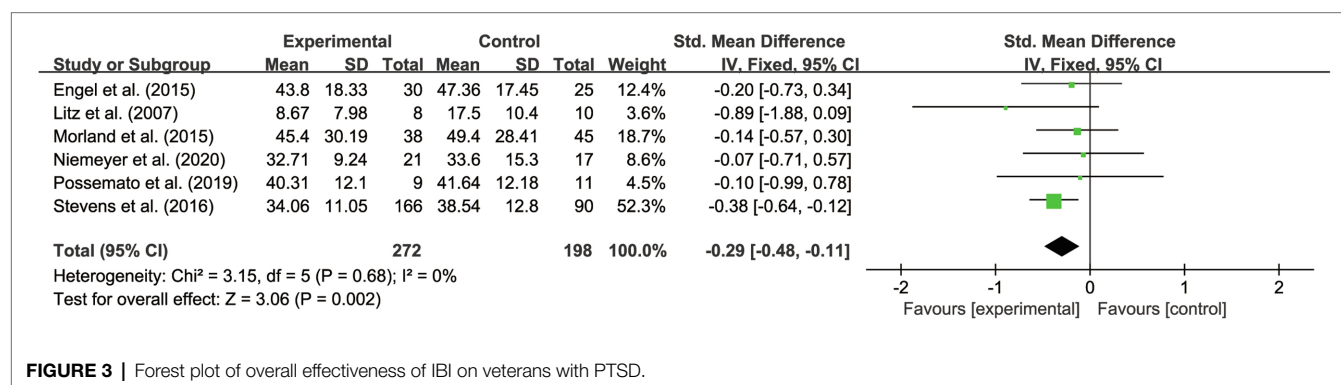

Study or Subgroup	Experimental Mean	SD	Total	Control Mean	SD	Total	Weight	Std. Mean Difference IV, Fixed, 95% CI
Engel et al. (2015)	43.8	18.33	30	47.36	17.45	25	12.4%	-0.20 [-0.73, 0.34]
Litz et al. (2007)	8.67	7.98	8	17.5	10.4	10	3.6%	-0.89 [-1.88, 0.09]
Morland et al. (2015)	45.4	30.19	38	49.4	28.41	45	18.7%	-0.14 [-0.57, 0.30]
Niemeyer et al. (2020)	32.71	9.24	21	33.6	15.3	17	8.6%	-0.07 [-0.71, 0.57]
Possemato et al. (2019)	40.31	12.1	9	41.64	12.18	11	4.5%	-0.10 [-0.99, 0.78]
Stevens et al. (2016)	34.06	11.05	166	38.54	12.8	90	52.3%	-0.38 [-0.64, -0.12]
Total (95% CI)			272			198	100.0%	-0.29 [-0.48, -0.11]

Heterogeneity: Chi² = 3.15, df = 5 (P = 0.68); I² = 0%
Test for overall effect: Z = 3.06 (P = 0.002)

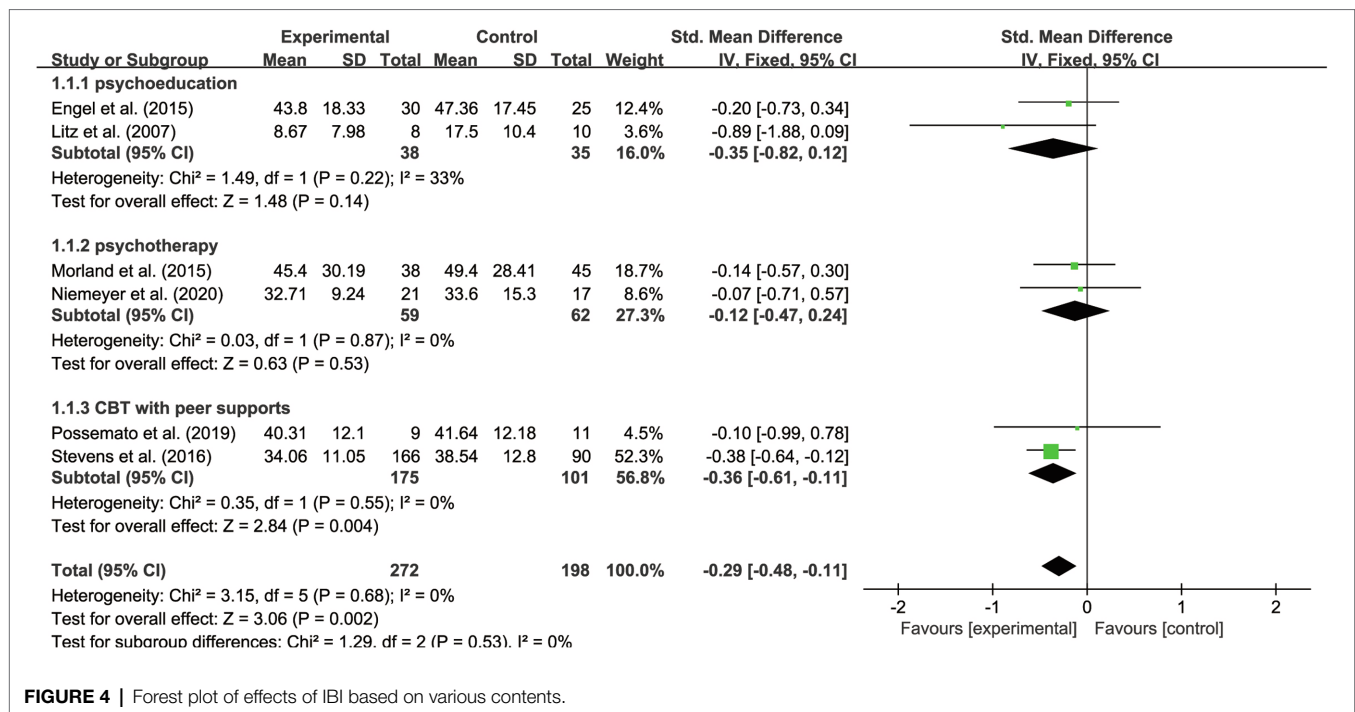**FIGURE 3** | Forest plot of overall effectiveness of IBI on veterans with PTSD.

FIGURE 4 | Forest plot of effects of IBI based on various contents.
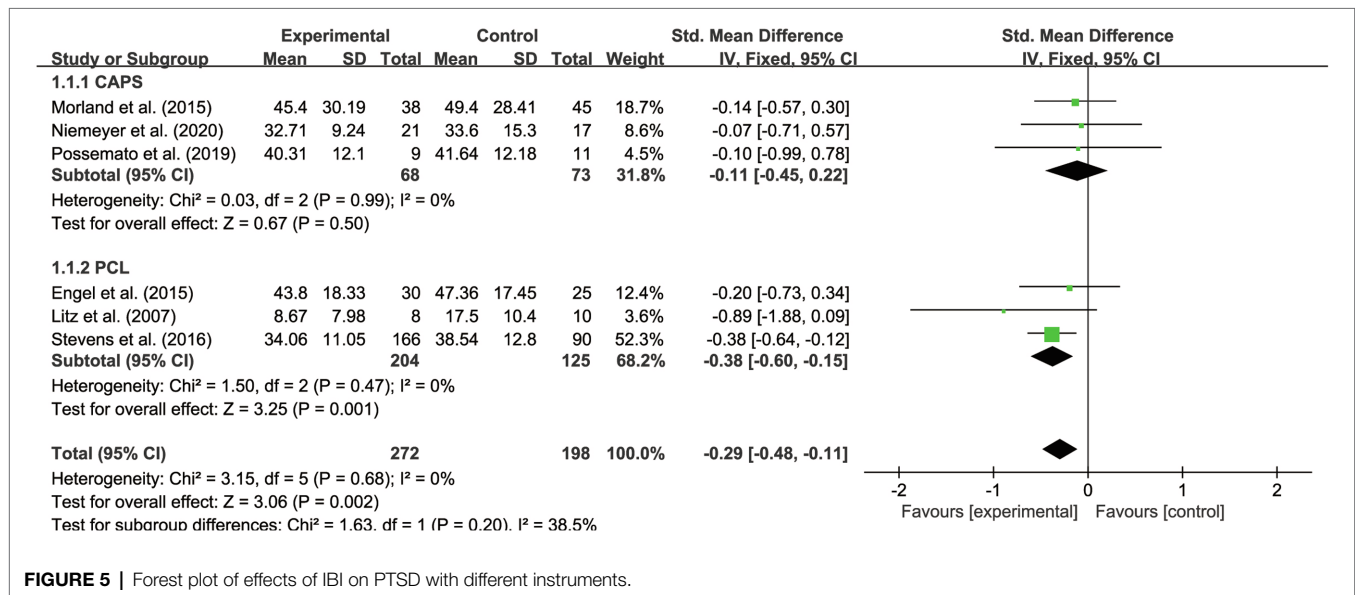

FIGURE 5 | Forest plot of effects of IBI on PTSD with different instruments.

and CBT with peer support (Stevens et al., 2016; Possemato et al., 2019). As suggested in **Table 3**, we found that for PTSD symptoms of veterans, the effects of CBT with peer support (SMD = −0.36, 95% CI −0.61 to −0.11) were more helpful than were the effects of psycho-education (SMD = −0.35, 95% CI −0.82 to 0.12) and the influences of psychotherapy (SMD = −0.12, 95% CI −0.47 to 0.24). According to **Figure 4** (see Appendix 1), it was also found that the subgroups were not significantly different ($p > 0.05$; $I^2 = 0\%$), suggesting there was no heterogeneity between the groups. Yet, the result with IBI based on psychotherapy

has been found significantly effective on PTSD outcome ($p < 0.01$). IBI with psycho-education ($p > 0.05$) and peer support ($p > 0.05$) had no statistically significant effects on veterans' PTSD outcomes. The results show high quality evaluated by GRADE.

Concerning outcome measurements of PTSD, we split the instruments into two subgroups: CAPS (Morland et al., 2015; Possemato et al., 2019; Niemeyer et al., 2020) and PCL (Litz et al., 2007; Stevens et al., 2016; Engel et al., 2015). It was proven that IBI was more effective on PTSD measured with PCL (SMD = −0.38, 95% CI −0.60 to −0.15)
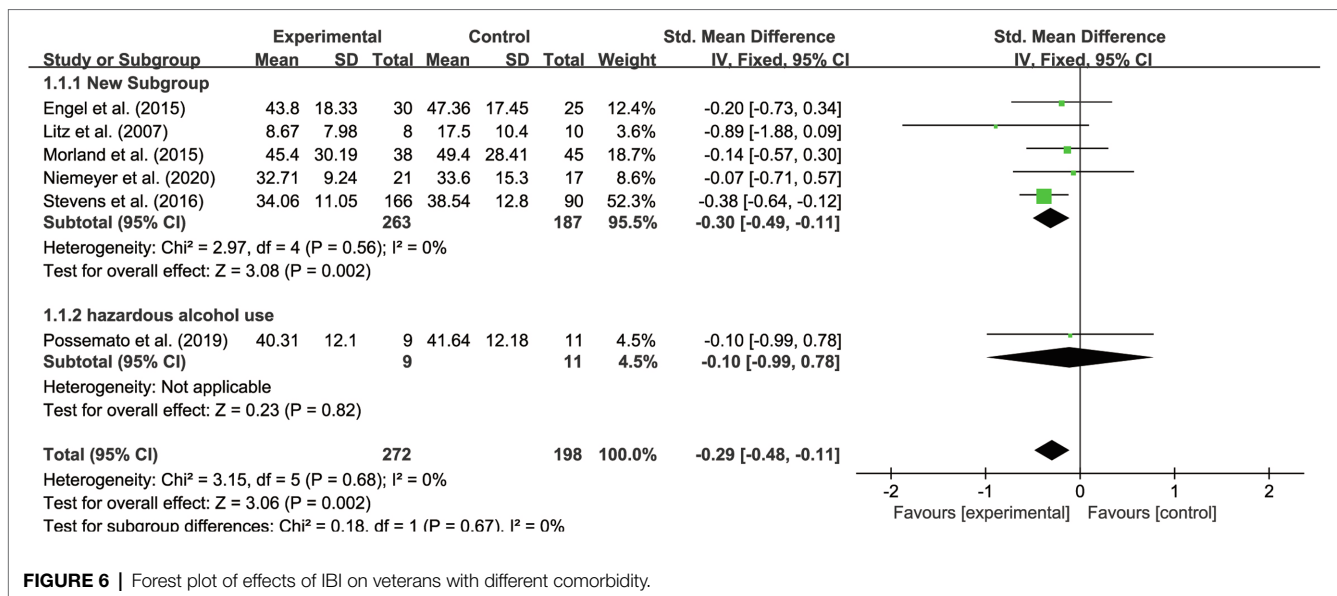
FIGURE 6 | Forest plot of effects of IBI on veterans with different comorbidity.
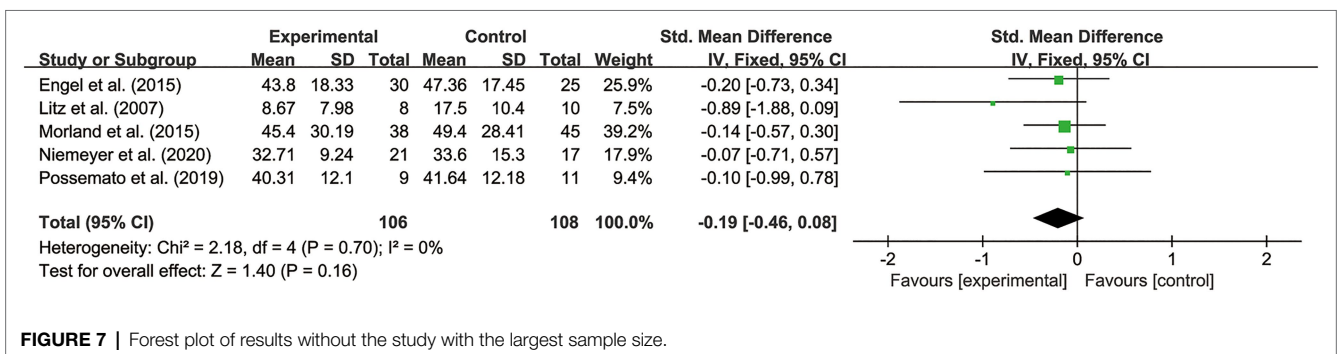
FIGURE 7 | Forest plot of results without the study with the largest sample size.

than was PTSD evaluated with CAPS (SMD = −0.11, 95% CI −0.45 to 0.22). As shown in **Figure 5**, it was proved that the subgroups were not significantly different ($p > 0.05$; $I^2 = 38.5\%$), indicating that there was no heterogeneity between the groups. However, IBI has been found to be significantly effective on PTSD outcomes measured with PCL ($p = 0.001$). IBI had no statistically significant effects on veterans' PTSD outcome accessed with CAPS ($p > 0.05$).

In the six studies, the veterans with PTSD all had comorbidity. Five had a sample with veterans with depression and anxiety symptoms in addition to PTSD (Litz et al., 2007; Engel et al., 2015; Morland et al., 2015; Stevens et al., 2016; Niemeyer et al., 2020), and one study had a sample with veterans with comorbid PTSD and hazardous alcohol use (Possemato et al., 2019). IBI was shown more effective in veterans having depression and anxiety as comorbidities (SMD = −0.30, 95% CI −0.49 to −0.11) than in veterans with PTSD and hazardous alcohol use (SMD = −0.10, 95% CI −0.99 to 0.78). As presented in **Figure 6**, the subgroups were not significantly different ($p > 0.05$; $I^2 = 0\%$), proving that there was no heterogeneity between the two groups.

IBI was found to work significantly on veterans with PTSD, depression, and anxiety ($p < 0.01$) and have no statistically significant effects on veterans with PTSD and hazardous alcohol use ($p > 0.05$).

Results of Sensitivity Analysis

In order to verify the stability of the results of the meta-analysis, the exclusion of a single study with a significantly large sample size was conducted to test its effects on the overall results. Based on the results shown in **Table 4**, of the six studies, the one by Stevens et al. (2016), an RCT from the United States with the largest sample size (166 participants in the experimental group and 90 participants in the control group) was eliminated. The sample size was much larger than that of other included studies. After excluding this study, the results (**Figure 7**) showed $p > 0.05$. This suggests that the overall effect was not significant, which is inconsistent with the conclusion before the sensitivity analysis, indicating that the overall results of this combination were unstable.

