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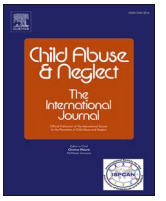

Trauma-informed care for children involved with the child welfare system: A meta-analysis

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ABSTRACT

Background: There has been a burgeoning development of trauma-informed care (TIC) interventions for children involved with the child welfare system. A quantitative synthesis of these interventions' effects on child wellbeing is warranted for the advancement of evidence-based practices.

Objectives: We conducted a systematic review and meta-analysis to estimate TIC interventions' pooled effect on the wellbeing of children involved with the child welfare system, while examining factors that may moderate the effect.

Methods: The search and review yielded 15 eligible studies. We first estimated the interventions' pooled effect based on a compound child wellbeing indicator, and then on three specific child wellbeing indicators: posttraumatic stress disorder (PTSD) symptom reduction, behavioral problem reduction, and other psychological wellbeing improvement. We further conducted subgroup meta-analyses to evaluate factors that may moderate the effect.

Results: TIC interventions had a moderate effect as shown through the compound child wellbeing indicator (SMD = 0.47, 95% CI = [0.27, 0.67]) as well as the three specific indicators (SMD = 0.37 to 0.52, 95% CI = [0.02, 0.88]). Subgroup meta-analyses indicated that the intervention effects varied but generally remained at a moderate level across study and intervention characteristics.

Conclusions: The findings suggest that TIC interventions for children involved with the child welfare system are promising, but the effect may vary by intervention strategies and other factors. Implications for practices and research are discussed.

Trauma, which has been found to be prevalent among children involved with the child welfare system, is a serious threat to overall child wellbeing (Bartlett et al., 2016; Lang et al., 2015). Integrating trauma-informed care (TIC) in child welfare practices has increasingly become a paramount priority (Bartlett et al., 2016; Day et al., 2015; Lotty et al., 2020; Schmid et al., 2020; Sullivan et al., 2019). Studies have evaluated the implementation and effectiveness of a broad range of TIC interventions, including assessing their impacts on child wellbeing (e.g., Bartlett et al., 2016; Day et al., 2015; Howard et al., 2014; Lotty et al., 2020; Purvis et al., 2015; Schmid et al., 2020; Sullivan et al., 2019). However, these studies' local samples and variations limit drawing a general conclusion on how TIC interventions have affected child wellbeing (Lang et al., 2015).

The current study aims to conduct a systematic review and meta-analysis to synthesize TIC interventions' effects on the wellbeing of children involved with the child welfare system. The study also examines factors that moderate the interventions' effects. The findings

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can contribute to the evidence-base for TIC interventions in the child welfare system.

1. Literature review

1.1. Trauma among children involved with the child welfare system

Trauma refers to experiencing or witnessing an event that is perceived as frightening, dangerous, or violent to an individual's life or bodily integrity (The National Child Traumatic Stress Network, 2020). Common causes of child trauma include child maltreatment (e.g., physical, sexual, or psychological abuse and neglect) and exposure to disaster, violence, loss, war, or other emotionally damaging events (Cook et al., 2005). Trauma impairs a child's psychological and physical wellbeing by increasing the risk of posttraumatic stress disorder ([PTSD], Center for Substance Abuse and Treatment, 2014), suicidality (Johnson, 2017), substance misuse (Fischer et al., 2016), delinquency and crime (Dierkhising et al., 2013; Lowe et al., 2016), academic failure (Blodgett & Lanigan, 2018), and various other psychological and physical health problems over the lifetime (Oral et al., 2016).

Trauma is especially prevalent among children involved with the child welfare system. In 2018, 678,000 children were victimized by child abuse and neglect in the U.S. (U.S. Department of Health and Human Services, 2020), and 437,000 children were placed in foster care (U.S. Department of Health and Human Services, 2019). Most of these children, especially children in foster care settings, experience at least one type of trauma (Greeson et al., 2011; Miller et al., 2011). These children may also experience re-traumatization through the investigation process, removal from the home to foster care, and/or transition across multiple foster care settings (Cook & Newman, 2014; Kenny et al., 2017; Sullivan et al., 2016; Themeli & Panagiotaki, 2014).

Child welfare workers who are not versed in the principles of trauma-informed care may not be aware of, and thus, not effectively respond to symptoms of trauma. A misinterpretation of a child's symptoms may lead to negligible or ineffective services (Burns et al., 2004; Conners-Burrow et al., 2013; Richardson et al., 2012). This calls for the integration of systemic, trauma-informed care into child welfare services.