The study by Morland et al. (2015) was an RCT in the United States with a sample of female veterans and female
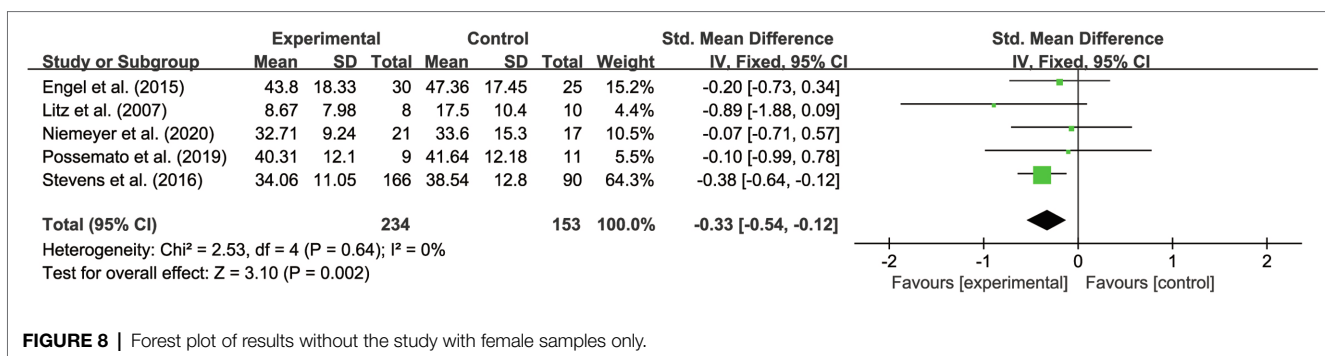
FIGURE 8 | Forest plot of results without the study with female samples only.
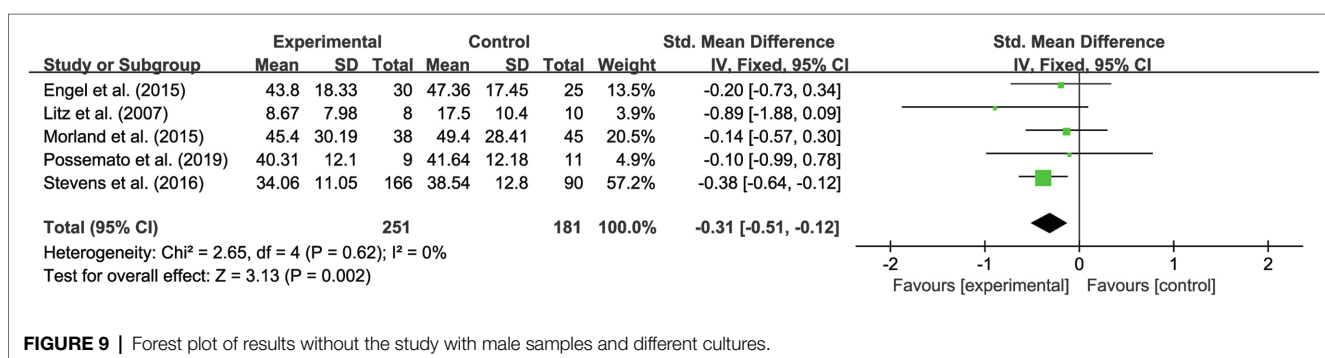

FIGURE 9 | Forest plot of results without the study with male samples and different cultures.

civilians. It was also reported as a high-risk study lacking reports on SD. After excluding this study (**Figure 8**), it showed that the overall effect was significant, which is consistent with the conclusion before the sensitivity analysis, suggesting that the overall results of this combination were stable. Similarly, Niemeyer et al. (2020) conducted an RCT with a sample of servicemen and male veterans in Germany. The trial was reported to be high risk in other biases. After excluding this study (**Figure 9**), it proved that the overall effect was significant, which is also consistent with the conclusion before the sensitivity analysis, showing that the overall results of this combination were stable.

DISCUSSION

Principal Findings

Several systematic reviews and meta-analyses of IBI have been conducted on a reduction in symptoms of the mental health of caregivers, including depression, stress or distress, and anxiety (Guay et al., 2017; Hopwood et al., 2018; Sherifali et al., 2018; Zhao et al., 2019). However, less often discussed are the effects on veterans of PTSD. This is the first meta-analysis to include RCT studies, and it is targeted at reducing the symptoms of PTSD of veterans using IBI. We screened the research based on the inclusion and exclusion criteria. A total of six studies were included in the final analysis, and these were assessed with a low risk of bias. All were RCTs done with rigorous research and experimental design and provided high-qualified. The results of these studies

reveal the beneficial effects of IBI on veterans with PTSD. A subgroup analysis was conducted to explore the interventions that were the most beneficial for veterans' PTSD, the efficacy differences within diverse outcome measurements, and the differences of the effects on groups with particular comorbidity. The quality of evidence was examined according to the GRADE scores. The quality of evidence was high for the outcomes examined. The research in this review was almost low-risk, indicating the convincing quality of evidence. However, the literature had a common problem of lacking research details and quality reports.

In this meta-analysis, we proved that IBI was indeed beneficial in reducing the effects of PTSD on veterans. This is consistent with the review that IBI is effective in lessening the effects on anxiety and depression in caregivers of persons with disabilities (PwD; Zhao et al., 2019). One possibility is the advantages of technology. The new modality offered strengths over traditional treatment methods, including a reduction in traveling time and transportation costs and enhancement of access to treatment for persons with serious injuries, physical disabilities, or scheduling difficulties (Bose et al., 2001). The efficacy, feasibility, and acceptability of this new approach have proved preferable, according to a review on psychotherapy delivered through VTC among diverse patient populations (Backhaus et al., 2012). Moreover, the effectiveness could come from the recipients feeling safer and more comfortable when using online services in their own homes (Krupnick et al., 2017). All trials showed there were positive improvements by various interventions on

veterans' PTSD status to some degree. Considering sample size, test efficiency, rates of loss in follow-up, lack of follow-up, and the evolution of veterans' illness (Melville et al., 2011; Zhao et al., 2019), we set a rule and chose the reported improved scores among several results of follow-ups. There was no follow-up in several studies (Stevens et al., 2016; Niemeyer et al., 2020). Also, the reduction of PTSD symptoms was greatest at 12-week follow-up but decreased over time. No benefits remained at 18-week follow-up (Engel et al., 2015). Another study found one significant enhancement at three-month follow-up (Morland et al., 2015). According to Litz et al. (2007), there was a great reduction in PTSD, and the veterans gained high functioning at 6 months. Also, continuing improvements have been observed in post-treatment (12 weeks) and follow-up (24 weeks) in the trial by Possemato et al. (2019). Thus, we chose the reported means and SD of 12-week follow-up (Engel et al., 2015), 3-month follow-up (Morland et al., 2015), 6-month follow-up (Litz et al., 2007), and 24-week follow-up (Possemato et al., 2019).

Regarding the categories and components of IBI, several aspects of IBI interventions showed a promising reduction in PTSD symptoms for veterans. Subgroup analyses were conducted to determine which components were effective in supporting veterans with PTSD (Hopwood et al., 2018). According to the results, CBT with peer support has more positive effects on veterans' PTSD than the other two kinds of IBI. This is highly consistent with one study finding that peer support helped patients manage physical health concerns effectively in peer navigation and support in self-management interventions (Cabassa et al., 2017). Supportive Accountability has clearly pointed out that interpersonal support improves the efficacy of eHealth interventions (Mohr et al., 2011). Only IBI based on CBT with peer support has been found to be significantly effective on PTSD outcome, which indicates that these two types of IBI might be not appropriate for veterans struggling with PTSD. It also shows that IBI is more effective on PTSD measured with PCL than was the outcome evaluated with CAPS. It might be that the study by Stevens et al. (2016) used the PCL-M scale especially for the military, which was more appropriate to measure veterans' situations than was CAPS as a general scale to access PTSD status. In particular, this study has the largest sample (166) of the six studies, which might play a decisive role. This result suggests that IBI is effective in PTSD outcomes measured with PCL, meaning PCL might be a significantly appropriate instrument for testing the effects of IBI on veterans with PTSD. Similarly, IBI is shown more effective in veterans with depression and anxiety as comorbidity than in veterans with PTSD and hazardous alcohol use. This is in accordance with the research finding that online interventions reported a significant decrease in caregivers' depressive symptoms and anxiety (Beauchamp et al., 2005; Hopwood et al., 2018). In particular, the internet proved an effective modality to deliver self-care for depression and PTSD (Christensen et al., 2002; Wagner et al., 2011). IBI has been found to work on veterans with PTSD and

depression and anxiety only, suggesting that IBI might be significantly appropriate across veterans with comorbid PTSD and depression and anxiety.

Based on the results of sensitivity analysis, the sample size is a key element that weakens the stability of meta-analysis. It has also been discussed in other reviews that the sample size of studies was insufficient (Sherifali et al., 2018; Zhao et al., 2019). In this review, the studies by Litz et al. (2007) and Possemato et al. (2019) were both based on a small sample size (<20).

Implications for Interventions and Researches

To develop IBI for veterans, some issues need to be addressed. The question of willingness of utilization is first. In one study, it was found out that only 30.9% of the veterans with probable PTSD were willing to use online interventions when faced with all seven kinds of e-Mental health services (Whealin et al., 2015). To solve this problem, familiar-sounding language and optimization of intervention should be used in the future, through which the veterans would feel more motivated to apply IBI (Murray et al., 2016). Based on the findings of subgroup analysis, intervention contents of IBI played a distinguished role in the reduction of veterans' symptoms of PTSD. Among diverse contents provided by IBI, CBT with peer support offered the most meaningful support for veterans with PTSD, and more similar online services could be delivered accordingly. Secondly, computer literacy and access to the internet are factors in need of attention, and this is described as a digital divide in the literature (Bernhardt, 2000). This is necessary before participation in IBI. Finally, internet privacy and security are emphasized (Schaller et al., 2016), in order to avoid secondary injury of veterans.

This meta-analysis has demonstrated the demands for more and high-quality RCTs to access the effects of IBI on veterans. Based on the results of subgroup analysis, more details like instruments of outcomes and comorbidity of participants could be evaluated in the research design. Meanwhile, a sufficient sampling size of participants could be set to raise the quality of RCT researches. Future studies should describe more details of interventions to help us understand the elements of IBI that provide the most benefits. Future research should focus on the different types of militaries and indicate the content of IBI that is beneficial for the differentiated groups. Moreover, this review failed to distinguish the treatment trajectory in various stages of PTSD among veterans. All IBI in this review was broad for the course of the entire treatment process, ignoring the special needs during each stage of PTSD, which should be addressed by future studies.

Strength and Limitations

This systematic review and meta-analysis have summarized the most relevant evidence in assessing the benefits of IBI

on veterans' PTSD outcomes. All six studies were published between 2007 and 2020, most published from 2015 to 2020, emphasizing the increasing interest in internet technologies to support veterans. This research is the most recent review and meta-analysis which examines the effects of IBI on PTSD outcomes of veterans, using the latest empirical studies and innovative subgroup analysis. In particular, it includes both Chinese and English studies, which take full account of cultural diversity.

However, three qualified research studies were dismissed without the full text in this meta-analysis. Also, only RCTs have been searched. Some of the trial protocols and reports have not been published. The lack of grey literature and limitation of language may lead to selection bias.

CONCLUSION

The basis of evidence for IBI on veterans with PTSD remains limited. This meta-analysis is the first study to discuss the effectiveness of IBI on veterans. IBI has been proved as a positive modality to reduce PTSD symptoms among veterans. Moreover, it encourages us to focus on IBI with CBT with peer support for veterans, specific instruments for veterans' PTSD, and veterans with comorbid depression and anxiety. Our research results highlight the promising potential of IBI to support veterans. It warrants further development and testing within more RCTs with high-quality and diverse cultural backgrounds.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

YZ, ZB, and WW designed this meta-analysis. CW, ZF, LL, and SL searched the literature. CW, ZF, and YZ evaluated the risk of bias and conducted GRADE. CW completed the writing of Methods. ZF finished the writing of Findings. YZ and ZF wrote the Discussion. YZ, LL, and SL contributed to the Introduction and Literature Review. ZB and WW modified the manuscript. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg. 2021.711652/full#supplementary-material

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The Effectiveness of Technology-Based Interventions for Reducing Loneliness in Older Adults: A Systematic Review and Meta-Analysis of Randomized Controlled Trials

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Objective: To systematically analyze the effectiveness of technology-based interventions for reducing loneliness in older adults.

Methods: We searched relevant electronic databases from inception to April 2021, which included Cochrane Library, PubMed, Web of Science, SpringerLink, EMBASE, CNKI, and Wanfang. The following criteria were used: (i) study design—randomized controlled trial (RCT) designs, (ii) people—older adults (aged $\geq$ 60 years), (iii) intervention—technology-based interventions in which a core component involved the use of technology to reduce loneliness in older adults; and (iv) outcome—reduction of loneliness level in terms of rating scale scores. Two reviewers independently identified eligible studies, extracted data, and assessed the risk of bias in the included studies. A third reviewer resolved any conflicts. The Cochrane Collaboration's bias assessment tool was used to evaluate the risk of bias for the included studies, and Review Manager 5.4 software was used for the meta-analysis. A random effects model was adopted to measure estimates of loneliness reduction, and standard mean differences (SMD) with a 95% confidence interval (CI) were calculated for each intervention-control contrast, and the I^2 statistic was applied to examine heterogeneity.

Results: A total of 391 participants from six RCTs were included in the review. Of these, three studies were rated as low-quality, and the remaining three were rated as moderate-quality studies. The meta-analysis showed that the evidence regarding the effects on loneliness of technology-based interventions compared with control groups was uncertain, and suggested that technology-based interventions resulted in little to no difference in loneliness reduction compared to control groups ($SMD = -0.08$, 95% CI -0.33 to 0.17, $p = 0.53$). Two types of technology-based interventions were identified: smartphone-based video calls and computer-based training with Internet usage. The subgroup analysis found low-quality evidence to support the effectiveness of both intervention types ($SMD = -0.01$, 95% CI -0.25 to 0.24, $p = 0.95$, and $SMD = -0.38$, 95% CI -0.19, 0.64, $p = 0.47$, respectively).

Conclusions: We found no current evidence to support that technology-based interventions were effective compared to different control conditions in reducing loneliness in older adults. This suggests that more research is needed to investigate the effects of technology-based interventions on loneliness in older adults.

Keywords: technology, intervention, loneliness, older adults, meta-analysis

INTRODUCTION

Loneliness is usually defined as a subjective negative feeling of a lack of meaningful or intimate social relationships (Gierveld, 1998; Valtorta and Hanratty, 2012). Older adults most commonly experience loneliness in daily life due to their withdrawal from social activities and a reduction of resources available to them (Hind et al., 2014; Fakoya et al., 2020). It is estimated that the global population aged 60 years and over will reach 22% by 2050 (Chen and Schulz, 2016). Therefore, loneliness among the older adult population could be a growing global concern. According to data from the United States and Europe, loneliness was widespread among older adults; ~40% of older adults in these countries experienced some form of loneliness, and this figure could remain constant for the next years (Savikko et al., 2005; Victor et al., 2005; Hind et al., 2014). Victor et al. (2005), for example, examined the prevalence of loneliness among older people in Great Britain, using a self-rating scale. Results showed that approximately one-third (31%) of participants rated themselves as "sometimes" lonely, five percent as "often" lonely, and two percent as "always" lonely. Loneliness is frequently reported by older adults living alone. According to data from China, ~17% of older Chinese adults lived alone in 2011 (Wang and Zhang, 2015). Since the number of older adults living alone is large, the actual number of people experiencing loneliness in China is considerable as well.

The COVID-19 global pandemic has exacerbated the situation. With implementation of social distancing strategies by many countries, millions of older people are confined to their homes or care units. Although social restrictions are crucial to limit the spread of COVID-19, they significantly increase the social isolation of older people, and may result in a severe sense of loneliness within the population group (Wu, 2020; Dahlberg, 2021; Tilburg et al., 2021).

Loneliness can negatively affect various aspects of older adult's daily lives, especially their psychological well-being (Hill et al., 2006; Luanaigh and Lawlor, 2008; Hawkley and Cacioppo, 2010; Hawkley et al., 2010; Nummela et al., 2011). Loneliness is a strong risk factor for low levels of well-being, psychological distress, mental disorders, hopelessness, and depression (Tiikkainen and Heikkinen, 2005; Paul et al., 2006; Golden et al., 2009). Furthermore, loneliness increases mortality rates in older adults and is a predictor of suicide among this population group (Cohen-Mansfield and Perach, 2015).

Loneliness has long been identified as a risk factor for well-being in later life. Over the last few decades, there has been continued interest in developing suitable interventions to alleviate loneliness in older adults. Cattan et al. (2005)

conducted a systematic review to summarize and explore the effectiveness of existing interventions for reducing loneliness in older adults. Based on an analysis of 30 research articles that met the review inclusion criteria, the review found that educational and social activity group interventions were most effective for alleviating loneliness in older adults and concluded that more research was needed to evaluate the effectiveness of one-to-one interventions. Whether group interventions or one-to-one interventions identified in the review were face-to-face interventions. In recent years, more intervention types or therapy techniques have been developed to address loneliness in older adults (Sander, 2005; Gardiner et al., 2018; O'Rourke et al., 2018; Poscia et al., 2018). A more recent systematic review conducted by Cohen-Mansfield and Perach (2015) highlighted the value of specific therapy techniques, such as humor therapy, animal aid therapy, and the use of technology in loneliness prevention programs for older adults.

The adoption of technology, especially information and communication technology, to reduce loneliness in older adults has attracted increasing attention worldwide (McCreadie et al., 2002; Magnusson et al., 2004; Ballantyne et al., 2010; Huang, 2010; Choi et al., 2012; Stojanovic et al., 2017; Morton et al., 2018; Pirhonen et al., 2020). Technology-based solutions, for example, the use of video calls and online chat groups, are believed to have potential for maintaining social relations and reducing loneliness during the pandemic (Hwang et al., 2020; Dahlberg, 2021; Tilburg et al., 2021). Although some studies have examined the effects of technology-based interventions on loneliness reduction in older adults, debates about its effectiveness still exist. While some scholars suggest that technologies can increase older adult's interaction with relatives and friends, enabling them to be socially connected without having face-to-face communication, thereby alleviating loneliness (Cattan et al., 2005; Holttum, 2016; Yuan, 2021), other argue that besides the difficulties older adults face when learning to use new technologies, benefits of technology-based interaction could be quite limited, and that increasing online interaction might come at the cost of important face-to-face communication, thus increasing social isolation and loneliness among older adults (Dickinson and Gregor, 2006; Cotten et al., 2013; Helliwell and Huang, 2013).

Considering the controversial opinions about the effects of technology-based interventions for reducing loneliness in older adults, it is necessary to conduct a systematic review to find more reliable evidence. However, to date, few reviews have examined the relationship between technology-based interventions and the reduction of loneliness in older adults. Regarding the research gap in the existing literature, the present study aimed to conduct a systematic review of existing studies that examined

the effectiveness of technology-based interventions for reducing loneliness in older adults.

METHODS

Inclusion and Exclusion Criteria

The inclusion criteria were as follows: (1) study design: randomized controlled trial (RCT) designs; (2) people—older adults (aged $\geq$ 60 years); (3) intervention—technology-based interventions in which a core component involved the use of technology to reduce loneliness in older adults, and (4) outcome—reduction of loneliness level in terms of rated scale scores. RCTs that had no significant effect on reducing loneliness in older adults were also included and analyzed. The exclusion criteria were as follows: (1) non-Chinese and non-English literature; (2) duplicate studies; (3) incomplete data; (4) full text not available; and (5) studies that included technology-based intervention as a co-intervention.

Search Strategy

Relevant electronic databases, which included the Cochrane Library, PubMed, Web of Science, SpringerLink, and EMBASE, were searched for eligible studies from inception till April 2021. We also conducted a Chinese language search using the following databases: China National Knowledge Infrastructure and Wanfang. The languages searched were limited to the Chinese and English languages. Electronic searches were performed using various combinations of search terms such as loneliness, technology, computer-based, web-based, smartphone-based, older adults, the elderly, the aged, the seniors, and older adults. For example, using PubMed, the specific search strategy was as follows: (((older people[Title/Abstract] OR older adults[Title/Abstract] OR elderly[Title/Abstract] OR seniors[Title/Abstract] OR 65+[Title/Abstract] OR aged[Title/Abstract] OR "Aged"[Mesh])))° AND (technology[Title/Abstract] OR APP[Title/Abstract] OR software[Title/Abstract] OR web[Title/Abstract] OR Technologies[Title/Abstract] OR smart[Title/Abstract] OR internet[Title/Abstract] OR mobile[Title/Abstract] OR Cell Phones[Title/Abstract] OR computer[Title/Abstract] OR smartphone[Title/Abstract]° OR "Technology"[Mesh]) AND (loneliness[Title/Abstract]° OR "Loneliness"[Mesh]) AND (Randomized Controlled Trial° [Title/Abstract]° OR "Randomized Controlled Trial" [Publication Type]). In addition, we also located articles through references cited in the relevant studies and reviews.

Selection of Studies

The selection process was conducted in accordance with PRISMA guidelines. Eligibility of studies was determined by two reviewers who independently searched for and selected the literature according to inclusion and exclusion criteria. The reviewers recorded the selection process in detail to complete a PRISMA flow diagram. Any discrepancies between the two reviewers were resolved through discussions with a third reviewer.

Data Extraction

Two reviewers worked independently to extract trial information. A predetermined data extraction form was used to summarize the characteristics of the included studies, such as information about the articles (e.g., title, author, country), the participants (e.g., gender, age), the intervention and control groups (e.g., intervention techniques, duration of follow-up), and outcome measures (loneliness scale). Any disagreements were resolved by involvement of a third reviewer.

Outcome Measures

The primary outcome of concern was the changes in loneliness level among older adults with regard to rated scale scores, which were considered the standard mean difference (SMD) with a 95% confidence interval (CI). Outcome measures were determined by the main indicators available in the included studies, such as the University of California Los Angeles Loneliness Scale (Russell et al., 1980) and the De Jong Gierveld Loneliness Scale (Iecovich, 2013; Hind et al., 2014). We analyzed validated self-rated measures if there were no reported clinical-rated measures.

Assessment of Risk of Bias

Two reviewers independently examined the quality of each eligible trial using the modified Cochrane Collaboration's Tool for Assessment of Risk of Bias. Any disagreements were resolved by a third reviewer. A total of six domains of risk of bias were assessed: selection bias, performance bias, detection bias, attrition bias, reporting bias, and other biases. The risk of bias for each domain was reported as high, low, or unclear. Studies with low risk of bias were considered to be of high quality. The implications of the risk of bias on the results of the included trials are discussed in a later section.

Data Synthesis

Review Manager 5.4 software was used to generate pooled estimates of effect size. With respect to different loneliness assessment methods, standard mean differences (SMDs) with 95% confidence intervals (CIs) were adopted to analyze the levels of loneliness among older adults. The I^2 statistic was used to examine heterogeneity across the included studies. Considering the influence of heterogeneity on the results, a random effects model was used to carry out the meta-analysis, as it is a more conservative measure. Subgroup analysis was used to explore the sources of heterogeneity. In the Cochrane Handbook, funnel plots were only suitable for reviews that included more than 10 trials. Therefore, a funnel plot was not generated in this review because only six studies met the inclusion criteria.

RESULTS

Literature Screening

The literature screening resulted in the identification of six RCTs, including a total of 391 participants (Shapira et al., 2007; Slegers et al., 2008; Tsai and Tsai, 2011; Hind et al., 2014; Tsai et al., 2015, 2020). Initially, as shown in **Figure 1**, a total of 759 studies were identified through a comprehensive literature search. After importing these articles into EndNote X9 software,

FIGURE 1 | Flowchart of study selection process.
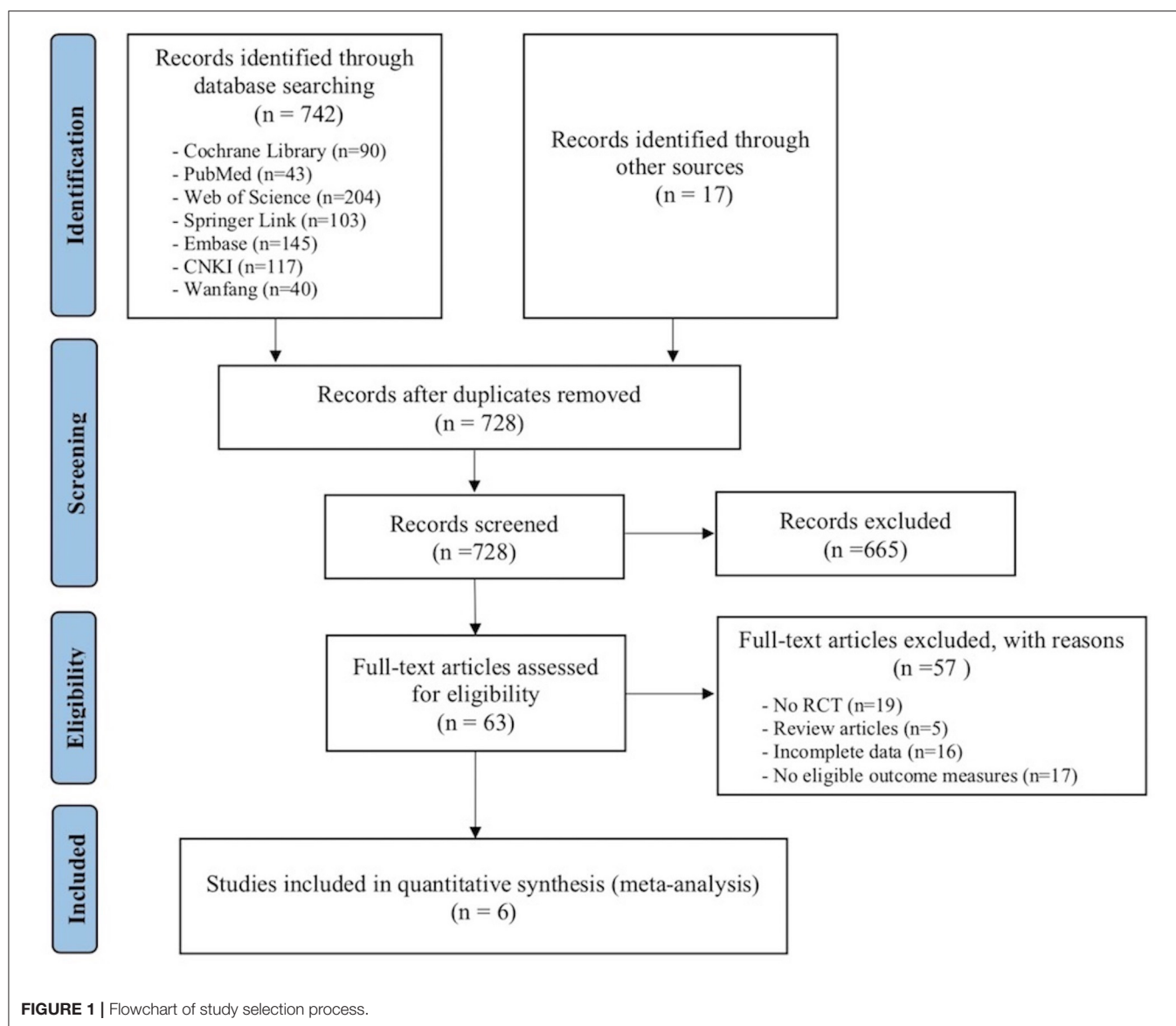
31 duplicates were removed. After reading the titles and abstracts of the remaining studies, 665 articles were excluded because they did not meet the inclusion criteria. In addition, 57 articles were excluded after reading their full text, including no RCTs ($n = $ 19), review articles ($n = 5$), incomplete data ($n = 16$), and no eligible outcome measures ($n = 17$). The remaining six trials met the eligibility criteria and were included in the review.

Characteristics of the Included Studies

The characteristics of the included studies are summarized in **Table 1**. All included studies were RCTs published in peer-reviewed journals. It is appropriate to use partial data from the RCTs included in the meta-analysis. The six RCTs were conducted in Taiwan, China, the United States, Israel, and the United Kingdom between 2006 to 2020. The sample size of the

studies ranged from 39 to 95, and the duration of follow-up ranged from three to six months.

Each of the six included studies compared technology-based interventions to different interventions and controls: study one (Tsai et al., 2020), two (Tsai et al., 2015) and three (Tsai and Tsai, 2011) examined smartphone-based videoconferencing program and a control group; study four (Slegers et al., 2008) examined computer training, internet usage, and a control group; study five (Shapira et al., 2007) examined computer operation, internet use, and alternative activities; and study six (Hind et al., 2014) examined teleconferences and usual health and social care provision. In terms of intervention protocol, Study one, two, and three required participants in the intervention group to interact with their family members using a smartphone to have a video conference once a week for three or six months. Study four offered three four-h training sessions in two weeks and free

TABLE 1 | Participant characteristics and study methods of included trials.

| References	Country	Participants	Intervention	Comparison	Outcome, Tools, and Timing	Design	Allocation Concealment	Blinding	Incomplete Data Addressed	Free or Selective reporting
Tsai et al. (2020)	Taiwan, China	Age: 60 and over N: 62	Interact with their family members using a smartphone and a "LINE" application (app).	Control group	Loneliness; the UCLA Scale; three months after baseline.	RCT	Unclear	No	No	Unclear
Tsai et al. (2015)	Taiwan, China	Age: 60 and over N: 49	Receive five min/week of videoconference interaction with their family members for three months.	Regular care	Loneliness; the UCLA Scale; three months after baseline.	RCT	Unclear	No	No	Unclear
Tsai and Tsai (2011)	Taiwan, China	Age: 60 and over N: 90	Use videoconferencing to communicate with their families plus their usual communication activities.	Regular family visits	Loneliness; UCLA Loneliness Scale; three months after baseline.	RCT	Unclear	No	No	Unclear
Slegers et al. (2008)	America	Age: 64–75 N: 56	Three 4-h training sessions over the period of 2 weeks; use the computer freely (once every 2 weeks in the first 4 months, once every month in the remaining period)	Control group	Loneliness; loneliness questionnaire; four months after baseline.	RCT	Unclear	Unclear	Yes	Unclear
Shapira et al. (2007)	Israel	Age: 70–93 N: 95	Computer operation and Internet use (last 15 weeks and included one or two lessons per week).	Taking part in activities like painting and sewing	Loneliness; UCLA Loneliness Scale; 15 weeks after baseline.	RCT	Unclear	Unclear	Yes	Unclear
Hind et al. (2014)	UK	Age: 75 and over N: 39	1-h teleconferences per week for 12 weeks.	Usual health and social care provision	Loneliness; the De Jong Gierveld Loneliness Scale; six months after baseline.	RCT	No	No	Yes	Unclear

MMSE, mini-mental state examination.
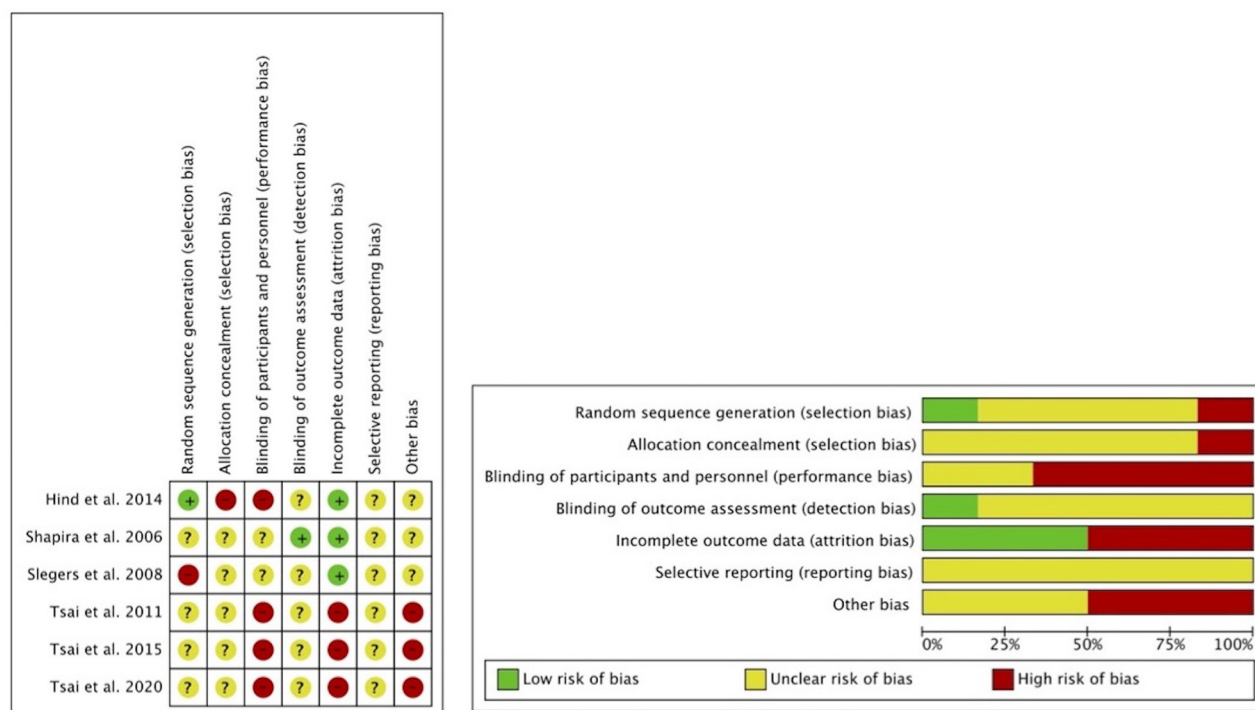
FIGURE 2 | Assessment of risk of bias with selected studies.

computer usage in 12 months. Study five provided one or two lessons per week over a period of 15 weeks, and each lasted ~60 min. Study six conducted a one-to-one volunteer befriender program, providing 10 to 20 min of calls once a week for up to six weeks and one-h teleconferences once a week for 12 weeks.

Study one, two, and three enrolled participants aged 60 and over in nursing homes with basic cognitive abilities and had wireless internet access on their residence floor. Study four enrolled participants aged between 64 and 75 years and excluded older adults who had a cognitive disorder. Studies five and six recruited retired people over 70 years old with mild chronic conditions, who lived independently, and had cognitive functioning. All studies reported on the outcomes of loneliness.

Quality of the Included Studies

Figure 2 shows the assessment of the risk of bias in the six eligible studies. We considered that there was an unclear risk of selection bias and detection bias for three studies, because they lacked information on random sequence generation, allocation concealment, and blinding of outcome assessment (Tsai and Tsai, 2011; Tsai et al., 2015, 2020). Three studies were considered to be at high risk of performance bias because participants were not blinded to the treatment assigned (Tsai and Tsai, 2011; Tsai et al., 2015, 2020). We considered one study to be at a low risk of attrition bias (Slegers et al., 2008) and five studies were at a high risk of attrition bias (Shapira et al., 2007; Tsai and Tsai, 2011; Hind et al., 2014; Tsai et al., 2015, 2020) as a relatively large number of participants in these studies did not complete

the training and no data were provided at baseline, follow-up, or both. We considered there to be an unclear risk of reporting bias for all six studies because none of them mentioned the study protocol or analysis intentions, which made it difficult to judge reporting bias. Three studies were judged to be at high risk of other sources of bias (Tsai and Tsai, 2011; Tsai et al., 2015, 2020) because they had similar research designs and were conducted in the same place by the same author; however, the research results showed significant differences.

Effect of Technology-Based Interventions on Loneliness in Older Adults

Figure 3 presents the meta-analysis results of the effect of technology-based interventions vs. control groups on loneliness rated scores among older adults. The pooled standardized mean difference (SMD) calculated using the random effects model was -0.08 (95% CI -0.33 to 0.17, $p = 0.53$), which showed that technology-based interventions resulted in little to no difference in reducing loneliness in older adults compared to control groups. Evidence about the effects of technology-based interventions on loneliness reduction among older adults is very uncertain. The value of 35% in the I^2 statistics reflected moderate heterogeneity. Study one and three showed a reduction in loneliness rated scores in the third month with SMD of -0.05 (95% CI -0.55 to 0.45) and -0.09 (95% CI -0.51 to 0.32) respectively. Study five also found a reduction in loneliness rated scores in the fourth month with an SMD of -0.93 [95% CI -1.60,
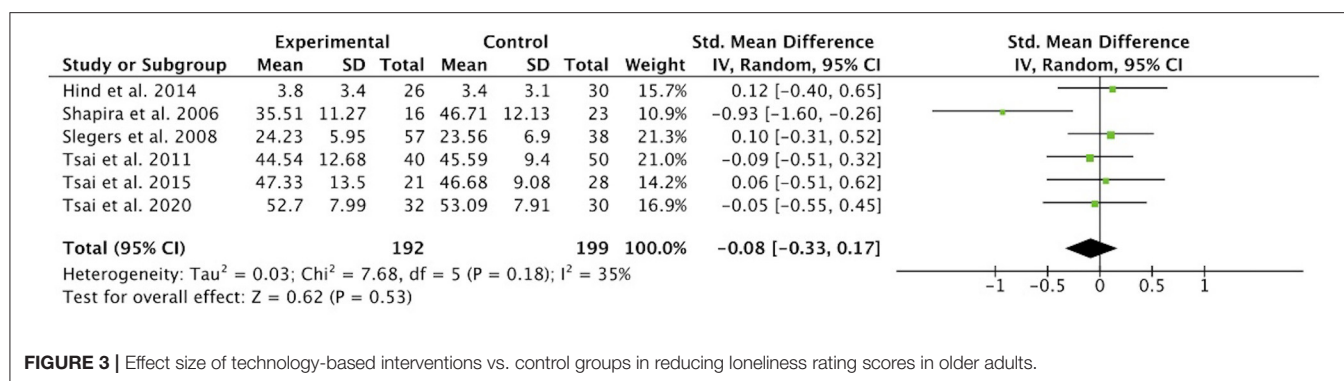
FIGURE 3 | Effect size of technology-based interventions vs. control groups in reducing loneliness rating scores in older adults.
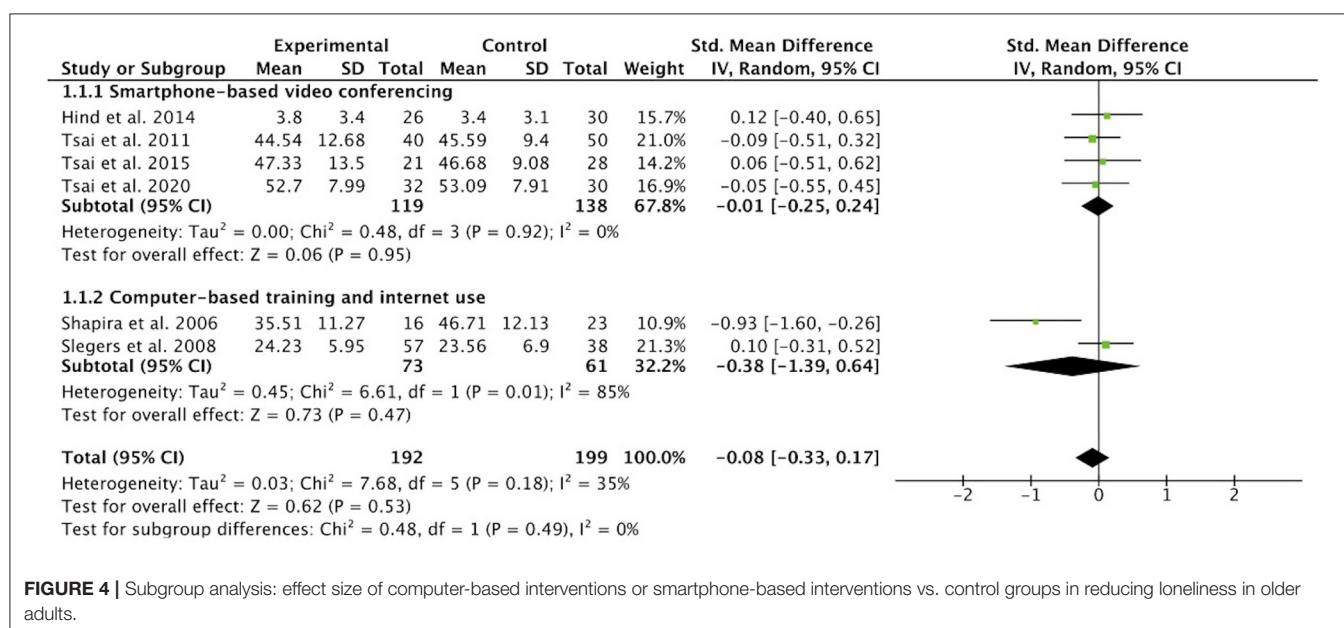

FIGURE 4 | Subgroup analysis: effect size of computer-based interventions or smartphone-based interventions vs. control groups in reducing loneliness in older adults.

−0.26]), which suggested no significant differences between technology-based interventions and conventional control. The trials included in this review provided no clear evidence of this effect.

Subgroup Analysis

Among the six studies included, two studies conducted computer-based training and Internet usage, and four studies used smartphone-based video conferencing. The subgroup analysis examined the effectiveness of each intervention type and found low-quality evidence to support the effectiveness of both intervention types ($SMD = -0.38$, 95% CI −1.39 to 0.64, $p = 0.47$ and $SMD = -0.01$, 95% CI −0.25, 0.24, $p = 0.95$, respectively) (see **Figure 4**). There was high heterogeneity between studies of computer-based interventions, while there was no heterogeneity between studies of smartphone-based videoconferencing.

Analyses on subgroups, such as age, living conditions, follow-up time, measurement tools, were planned to explore the sources of heterogeneity. There were too few trials and too little information, however, to permit meaningful analyses.

DISCUSSION

This systematic review is one of the first to address the potential of technology-based interventions to prevent or reduce loneliness, a subjective negative feeling that may deteriorate the physical and psychological well-being of older adults. Six randomized control trials with a total of 391 older participants were assessed to examine the effects of technology-based interventions on loneliness outcomes. All six studies reported loneliness outcomes, making them eligible for the meta-analysis. The results of the meta-analysis showed that technology-based interventions had little or no effect on loneliness reduction in older adults ($SMD = -0.08$, 95% CI −0.33, 0.17, $p = 0.53$). There was a wide variation among the included trials in terms of sample size, participants' demographics, measurement tools, intervention methods, and duration of the intervention. Heterogeneity in the comparison interventions was resolved through subgroup analyses. We used subgroup analysis to examine the effect of different intervention types on loneliness outcomes in older adults. The results of the

subgroup analysis showed that the effectiveness of computer-based training and Internet usage and smartphone-based video conferencing on reducing loneliness in older adults were both very uncertain ($SMD = -0.38$, 95% CI -1.39 to 0.64, $p = 0.47$ and $SMD = -0.01$, 95% CI -0.25, 0.24, $p = 0.95$, respectively) when compared with various control groups.

Subgroup analysis for age, living conditions, follow-up time, and measurement tools were planned; however, there were not enough trials or information to perform meaningful analyses. Technology-based interventions were compared with usual activities, no intervention, regular family visits, regular health and care provision, and group activities. However, these comparisons could not be analyzed because most of the alternative interventions were part of a single study.

We only included six studies in the review because few studies have focused on the effect of technology-based interventions on loneliness outcomes for older adults. Among these studies, some only collected baseline data, and some did not present data on loneliness outcomes, so they were excluded from this review. Among the six included studies, study one, two, and three were rated as low-quality studies as they were assessed to have three high bias risk and none of the low bias risk according to Cochrane Collaboration's Tool for Assessment Risk of Bias. The remaining three studies were rated as moderate-quality studies, as they were assessed to have three or more unclear bias risks. Quality issues mainly included imprecision and the risk of bias.

By introducing electronic devices to older adults, technology-based interventions are designed to help increase social connections and reduce loneliness. However, the results of the present review showed that technology-based interventions could be ineffective in alleviating loneliness in older adults. Our review did not support the conclusion of a review published in 2015 that showed that technology-based interventions were effective for alleviating loneliness in both one-to-one and group formats, as well as in samples of community residents and institutionalized persons (Cohen-Mansfield and Perach, 2015). The overall evidence about the effectiveness of technology-based interventions for reducing loneliness in older adults is mixed, and results from existing reviews and individual clinical trials vary. The diversity of interventions involving dose, duration, location, and intervention types, along with methodological constraints such as small samples and various risk of bias, may account for the disparate results.

Based on the meta-analysis and a systematic review of existing literature, we identified some key issues that may be helpful for examining the true effects of technology-based interventions on loneliness outcomes in older adults. First, regarding research participants, we noted that heterogeneity among older adults was largely neglected in existing literature. According to Hind et al. (2014), loneliness does not progress linearly across old age; instead, it peaks among the oldest-old who are aged 80 and over. Oldest-old individuals are more likely to experience loneliness and social isolation when compared with younger individuals. Technology-based interventions could be more helpful and beneficial for those who experience

loneliness. Future studies or reviews should focus on older adults who have a high risk of experiencing loneliness in daily life, such as the oldest-old group, especially those who are homebound. Second, regarding intervention methods, we noted that the main intervention methods were smartphone-based videocalls, computer-based training and Internet usage. Exploring technology-based interventions more broadly may help to identify more evidence on the role of technology in reducing loneliness in older adults. Third, in terms of study design, we noted that studies that adopted an RCT design were quite limited. Including a wider range of study designs may help to find more potentially informative evidence. Fourth, most studies had no or limited follow-up which makes it difficult to examine the ongoing effect of technology-based interventions on loneliness outcomes. Hence, studies over a longer time period should be undertaken. Finally, more high-quality research is required on the effects of technology-based interventions on loneliness outcomes among older adults.

This systematic review has some important limitations. First, the included studies did not specifically target older adults who were demonstrably lonely to determine the effects of technology-based interventions on loneliness outcomes among them. The second limitation was the small sample size employed in several studies. The third was that the number of studies included in the review was relatively small, which may limit our understanding of the overall effects of technology-based interventions on loneliness outcomes among older adults and effects under different conditions. Finally, the present systematic review only concentrated on loneliness in older adults, and other meaningful indicators, such as depression, social support, and quality of life, were not analyzed, which limited the examination of the overall effects of technology-based interventions.

CONCLUSIONS

The present systematic review concluded that evidence on the effectiveness of technology-based interventions for alleviating loneliness in older adults is uncertain. Although the results of the present review showed that technology-based interventions had little to no differences in alleviating loneliness in older adults when compared with control groups, this does not mean that this kind of intervention is absolutely ineffective in clinical practice. According to existing research, technology usage, at a minimum, has no harmful effects on older adults who experience loneliness and desire social connection. For practical purposes, caution should be given to older adult's abilities, conditions, needs, and resources to determine whether technology-based interventions are an appropriate approach for reducing loneliness. Essentially, technology was not a solution to reduce loneliness in older adults, but a tool that helps them stay connected with their family members, friends, neighbors, etc., and get access to information and resources. We argue that more research should be conducted to explore the mechanisms of technology-based interventions to alleviate loneliness in older adults in the future.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article, further inquiries can be directed to the corresponding author/s.

AUTHOR CONTRIBUTIONS

WJ designed the study. WJ, YL, and SY performed the literature search, article selection, quality appraisal, statistical analysis, and wrote the first draft of the manuscript. ZB supervised the paper production. WJ, ZB, RB, and XL participated in the revision of the subsequent draft. All authors read and approved the final manuscript.

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Effectiveness of Dance-Based Interventions on Depression for Persons With MCI and Dementia: A Systematic Review and Meta-Analysis

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Background: There is a growing need to offer appropriate services to persons with mild cognitive impairment (MCI) and dementia who are faced with depression and anxiety distresses beyond traditional pharmacological treatment. Dance-based interventions as multi-dimensional interventions address persons' physical, emotional, social, and spiritual aspects of well-being. However, no meta-analysis of randomized controlled treatment trials (RCTs) has examined the effectiveness of dance-based interventions on depression and anxiety among persons with MCI and dementia, and the results of RCTs are inconsistent. The study aimed to examine the effectiveness of dance-based interventions on depression (a primary outcome) and anxiety (a secondary outcome) among persons with MCI and dementia.

Methods: A systematic review with meta-analysis was conducted. The inclusion criteria were: population: people of all ages with MCI and dementia; intervention: dance-based interventions; control group: no treatment, usual care, or waiting list group; outcome: depression and anxiety; study design: published or unpublished RCTs. Seven electronic databases (Cochrane, PsycINFO, Web of Science, PubMed, EBSCO, CNKI, WanFang) were searched from 1970 to March 2021. Grey literature and reference lists from relevant articles were also searched and reviewed. The Cochrane "Risk of Bias" tool was used to assess study quality. RevMan 5.4 was used for meta-analysis and heterogeneity was investigated by subgroup and sensitivity analysis. GRADE was applied to assess the evidence quality of depression and anxiety outcomes.

Results: Five randomized controlled trials were identified. Sample sizes ranged from 21 to 204. The risk of bias was low, except for being rated as high or unclear for most included studies in two domains: allocation concealment, blinding participants and personnel. Meta-analysis of depression outcome showed no heterogeneity ($I^2 = 0\%$), indicating that the variation in study outcomes did not influence the interpretation of results. There were significant differences in decreasing depression in favor of dance-based interventions compared with controls [SMD = −0.42, 95% CI (−0.60,

−0.23), $p < 0.0001$] with a small effect size (Cohen's $d = 0.3669$); Compared with the post-intervention data, the follow-up data indicated diminishing effects (Cohen's $d = 0.1355$). Dance-based interventions were more effective in reducing depression for persons with dementia than with those having MCI, and were more effective with the delivery frequency of 1 h twice a week than 35 min 2–3 times a week. Also, one included RCT study showed no significant benefit on anxiety rating scores, which demonstrated small effect sizes at 6 weeks and 12 weeks (Cohen's $d = 0.1378, 0.1675$, respectively). GRADE analysis indicated the evidence quality of depression was moderate, and the evidence quality of anxiety was low.

Conclusions: Dance-based interventions are beneficial to alleviate depression among persons with MCI and dementia. More trials of high quality, large sample sizes are needed to gain more profound insight into dance-based interventions, such as their effects of alleviating anxiety, and the best approaches to perform dance-based interventions.

Keywords: depression, anxiety, meta-analysis, dance-based intervention, GRADE, MCI, dementia

INTRODUCTION

The importance of treating and researching MCI and dementia has gained widespread recognition in recent decades. About 16% of older adults suffer from MCI (World Health Organization, 2017a), and ∼50 million people worldwide are affected by dementia (World Health Organization, 2020). Additionally, there will be 65.7 million people with dementia by 2030 (Alzheimer's Association, 2019), and 152 million by 2050 (World Health Organization, 2017b). Different stages and different symptoms of MCI and dementia impair one's cognition, thinking, and memory, and lead to social functioning decline, problematic behaviors, negative emotions, psychological symptoms, such as depression (Karkou and Meekums, 2017; Renom et al., 2020), and anxiety (Shaji et al., 2009; Krishnamoorthy and Anderson, 2011).

Depression and anxiety are among behavioral and psychological symptoms of dementia (BPSD) which are strongly correlate with and prevalent and persistent during the course of the progression of cognitive impairment (Cerejeira et al., 2012; van der Linde et al., 2016; Zhao et al., 2016). Depression is a highly prevalent concomitant of dementia (Grammes and Kubiak, 2020), causing distress, reducing the quality of life, exacerbating cognitive and functional impairment, and increasing caregiver stress. Even mild levels of depression can significantly add to the functional impairment of persons with MCI and dementia, while the severity of psychopathological and neurological impairments increases with that of depression (Gutzmann and Qazi, 2015). Although it is still under debate whether depression leads to dementia or depression is one of the symptoms of dementia (Kuo et al., 2020; Yang et al., 2021), there is no doubt that depression is closely related to MCI and dementia. Thus, identifying and alleviating depression for persons with MCI and dementia is an important strategy to facilitate the prevention and treatment of MCI and dementia. Also, the prevalence of anxiety in persons with MCI and dementia ranges from 8 to 71%, resulting in poor outcomes (Kwak et al., 2017). Persons with MCI and dementia with co-morbid anxiety have more difficulties with activities of daily living, leading to greater functional impairment and resulting in early long-term care (Cummings et al., 2015; Brown Wilson et al., 2019). It is also associated with having poor quality of life (Livingston et al., 2014; Kwak et al., 2017), problematic behaviors, nighttime awakenings, worse neuropsychological performance (Seignourel et al., 2008), and increased mortality (Tatsumi et al., 2009). Therefore, evaluating and treating depression and anxiety among persons with MCI and dementia is urgent (Grammes and Kubiak, 2020). More mental health services should be used to help persons with MCI and dementia deal with their depression and anxiety.

Traditional pharmacologic treatments are used to relieve depression or anxiety among persons with MCI and dementia (Dafsari and Jessen, 2020). Besides, there are many non-pharmacologic interventions, such as physical exercise (Aliev et al., 2013), mindfulness-based cognitive therapies (Aguirre et al., 2017), and music interventions (Ing-Randolph et al., 2015). The literature highlights that given the complexity of MCI and dementia' symptoms, researchers and practitioners should take a multi-dimensional and comprehensive perspective (Karkou and Meekums, 2017). Using diverse treatments (e.g., non-pharmacological interventions) and multi-component approaches might be most effective (Bennett et al., 2021). Non-pharmacologic interventions have been shown to effectively manage neuropsychiatric symptoms from comprehensive perspectives, including cognitive, emotional, physical, social aspects, and thus should be considered first before starting pharmacological treatments (Brasure et al., 2016; Austrom et al., 2018).

Dance-based interventions are any type of movement-with-music activity, such as tango, waltz, ballroom, polka, jazz, foxtrot, cha-cha, rumba, samba, bolero, and salsa. Dance-based interventions focused on dynamic balances of the physical movements with music's rhyme and rhythm (e.g., yoga and meditation focus on the posture of the static body, and thus they do not belong to dance-based interventions)

(Ucznik and Loesche, 2017; Leach and Stevens, 2019). Dance-based interventions as non-pharmacologic interventions have gained rising attention and recognition (Burns, 2009; Hayes and Povey, 2010; Kiepe et al., 2012; Karkou and Meekums, 2017), although dance has been part of many cultures and histories for ages. The National Institute for Health and Care Excellence (NICE) in England recommends dancing as an intervention for dementia (Lyons et al., 2018). Literature shows that dance-based interventions as a mind-body movement can improve the cognitive function among aging adults (Wu et al., 2019), or persons with MCI (Chan et al., 2020; Hewston et al., 2020), and dementia (Lyons et al., 2018; Mabire et al., 2018). Regarding global cognition, dance-based interventions are more effective than physical exercises among persons with MCI, and more effective than combined training of cognitive and physical exercise among persons with cognitive impairments (Wang et al., 2018). Dance-based interventions can reduce psychological distress in patients with depression (Kiepe et al., 2012) and anxiety, increase quality of life, interpersonal and cognitive skills (Koch et al., 2019). Literature also highlights the advantages of dance-based interventions which include multidimensional components (Bruyneel, 2019), showing that it could effectively deal with the complexity of symptoms (Karkou and Meekums, 2017) and with no adverse effects (Bruyneel, 2019). They can also relieve depression and anxiety for persons with neurocognitive disorders from physical, psychological and other dimensions by adopting mind-body movement (Bruyneel, 2019; Wu et al., 2019). Dance-based interventions are recognized as more integrated interventions (Lyons et al., 2018) and holistic interventions (Mabire et al., 2018).

As of March 2021, based on our literature review, no systematic reviews have been conducted on dance-based interventions on depression or anxiety among persons with MCI and dementia. Only one integrative review is about dance-based interventions on anxiety among persons with dementia (Bennett et al., 2021), which included one non-RCT study and results indicate that dance might affect anxiety symptoms in patients with dementia. Given these considerations, we aimed to conduct a systematic review and meta-analysis to assess the effect of dance-based interventions on depression and anxiety for persons with MCI and dementia. We focused on two outcomes: depression as the primary outcome, and anxiety as the secondary outcome.

METHODS

Criteria for Including and Excluding Studies for This Review

Inclusion and exclusion criteria regarding study participants, intervention, control, outcome, and study design can be found in **Table 1**.

Search Methods for Identification of Studies

Electronic Searches

Seven electronic databases (Cochrane, PsycINFO, Web of Science, PubMed, EBSCO, CNKI, WanFang) were searched from 1970 to March 2021. Grey literature was also searched and reviewed in Google Scholar, ProQuest Dissertations & Theses Database (PQDT), and Duxiu. Authors of relevant conference abstracts were reached out for possible information sharing. The search strategy was: ((MCI OR dementia OR Alzheimer's OR "cognitive impai*" OR "cognitive loss" OR "cognitive decline" OR ("MCI"[Mesh])) OR ("Dementia"[Mesh])) OR ("Alzheimer's Disease"[Mesh])) AND ((dance* OR "authentic movement" OR "movement therap*" OR "movement psychot*" OR "body psychot*" OR tango OR waltz OR ballroom OR polka OR jazz OR foxtrot OR chacha OR rumba OR samba OR bolero OR salsa) OR ("Dance Therapy"[Mesh]) AND (RCT OR random* OR "controlled clinical trial" OR placebo OR "drug therapy" OR trial or groups).

Data Collection and Analysis

Studies Screening

The searched literature was imported into Zotero software (version 5.0.96.2) for screening, and the included and excluded literature was documented in Zotero. Six reviewers (YW, DS, YT, JW, HC, ZD) were divided into two groups, with each group member responsible for half of the articles according to inclusion and exclusion criteria. Each member independently removed duplicates, reviewed studies' titles, and abstracts, and then screened the full text. If there were disagreements and uncertainties, they were discussed at weekly group meetings with all reviewers.

Assessment of Risk of Bias in Included Studies

We used the Cochrane "Risk of Bias" tool (Higgins et al., 2011) to identify any risk of bias with a judgment of low risk, high risk, or unclear risk of bias for each trial of the following areas:

1. selection bias:
   a. random sequence generation
   b. allocation concealment

2. blinding of participants and personnel;
3. blinding of outcome assessment;
4. incomplete outcome data;
5. selective reporting;

Six reviewers (YW, DS, YT, JW, HC, ZD) were divided into two groups, with each group member conducted the ROB assessment for half of the articles. Each member independently conducted the ROB assessment. Disagreements and uncertainties were discussed at weekly group meetings with all reviewers.

Data Extraction

The data extraction was conducted manually. Six reviewers, again in two groups, independently extracted data using a pre-designed form. Each member extracted data from half of the included studies. The following data were extracted:

1. Basic study information: authors, reference, country/region;
2. Participant characteristics: illness/condition, total number, and number in each group, age, gender, race/ethnicity;

TABLE 1 | Criteria for including and excluding studies.

Domain	Criteria for including studies	Criteria for excluding studies
Population	• MCI • Dementia • Participants' formal diagnoses on types and severity of MCI and dementia were based on corresponding scales, including the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) (American Psychiatric Association, 2013), International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10) (World Health Organization, 1992), or other comparable diagnostic criteria, and were formally diagnosed as having any type and severity of MCI, dementia. • People of all ages • Diverse settings (e.g., the community, hospitals, nursing homes.)	• If a mixed sample of participants (e.g., dementia patients and their caregivers) was found, the data of persons with MCI and dementia were not reported separately, or the data could not be retrieved by contacting the article authors.
Intervention	• Any style of dance (e.g., tango, waltz, ballroom, polka, jazz, foxtrot, cha-cha, rumba, samba, bolero, and salsa.) • Any type of movement-with-music activities (Dance-based interventions focused on dynamic balances of the physical movements with music's rhyme and rhythm (e.g., yoga and meditation focus on the posture of the static body, thus they do not belong to dance-based interventions). The dance-based interventions included: a) 1) Non-improvised and fixed form, or structured or pre-choreographed physical movements with music (Lapum and Bar, 2016); b) or 2) improvisation of body movements following the rhythm of music; c) or 3) authentic body movements expressing mood or psychology state or subconsciously in the background of music, such as dance movement therapy (DMT). Dance-based interventions can be implemented individually, in pairs, or in groups (Ucznik and Loesche, 2017; Leach and Stevens, 2019).	• Animal trials (e.g., physical activity training of animals) • Pharmacological interventions (e.g., treatment with antidepressants).
Control group	• No intervention • Usual care (e.g., regular medication and routine care, chatted casually) • Waiting list group	• If there were more than one control group, such as music, physical, cognitive-behavioral, or integrative therapies, meta-analysis only utilized the control group of no intervention, or usual care
Outcome	• The primary outcome: Depression • The secondary outcome: anxiety • Depression and anxiety could be measured by any instruments, such as the Geriatric Depression Scale (GSD), Beck Depression Inventory (BDI), the Rating Anxiety in Dementia (RAID), Hospital Anxiety, and Depression Scale (HADS).	• The values of mean and standard deviation (SD) were not reported in the description of outcome • Mean and SD could not be obtained by contacting the authors • Mean and SD could not be calculated by review manager software or calculator provided by Cochrane (Calculator: https://training.cochrane.org/online-learning/core-software-cochrane-reviews/revman/revman-5-download; https://training.cochrane.org/resource/revman-calculator).
Study design	• Randomized controlled trials (RCTs) (including cluster-RCTs) a) Published or unpublished RCTs in Chinese or English language. b) No limitation for the year of publication.	

3. Intervention characteristics: intervention content, individual or group format, in-person or virtual, setting, length (e.g., number of weeks), number of sessions, duration per session, control;
4. Intervention assessment information: time point (e.g., pretest, posttest, follow-up), measures, outcomes with screenshots (including the mean, standard deviation, and the number of participants in each group at each time point), outcome raters (e.g., patients, caregivers, staff);
5. Sources of funding.

After comparing results within a group, any uncertainties that could not be solved were discussed in weekly meetings with all reviewers.

Data Analysis

RevMan 5.4 was used for meta-analysis. Outcomes measured in at least two studies were included in the meta-analysis. Heterogeneity was assessed and interpreted using an I^2 statistic according to Cochrane guidance: 0–40% means not important; 30–60% represents moderate heterogeneity, 50–90% represents substantial heterogeneity; and 75–100% is considerable heterogeneity (Higgins et al., 2020). Given the possible clinical heterogeneity, a random-effects model was used. If one study used more than one instrument to measure the same outcome variable, the team employed the more commonly used instrument for the analysis. Subgroup analyses were conducted with the following characteristics if applicable:

outcome instrument, disease/conditions, country/region, setting, frequency, session, post-intervention, follow-up, raters. Cohen's d was calculated for subgroup analyses to compare the effect size. A funnel plot was used to assess publication biases when the number of studies used for meta-analysis was more than ten, according to Cochrane guidelines.

Rating the Evidence Quality

We used the tool of GRADEpro GDT (Schünemann et al., 2013) to rate the evidence quality of meta-analysis results in five aspects: risk of bias, inconsistency, imprecision, indirectness, and publication bias, according to Cochrane guidelines, and then we chose whether to downgrade or not. The final evidence quality was judged as high, medium, low, or very low. Different opinions on the rating were discussed and finally decided at the weekly meetings.

RESULTS

Search Results

Figure 1 shows the PRISMA flowchart of the study review and selection process. A total of 563 studies were identified from electronic searches. These studies were de-duplicated and screened at the title and abstract level with the pre-stated inclusion and exclusion criteria. Fifty-five full-text articles were then screened, among which 50 were excluded based on the same

criteria. As a result, five studies representing 579 participants were included in the systematic review and meta-analysis.

Study Characteristics

Table 1 presents the characteristics of included studies. Among five studies, three were conducted in China (one in mainland China and two in Hong Kong), one in Greece, and one in the United States. All five studies were RCTs.

Regarding participants' diseases/conditions, participants in most studies ($n = 3$) were persons with MCI (Aguiñaga, 2016; Lazarou et al., 2017; Zhu et al., 2018), one was persons with moderate dementia (Cheung et al., 2018), and one was mild dementia (Ho et al., 2018). The total number of participants ranged from 21 to 204, with three studies having more than 100 participants. Participants from two studies were community residents (Aguiñaga, 2016; Lazarou et al., 2017); one was recruited from residential care facilities (Cheung et al., 2018); one was from a local hospital and older adult community centers (Ho et al., 2018); and one was from a dementia clinic as well as through radio and newspaper recruitment ads (Zhu et al., 2018).

In terms of the intervention details, the included studies were all group-based interventions. Intervention length ranged from 6 weeks to 12 months. The frequency of each intervention included 20 min twice a week ($n = 1$), 35 min three times a week ($n = 1$), and 60 min twice a week ($n = 3$). All interventions were conducted with persons older than 50 years old. The intervention sessions ranged from 12 to 80 sessions, including 12 sessions
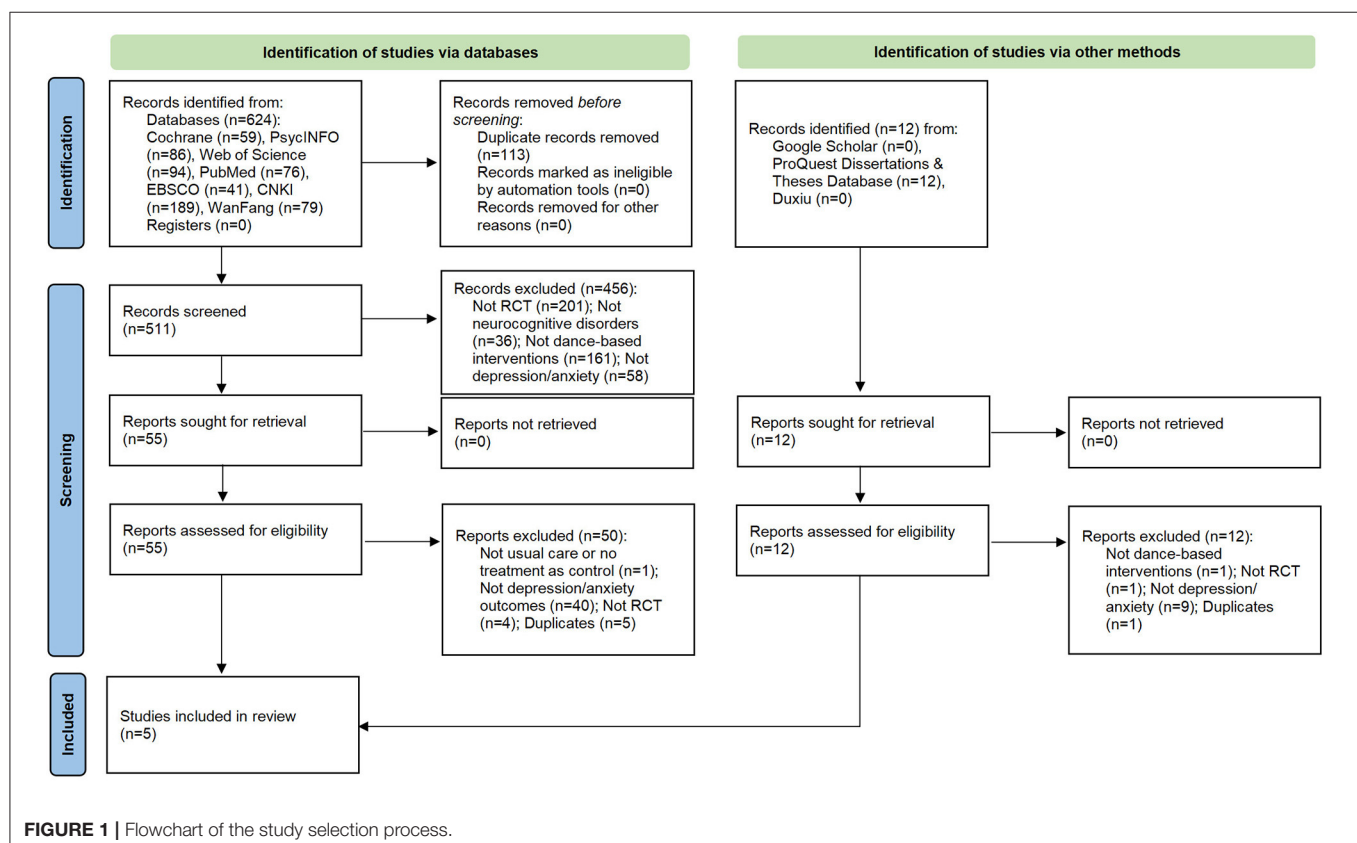

FIGURE 1 | Flowchart of the study selection process.

TABLE 2 | Characteristics of included studies.

Study reference	Participants	Study design	Intervention Group (IG)	Control Group (CG)	Outcome measures	Data collection time and raters	Results	Sources of funding
Cheung et al. (2018) The effects of the music-with-movement intervention on the cognitive functions of people with moderate dementia: A randomized controlled trial	$N = 165$ Age ≥ 65 y/o Individuals with moderate dementia from 12 residential care facilities in Hong Kong, China	RCT	$N = 58$ each group: 4–6 persons 6-week music-with-movement (MM) intervention happening twice a week, with 20 min in each session. The first author served as the interventionist and was well-trained in delivering the intervention, including batting balloons, waving ribbons, foot-tapping, playing musical instruments (e.g., handbells, drums, triangles, etc.), and mimicking movements 12 session	$n = 54$, music listening group (listened to their preferred music) $n = 53$, social activity group (SA, chatted casually)	Depression: GDS Anxiety: RAID	T_0 (baseline) T_1 (6 weeks) T_2 (6 weeks post-intervention, 12 week) Rated by research staff	T0-T1: GDS (MM: $p = 0.002$ SA: $p = 0.194$) RAID (MM: $p<0.001$ SA: $p = 0.128$) TI-T2: GDS (MM: $p = 1.000$ SA: $p = 0.078$) RAID (MM: $p = 0.873$ SA: $p = 0.626$) T0-T2: GDS (MM: $p = 0.052$ SA: $p = 0.922$) RAID (MM: $p<0.001$ SA: $p = 0.001$)	No funding
Lazarou et al. (2017) International ballroom dancing against neurodegeneration: A randomized controlled trial in Greece community-dwelling elders with mild cognitive impairment	$N = 129$ Age: 55–75 y/o, mean age 66.8 ± 10.1 Community residents with MCI in Greece	RCT	$N = 89$: received allocated intervention ($n = 74$); did not receive allocated intervention ($n = 15$); lost to follow-up ($n = 5$); discontinued intervention ($n = 3$); analyzed ($n = 66$) International Ballroom Dancing; Group practice; Twice a week for 60 min for 10 months, 40 weeks in a total of 80 sessions per person. An experienced dance instructor supervised the dance class. Each 60-min dance class included a 5-min warm-up revising previous dance sessions, 45 min of new material (figures/dances), and a 10-min cool-down period with a dance of participants' preference; recognize music, dance, and rhythm, to stay in the rhythm in basic simple steps, and finally remember step combinations, leading hints and following alertness.	$N = 65$: lost to follow-up ($n = 2$), analyzed ($n = 63$), no intervention, continued participants' usual lifestyle	Depression: GDS, BDI	Pre, post, and after the end of the program-—10 months later Rated by researchers.	GDS: Post: $p = 0.022$ The independent sample t-test at the follow-up: GDS $p = 0.007$; DBI $p = 0.04$	The project "Augmentation of the Support of Patients suffering from Alzheimer's Disease and their caregivers (ASPAD/2875)", The European Union (European Social Fund) and the Ministry of Education, Lifelong Learning and Religious Affairs in the context of the National Strategic Reference Framework (NSRF, 2007-2013).

TABLE 2 | Continued

Study reference	Participants	Study design	Intervention Group (IG)	Control Group (CG)	Outcome measures	Data collection time and raters	Results	Sources of funding
Aguiñaga (2016) Latinos unique scenario, addressing cognitive impairment via dance	$N = 21$ Age > 60 y/o, mean age 75.4 ± 6.3 Community-dwelling older Latinos with MCI (score 18–26) in Chicago, U.S.	RCT	$N = 10$, completers $n = 6$ 16-week (four months), 1 h twice a week 32 sessions. BAILAMOS© program is an innovative, culturally appropriate dance program and has been developed by Dr. Marquez and an accomplished Latin dance instructor, and revised and practice by a professional dance instructor.	$N = 11$, the wait-list control group were asked to maintain their usual activities during weeks 1 through 16	Depression: GDS-15	Testing occurred at baseline, 2 months, 4 months, 6 months, and 8 months Rated by the research staff member	The GDS-15 showed an interaction effect, $[F_{(1.61, 30.67)} = 5.76, p = 0.01]$ in the direction contrary to hypothesize, that is the intervention will yield small-medium effect sizes reflecting improvements om depression	The University of Illinois at Chicago Department of Kinesiology and Nutrition, and the Rush Alzheimer's Disease Center
Ho et al. (2018) Psychophysiological effects of dance movement therapy and physical exercise on older adults with mild dementia: A randomized controlled trial	$N = 204$ Age ≥ 65 y/o Individuals with a clinical diagnosis of mild dementia from psychogeriatric outpatient departments of a local hospital and older adults community centers in Hong Kong, China	RCT	$N = 69$ DMT, group, 12 weeks, with 1-h sessions held twice a week, led by registered dance-movement therapist or one in training; 24 session. Four main elements: simple group dance, movement games, improvisational dance movement, and movement interactions among group members.	Exercise group: $n = 67$, mild to moderate exercise program, 2 h per week (12 weeks) mild to moderate exercise program (a warm-up, stretching, and joint movements, exercising with towels and a cooldown) Control group: $n = 68$, the waitlist control group received regular medication and routine care	Depression: four dichotomous items of GDS	T_1 (baseline) T_2 (3 months) T_3 (6 months) T_4 (1 year) Research coordinators+ Participants completed self-rated scales	From Time 1 to Time 2, the DMT group showed significantly lower scores in depression ($B = -0.51$, SE $= 0.19$, $p < 0.01$, $d = 0.33$) than the control group. From Time 2 to Time 4, however, the DMT group showed considerable rebounds in depression, At Time 4, the DMT and control group no longer differed significantly in these three variables ($d = 0.10$–0.21, $p = 0.08$–0.42).	The General Research Fund, Hong Kong Research Grants Council (GRF/HKU17402714).
Zhu et al. (2018) Effects of a specially designed aerobic dance routine on mild cognitive impairment	$N = 60$ Age ≥ 50 y/o and ≤ 85 y/o MCI patients recruited through the dementia clinic at the First Affiliated Hospital of Nanjing Medical University or through radio and newspaper recruitment ads inNanjing, China	RCT	$N = 29$; Aerobic dance taught by a dance instructor including a 5-min warm-up, a 25-min dance with the target heart rate, and a 5-min cool-down; seven sub-sessions performed consecutively: knee bending, heel up, boxing, shoulder movement, kicking, square-stepping, and sculling exercise; 35-min dance session, three times a week for 3 months; 36 session. 3 months later continue practicing in their own home	$N = 31$, usual care only	Depression: GDS-15	T_0 (baseline) T_1 (3 months) T_2 (6 months) Rated by physicians and technician	Patients in the control group had a significant improvement at 3 months in depression symptoms (mean GDS-15 score change −3.4, 95% CI −5.2, −1.5; p, 0.01) but no significant at other time points.	The Science and Technology Department of Jiangsu Province (Project Number: 2013-DB13)

BDI, Beck Depression Inventory; GDS, Geriatric Depression Scale; RAID, The Rating Anxiety in Dementia; HADS, Hospital Anxiety and Depression Scale.

(Cheung et al., 2018), 24 sessions (Ho et al., 2018), 32 sessions (Aguiñaga, 2016), 36 sessions (Zhu et al., 2018), and 80 sessions (Lazarou et al., 2017).

Regarding dance-based intervention approaches, there are two main approaches: one is dance movements therapy (DMT) with improvisation elements led by a registered dance-movement therapist. This approach includes four main elements: simple group dance, movement games, improvisational dance movement, and movement interactions among group members (Ho et al., 2018). The other approach is non-improvised, fixed form and structured movements with music, including music-with-movement, international ballroom dancing, BAILAMOS© program, and aerobic dance. Specifically, music-with-movement was delivered by a well-trained interventionist using batting balloons, waving ribbons, foot-tapping, playing musical instruments, and mimicking movements (Cheung et al., 2018). International ballroom dancing was led by an experienced dance instructor with a 5-min warm-up, 45 min of new material (figures/dances), and a 10-min cool-down. The instructor paid attention to a dance of participants' preference, taught them to recognize music, dance, and rhythm, and finally remember step combinations, leading hints, and following alertness (Lazarou et al., 2017). BAILAMOS© program was an innovative, culturally appropriate dance program developed by Dr. Marquez and an accomplished Latin dance instructor. When used in the study, it was revised and practiced by a professional dance instructor (Aguiñaga, 2016). Aerobic dance was taught by a dance instructor with a 5-min warm-up, a 25-min dance with the target heart rate, and a 5-min cool-down. Seven sub-sessions were performed consecutively: knee bending, heel up, boxing, shoulder movement, kicking, square-stepping, and sculling exercises (Zhu et al., 2018).

Control groups included usual care in one study (Zhu et al., 2018), and participants' usual lifestyle/usual activities in two

studies (Aguiñaga, 2016; Lazarou et al., 2017). In the remaining two studies, two control groups were used. Specifically, in Ho et al. (2018), one group was waitlist control, and the other was a moderate exercise program. In Cheung et al. (2018), one group was social activity group (chatted casually), and the other was a music listening group.

Regarding funding sources, four studies reported the source of funding (Aguiñaga, 2016; Lazarou et al., 2017; Ho et al., 2018; Zhu et al., 2018), which were all educational and research grants. The remaining one study reported receiving no funding (Cheung et al., 2018).

Regarding measurement instruments, depression was measured in all five of the included studies, with measurement tools including the Geriatric Depression Scale (GDS), GDS-15, and four dichotomous items of the GDS. Anxiety was measured in one included study which used the Rating Anxiety in Dementia (RAID). As for measurement time points, all five studies had pre-and post-intervention assessments. Four studies had follow-up (f/u) assessments, and the f/u assessments were conducted at various time points (e.g., 3 months, 4 months, 6 months, 8 months, and 12 months) (**Table 2**).

Risk of Bias

Risks of bias were judged based on the Cochrane guidance, as shown in **Figure 2**. Regarding random sequence generation, five studies were judged to be at low risk, as they used computer-generated random numbers (Aguiñaga, 2016; Ho et al., 2018; Zhu et al., 2018), or block randomization method (Cheung et al., 2018), or a technician performed randomization using an algorithm (Lazarou et al., 2017).

Regarding allocation concealment, only one of five studies was judged to be at low risk, which used sealed envelopes (Zhu et al., 2018). Two studies were judged as high risk which reported that no concealment was used in the allocation process (Aguiñaga,
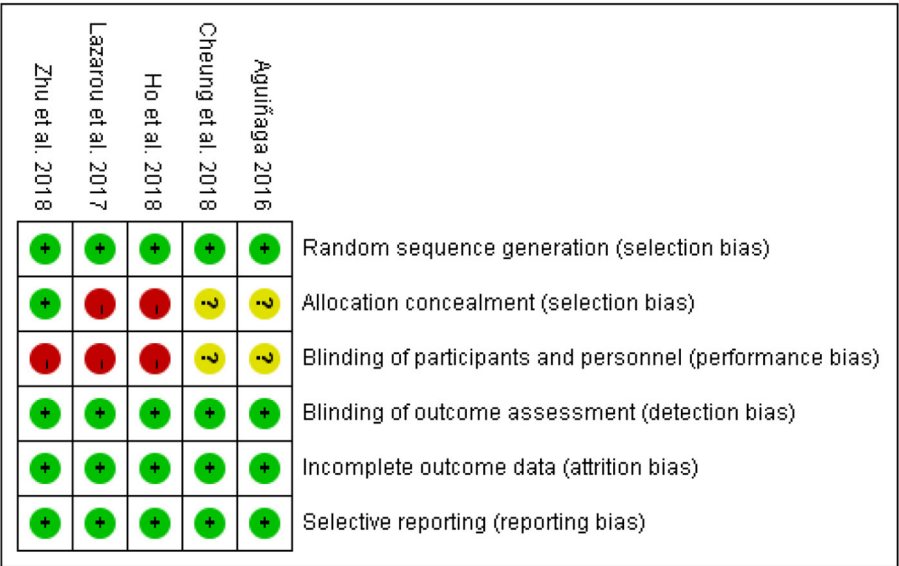

FIGURE 2 | Risk of bias summary. *Green represents low risk; Red represents high risk; Yellow represents unclear.

2016; Ho et al., 2018). The remaining two studies did not report information on allocation concealment and were judged to be unclear.

Regarding blinding participants and interventionists, three studies (Lazarou et al., 2017; Ho et al., 2018; Zhu et al.,

2018) were rated as high risk, and two studies (Aguiñaga, 2016; Cheung et al., 2018) as unclear. Meanwhile, all five studies were judged as low risk for blinding outcome assessment through using personnel not included in the intervention process.
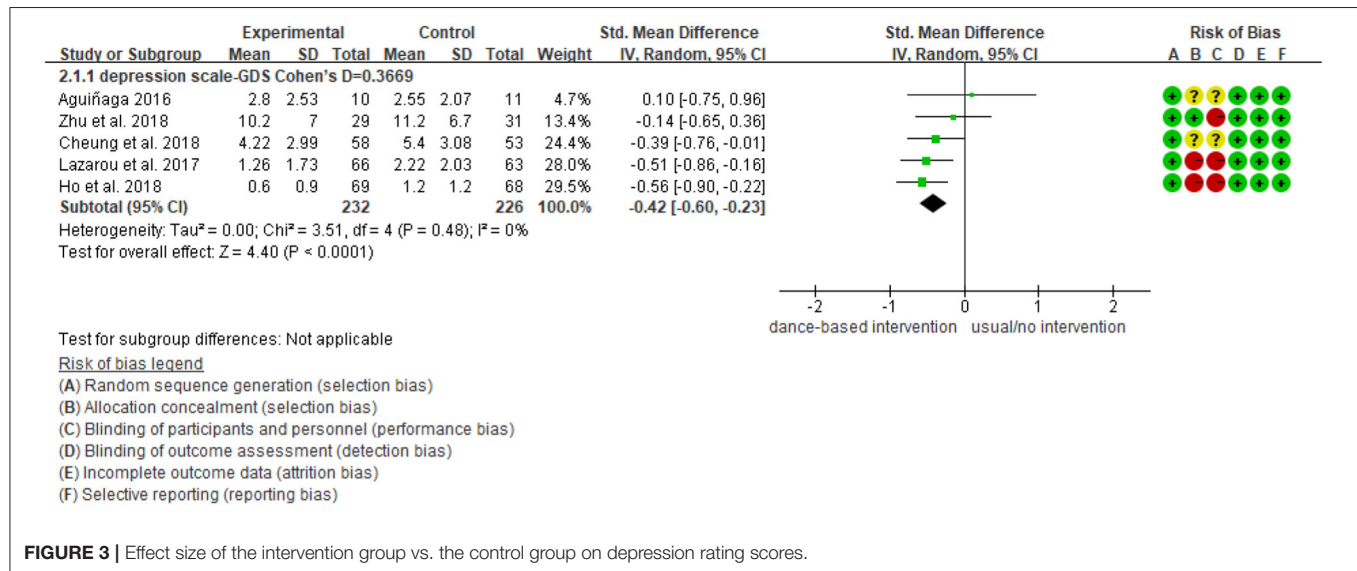

FIGURE 3 | Effect size of the intervention group vs. the control group on depression rating scores.
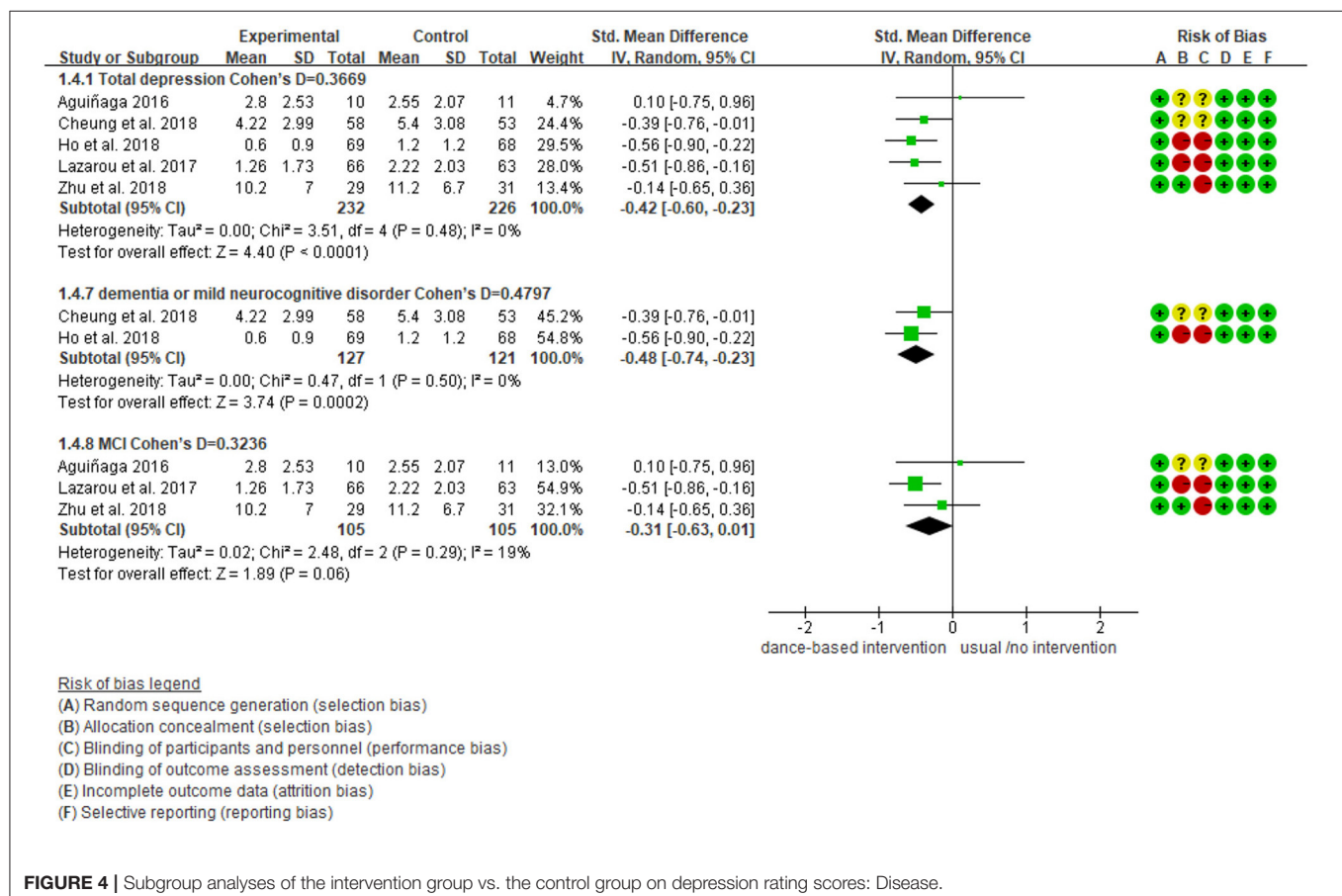

FIGURE 4 | Subgroup analyses of the intervention group vs. the control group on depression rating scores: Disease.

All studies were judged to be at low risk for incomplete outcome data because the dropout rate was low (<30%) during the intervention. All explained the numbers and reasons for dropout and the data analysis methods of deal with missing values. Lastly, all studies were judged as low risk for selective reporting.

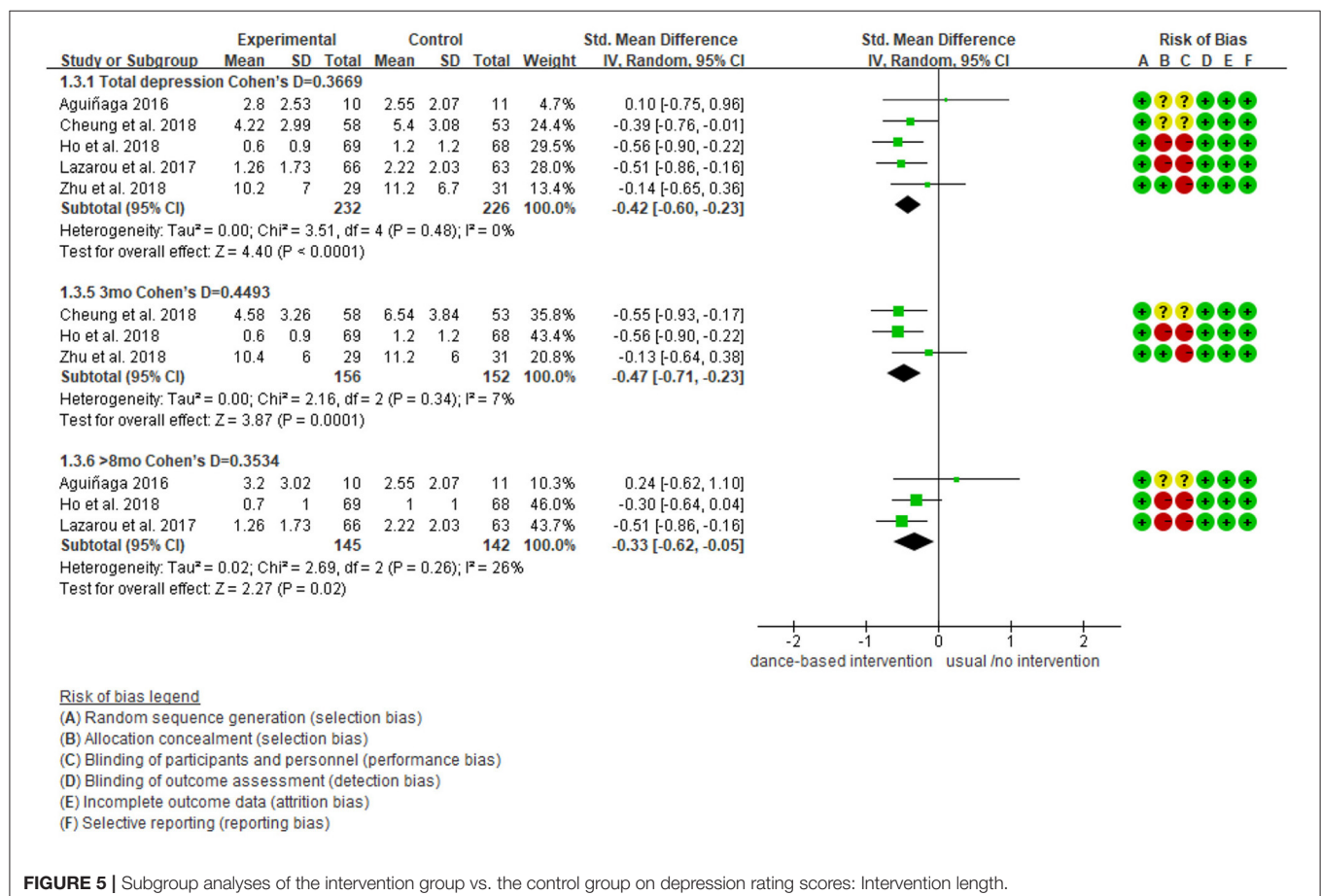## Meta-Analysis Results for Depression

As shown in **Figure 3**, five studies reported data on depression and were pooled for a meta-analysis using the random-effects model. Results showed no heterogeneity ($I^2 = 0\%$), meaning that the variation in study outcomes did not influence the interpretation of results. There were significant standardized mean differences in favor of dance-based interventions compared with controls for depression [SMD = −0.42, 95% CI (−0.60, −0.23), $p = <0.05$] at the time point of post-intervention (The intervention length in the five included studies were 3 months, 4 months, 10 months, 6 weeks, respectively). The result indicated that dance-based interventions were significantly beneficial to persons with MCI and dementia compared with the control group, although the effect size was small (Cohen's $d = 0.3669$).
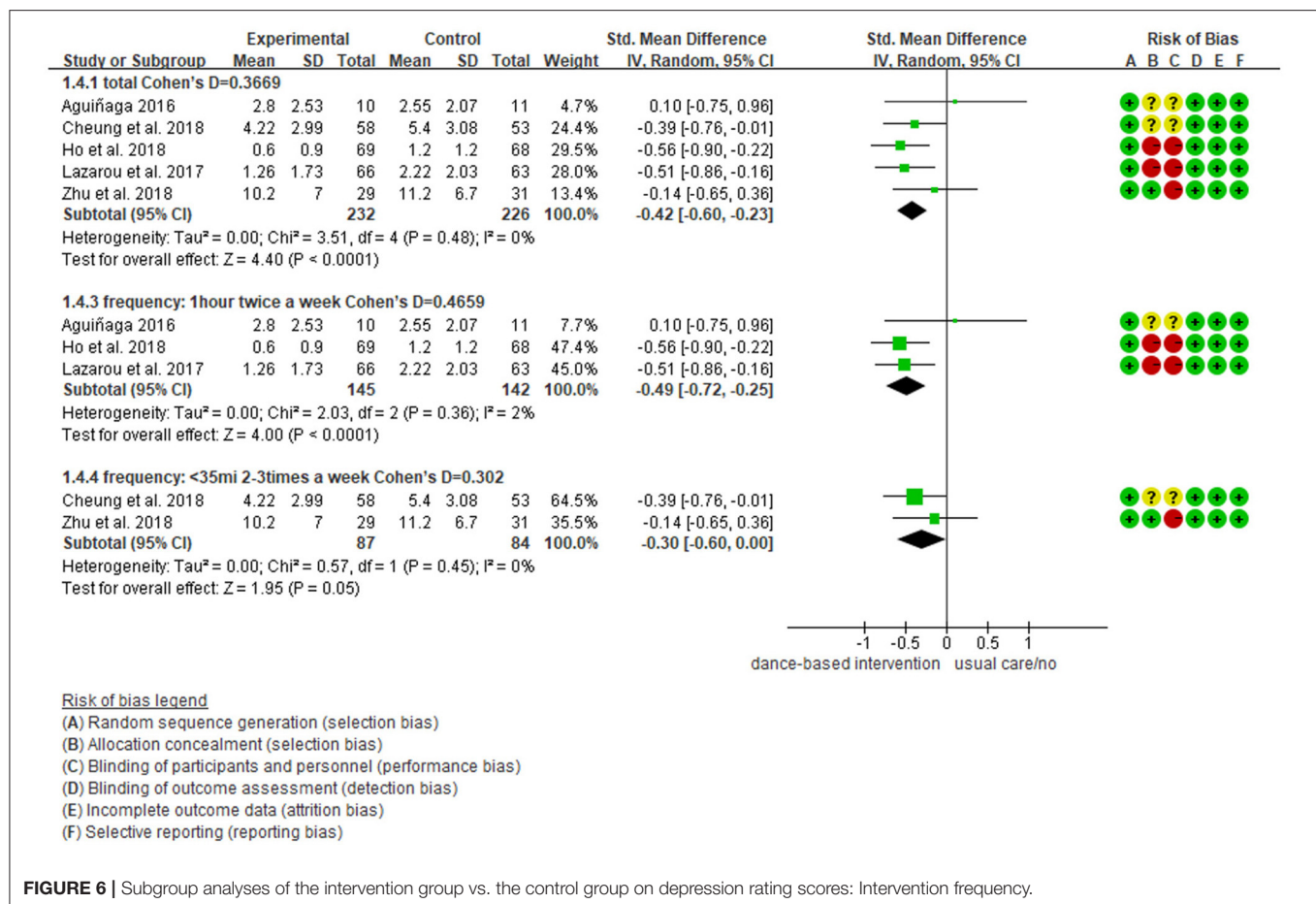
We further performed subgroup analyses with results showing in **Figures 4–9**. Overall, results showed heterogeneity ranged from 0 to 55%, showing small or moderate heterogeneity according to Cochrane guidance. The subgroup analysis for the assessment points of follow-ups showed moderate heterogeneity ($I^2 = 55\%$).

Subgroup analyses showed Cohen's d ranged from 0.1355 to 0.4797, indicating that the effect of dance-based interventions tended to be small or medium in different conditions. Specifically, in terms of disease (**Figure 4**), studies with MCI patients had a smaller effect size than those with dementia patients (0.3236 vs. 0.4797). In terms of intervention length (**Figure 5**), studies with 8 months had a smaller effect size than that of 3 months (0.3534 vs. 0.4493).

In terms of intervention frequency (**Figure 6**), studies with 35 min 2–3 times a week had a smaller effect size than that of 1 h twice a week (0.3020 vs. 0.4659). In terms of time points of data collection (**Figure 7**), studies assessed at post-intervention had a larger effect size than those assessed at follow-ups (0.3669/0.4493/0.3534 vs. 0.1355), which showed that dance-based interventions had diminishing effects. In terms of intervention settings (**Figure 8**), studies in hospitals and communities showed similar effect sizes (0.4262 vs. 0.4283). In terms of intervention countries (**Figure 9**), studies in China showed a similar effect size to non-Asia studies (combining Greece and the United States) (0.4168 vs. 0.4262).

FIGURE 5 | Subgroup analyses of the intervention group vs. the control group on depression rating scores: Intervention length.

FIGURE 6 | Subgroup analyses of the intervention group vs. the control group on depression rating scores: Intervention frequency.

Analysis of Publication Bias for Depression

Only five RCTs were included, so the funnel plot was not made and publication bias was undetected; however, it could not be ruled out.

Intervention Effects on Anxiety

One included study (Cheung et al., 2018) reported data on anxiety representing 165 older adults with moderate dementia. Results showed that there were no significant standardized mean differences in favor of the dance-based intervention compared with the control for anxiety at post-intervention [MD = −0.63, 95% CI (−2.36, 1.10), $p = 0.47$], with a small effect [Cohen's $d = 0.1378$]. Also, the result was not significant at the 6-week follow up [MD =0.80, 95% CI (−0.99, 2.59), $p = 0.38$], although a small effect existed [Cohen's $d = 0.1675$] (**Figure 10**).
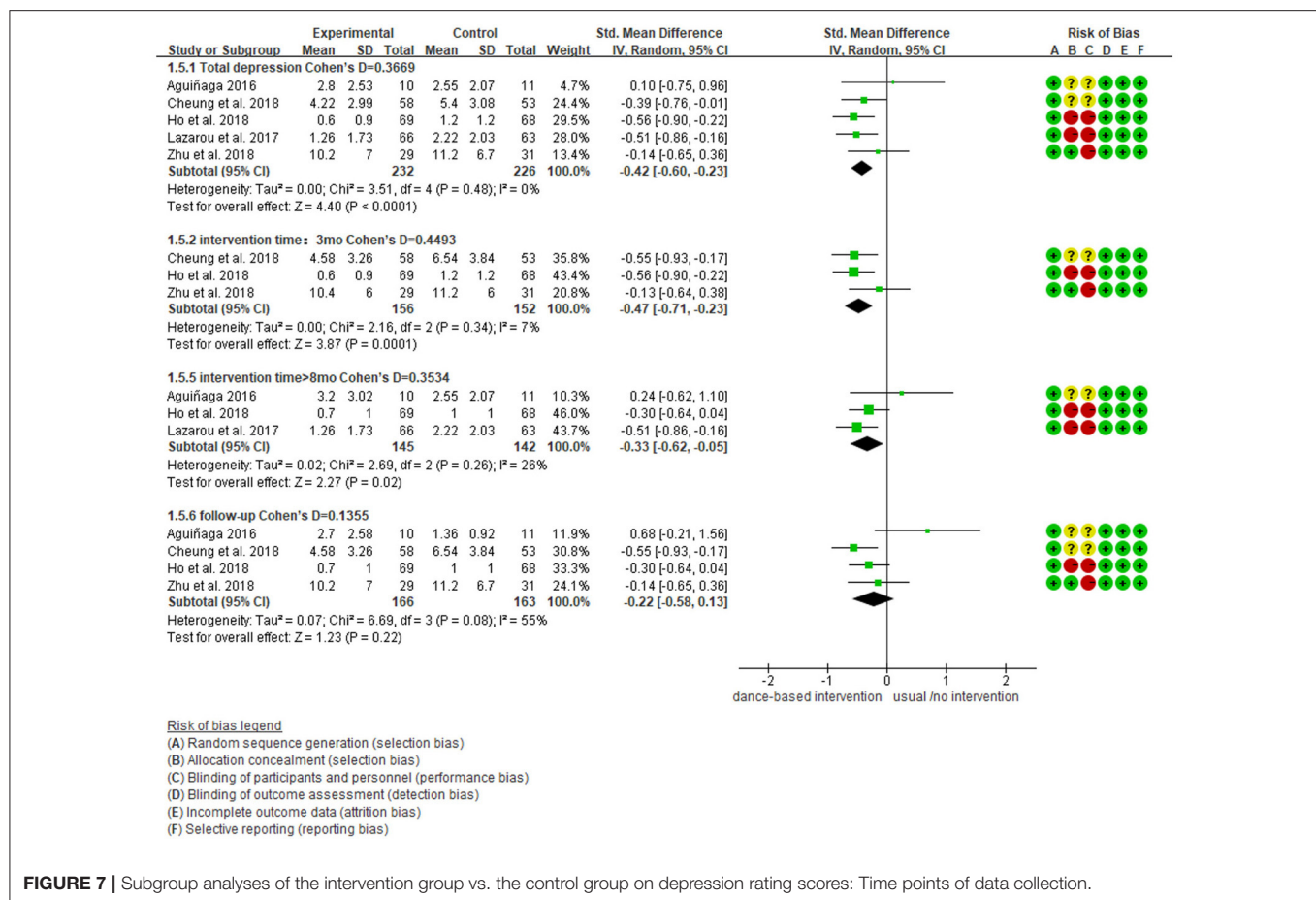
GRADE Evidence Quality Rating

Figure 11 shows the evidence quality of the depression and anxiety outcomes rated by GRADE. The final judgment of the evidence quality of depression outcome was moderate. This was related to the risk of bias rated as serious because most included studies were judged to be unclear or high risk in the two domains of allocation concealment, and blinding participants and personnel. Also, the evidence quality of the

anxiety outcome was low. This was related to risk of bias and imprecision. The risk of bias was judged to be serious because the included study (Cheung et al., 2018) was assessed as unclear in the two domains of the allocation concealment, and blinding participants and personnel. Imprecision was judged to be serious because the study had a small sample size ($n = 53$) which did not meet the requirements of optimal information size (OIS); the confidence interval was wide [CI (−2.36, 1.10)]. These led to a degradation in the evidence quality due to precision (Guyatt et al., 2011).

DISCUSSION

This systematic review and meta-analysis study examined the effects of dance-based interventions on depression and anxiety among persons with MCI and dementia. A total of five studies representing 579 participants were identified. As shown in results, dance-based interventions are significantly beneficial to persons with MCI and dementia in decreasing depression compared with controls. The evidence quality of depression outcome is moderate. Also, dance-based interventions are shown to be beneficial but not significant to persons with moderate dementia in decreasing anxiety compared with controls. The evidence quality of the anxiety outcome is low.

FIGURE 7 | Subgroup analyses of the intervention group vs. the control group on depression rating scores: Time points of data collection.

Our review confirms that dance-based interventions are important and feasible to cope with depression for persons with MCI and dementia. Consistent with our findings, the meta-analysis on health-related psychological outcomes by Koch et al. (2019) suggests that DMT can improve the symptoms of depression; the systematic review on physical and mental illnesses from Kiepe et al. (2012) also shows that patients with depressive psychological distress can be alleviated by dance therapy. However, the review of Koch et al. (2019) shows high heterogeneity of included studies; both Koch et al. (2019) and Kiepe et al. (2012) examined diverse diseases, and depression was assessed in the general populations, not with persons with MCI and dementia. Our review includes RCTs and proves the significance of the effect on depression for persons with MCI and dementia.

In this review, we further identified practice characteristics of dance-based interventions. For example, practitioners should be sensitive to the decreasing effect of interventions. That is, the effect at the post-intervention might be more effective than that of follow-ups. This result also suggests that its current intervention levels of frequency and duration might not be sufficient to yield a long-lasting effect.

Meanwhile, the effects of dance-based interventions are better for persons with dementia than those with MCI. It could be

because individuals with MCI represent the earliest symptomatic stage of dementia, and not all individuals with MCI would progress to dementia (Morris, 2005). Thus, depressive symptoms in persons with MCI are lighter than those with dementia. However, patients with MCI and concomitant depression/anxiety have more pronounced cognitive deficits and progress more often to dementia than MCI patients without depression/anxiety (Ma, 2020). Thus, the interventions for decreasing negative emotions and psychological symptoms should be carried out as early as possible. Also, we recommend the intervention frequency of an hour twice a week.

Additionally, we suggest that practitioners must consider the safety of dance-based interventions because falls are a key risk among persons with MCI and dementia who typically also have high frailty levels (Van Doorn et al., 2003; Fernando et al., 2017). Besides, our review shows that there is a similar effect of dance-based interventions in both hospital and community settings, indicating the interventions can be carried out in various settings to achieve their beneficial effects. Besides, although meta-analysis shows no statistical heterogeneity, we would like to emphasize that statistical heterogeneity could only reflect clinical and methodological heterogeneity to a certain extent. There is no statistical heterogeneity, but it does not mean that there is no clinical and methodological heterogeneity. For example,
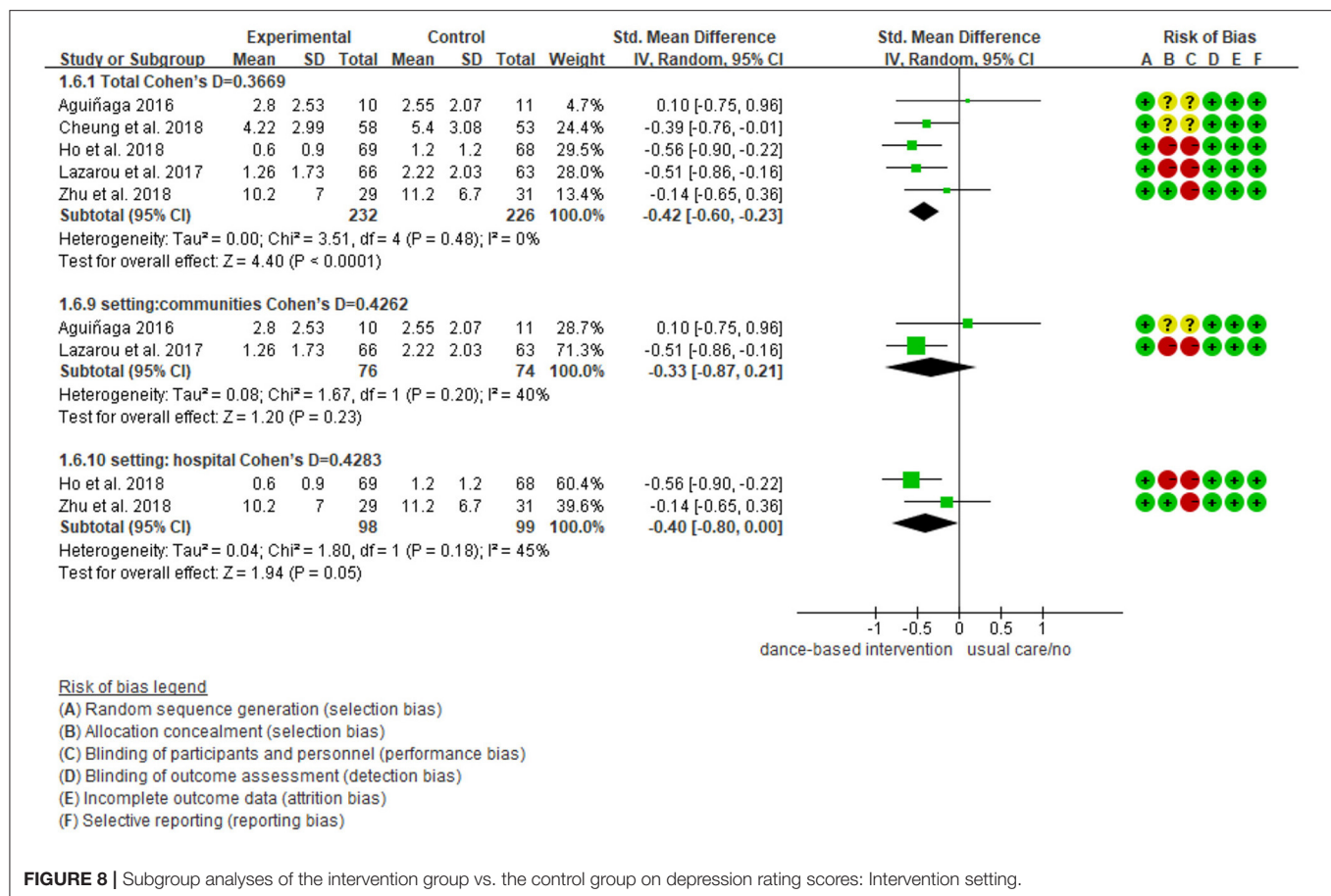
FIGURE 8 | Subgroup analyses of the intervention group vs. the control group on depression rating scores: Intervention setting.

effects are likely to be different if dance-based interventions are conducted 6 weeks or 10 months, likewise 12 or 80 sessions, or the wildly differing lengths of follow-up. Given the clinical heterogeneity, we call for more studies to provide more clinical guidance for practitioners.

Regarding the anxiety outcome, our review only identified one RCT study. Results suggest that the dance-based intervention is beneficial but not statistically significant in reducing anxiety in persons with moderate dementia compared with the control. Consistent with our review, the integrative review (Bennett et al., 2021) shows the same result, but it included one non-RCT study. This means that we need more evidence to confirm the effect of dance-based interventions on anxiety among persons with MCI and dementia. Notably, anxiety is a risk factor for persons with MCI and dementia (Rosenberg and Lyketsos, 2013; Somme et al., 2013), and dance-based interventions as a type of embodied psychological intervention can address mental symptoms (Wang et al., 2018; Wu et al., 2019). However, a presentation of anxiety in the context of MCI and dementia can be different from a typical early-onset anxiety disorder, and it is not easy to identify and quantify anxiety reliably (Kwak et al., 2017). Thus, more research on effects of dance-based interventions on anxiety is needed.

In this review, we further used GRADE to rate evidence quality and identified the moderate quality evidence of depression outcome and low-quality evidence of anxiety

outcome. It is noteworthy that the risk of bias is one of the crucial reasons for evidence degradation for both depression and anxiety outcomes. Only one study reported adequate allocation concealments and the risk bias was rated as low in this domain; no study was rated as low risk in blinding of participants and personnel. This can generate bias as unblinded interventionists might exaggerate the intervention effects, and the intervention might have a placebo effect on the participants.

Our study has several limitations. First, this review only included five studies, and publication bias may exist. Second, we only included English and Chinese literature and thus excluded potential useful information written in other languages. Third, this study might be limited by the selected databases. Although this review included the most widely used English and Chinese databases, it remains possible that some works, particularly unpublished studies conducted in other countries, were not located and examined. Also, our review aimed to assess the effect of dance-based intervention in alleviating depression and anxiety compared with non-intervention/usual care/waitlist control group, so the review can not prove whether dance-based interventions are more or less effective than other therapies. Additionally, we recognize the limitation that GDS measures depressive symptomatology, but it is not clear whether the patients were clinically depressed. More attention should be paid to the measurement instrument in the future. Finally, we did not
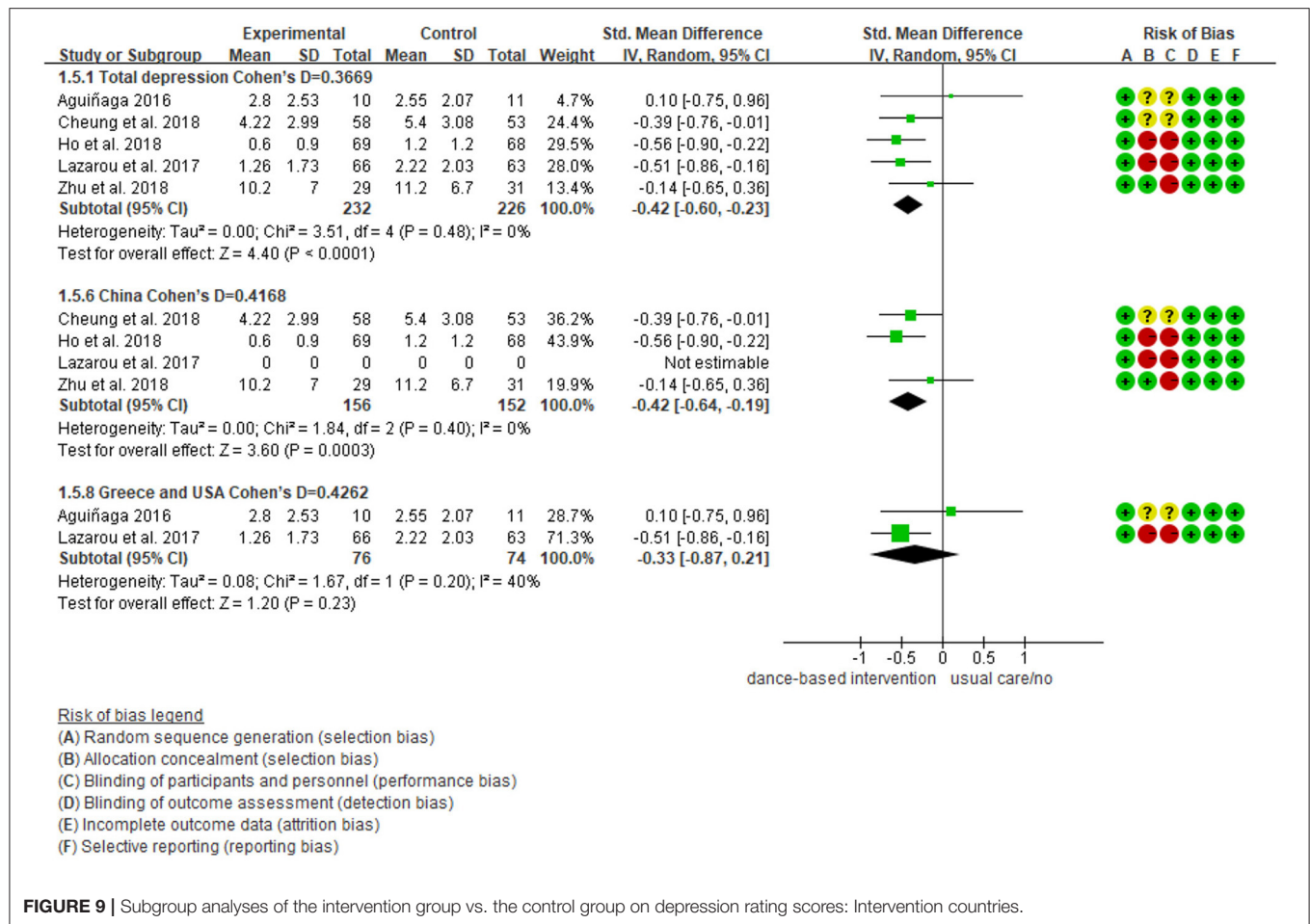
FIGURE 9 | Subgroup analyses of the intervention group vs. the control group on depression rating scores: Intervention countries.
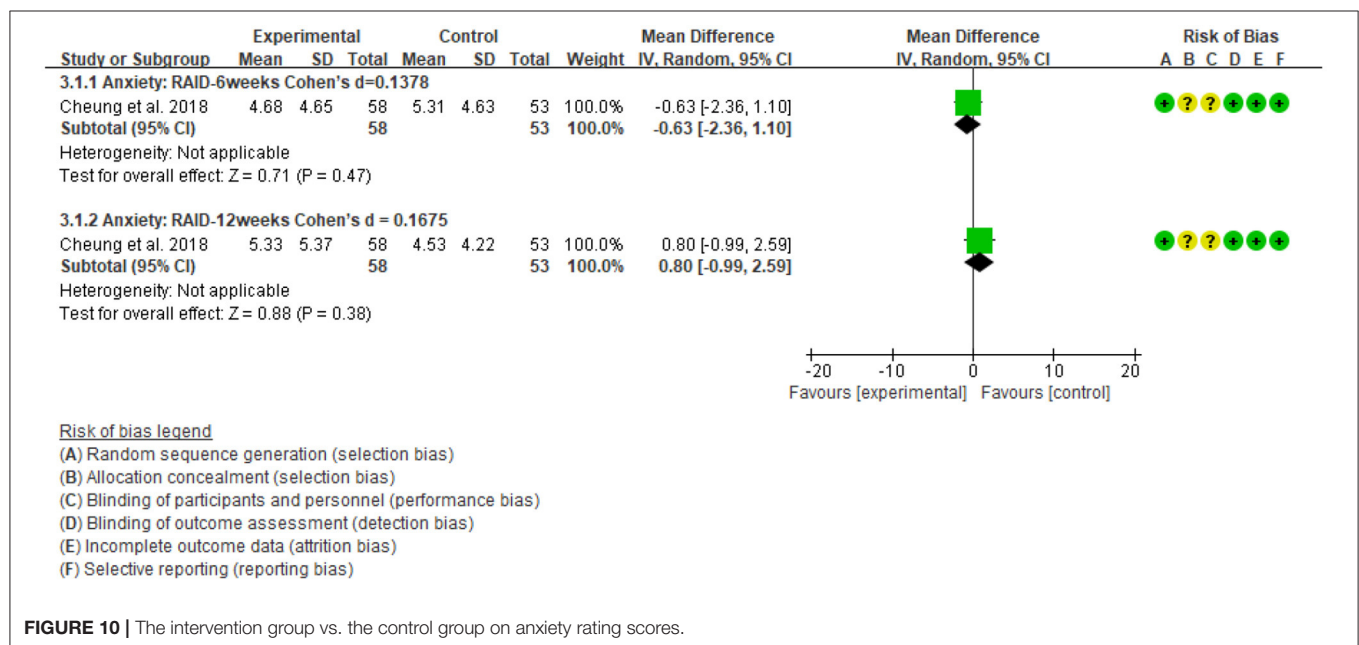

FIGURE 10 | The intervention group vs. the control group on anxiety rating scores.

№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	dance-based intervention	no intervention/usual care/ waiting-list	Relative (95% CI)	Absolute (95% CI)	Certainty	Importance
Depression scale-GDS												
5	randomised trials	serious [a]	not serious	not serious	not serious	none [b]	232	226	-	SMD 0.42 SD lower (0.6 lower to 0.23 lower)	⊕⊕⊕◯ MODERATE	CRITICAL
Anxiety scale-RAID												
1	randomised trials	serious [c]	not serious	not serious	serious [d]	none [e]	58	53	-	MD 0.63 lower (2.36 lower to 1.1 higher)	⊕⊕◯◯ LOW	CRITICAL

CI: Confidence interval; **SMD:** Standardised mean difference; **MD:** Mean difference

Explanations
a. Most included studies in two domains of allocation concealment, blinding participants and interventionists were unclear or high risk.
b. Only 5 studies were included.
c. Two domains of allocation concealment, blinding participants and interventionists were unclear.
d. The sample size was small. The confidence interval was wide.
e. Only one study was included. No funding.

FIGURE 11 | GRADE evidence quality rating of depression and anxiety.

get a chance to register our protocol on PROSPERO which may lead to bias.

Future research implications are as follows. First, more well-designed RCT studies are warranted to evaluate the effects of dance-based interventions among persons with MCI and dementia. The outcome should include not only depression and anxiety, but also other psychosocial outcomes that are crucial to one's holistic well-being. We also call for more rigorous design, especially high-quality designs that minimize biases in domains of allocation concealment and blinding of participants and personnel. In addition, a variety of studies with a larger sample size is necessary to clarify the efficacy. Meanwhile, more rigorous trials that investigate the effect of dance-based interventions during a longer time period should be undertaken, in order to monitor the ongoing effect of the intervention. Finally, future research can include qualitative studies to obtain participants' opinions on the optimal time, length, and the number of sessions of dance-based interventions.

CONCLUSION

Dance-based interventions have a positive effect on depression outcomes among persons with MCI and dementia. Healthcare providers and dance interventionists in different settings may continue to utilize dance-based interventions for this population. Also, more and higher quality RCT studies with larger sample sizes are recommended to be advocated and implemented. The effects of dance-based interventions on depression and anxiety outcomes should be measured and monitored to investigate how these interventions help persons with MCI and dementia decrease depression and anxiety, and help them keep active coping behaviors, to maintain hope and improve quality of life and resilience.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

YW conceived the study, conducted the meta-analysis, wrote the manuscript, and supervised the overall project. YW, YT, ZD, JW, HC, and DS screened the title, abstract and full text, and extracted data. ML and IC reviewed and proofread the manuscript. All authors contributed to the article and approved the submitted version.

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*Studies included in this systematic review and meta-analysis study.

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