1.2. Trauma-informed care for children involved with the child welfare system

Although trauma is prevalent among children involved in the child welfare system, the introduction of evidence-based TIC into the system is a recent phenomenon (Cook et al., 2005; Substance Abuse and Mental Health Services Administration, 2014). TIC in child welfare services focuses on raising the system's awareness of trauma and screening and referring children with trauma concerns to appropriate mental health services (Lang et al., 2015; The National Child Traumatic Stress Network, 2020). It requires work force training and collaborations across child welfare, mental health, and other systems to meet children's service needs at the individual, organizational, and community levels (Lang et al., 2015; Middleton et al., 2019).

NCTSN, established by Congress in 2000, aimed to support the development of TIC through strengthening collaborations between academia and community agencies in the U.S. (Bunting et al., 2019). This has substantially advanced TIC interventions focusing on children involved with the child welfare system (e.g., Agazzi et al., 2019; Bartlett et al., 2016; Bernard et al., 2012; Crosby et al., 2019; Day et al., 2015; Howard et al., 2014; Purvis et al., 2015; Sullivan et al., 2019). The TIC interventions have also gained popularity beyond the U.S. For example, guided by the NCTSN curriculum, Ireland has implemented a TIC-based foster parent training program in its child welfare system (Lotty et al., 2020), and Switzerland has experimented with TIC services in multiple child welfare agencies and aimed for a full implementation of the protocol in their child welfare system within a few years (Schmid et al., 2020).

Several challenges in studying the effectiveness of TIC interventions are worth noting. TIC interventions in child welfare may vary substantially because they often face a number of limitations that affect the implementation process, such as the lack of effective and brief screening measures; workers' limited time to administer the measures; inadequate worker training on trauma; limited availability of trauma-focused services for child referrals; and the concern of workers' secondary traumatic stress (Conradi et al., 2011; also see Lang et al., 2017). Other factors such as lawsuits, union requirements, information system restrains, and staff turnover may also have contributed to the variation in TIC implementation (Middleton et al., 2019). The Family First Prevention Services Act (FFPSA), which was signed into law in 2018, required offering trauma-informed services to child welfare-involved families. However, FFPSA did not define the term “trauma informed,” and thus may be a cause of variation in TIC interpretation and implementation (Middleton et al., 2019).

Besides the aforementioned variations in TIC interventions, studies on TIC interventions vary in aspects such as sample selection, research design, and outcome measurement (e.g., Bartlett et al., 2016; Bernard et al., 2012; Day et al., 2015; Lotty et al., 2020; Spehr et al., 2019; Topitzes et al., 2019; Wood et al., 2019). Many of these studies used a small local sample, which limits statistical power to assess potential intervention effects and finding generalizability. Further, there is a dearth of research assessing how TIC interventions affect child wellbeing (Lang et al., 2017). It is therefore important to systematically review and synthesize the findings to estimate TIC interventions' overall effect on the wellbeing of children involved with the child welfare system, while examining factors that may contribute to the variation of the effect.

1.3. Current research

Despite that increasing research has examined TIC interventions in child welfare, findings from individual studies often have limitations in generalizability, and variations across studies further complicate finding interpretation. Recently, Bunting et al.'s (2019) review study summarized features of TIC interventions in the child welfare system, but the narrative review cannot synthesize

intervention effects.

In response to the knowledge gaps, the current systematic review and meta-analysis aims to answer the following questions: a) What are the features of child welfare-related TIC interventions and evaluation studies?; b) How do these TIC interventions affect child wellbeing measured by a compound indicator and more specific indicators (i.e., PTSD reduction and behavioral problem reduction)?; and c) What factors moderate the effect of these TIC interventions on child wellbeing?

2. Method

2.1. Study selection

We used multiple databases including Academic Search Premier, PsychInfo, and SocIndex to search for relevant articles, which was further supplemented by a search through Google Scholar and article references. Because empirical research on TIC interventions in the child welfare field generally appeared after 2010, we limited the search timeframe from 2010 to present. A series of keywords were used for the search, including *child welfare OR child maltreatment OR child abuse and neglect AND trauma informed care, trauma informed practice, trauma informed approach, trauma informed program, trauma informed strategy, trauma informed treatment*. To be eligible for inclusion, a study should meet the following criteria in the screening process: a) evaluating a TIC intervention concerning children involved with the child welfare system (including children adopted from the child welfare system); b) using an experimental or quasi-experimental design that compared an intervention status with a non-intervention status; c) measuring outcomes related to child wellbeing, including emotional and behavioral wellbeing, and child welfare system performance outcomes such as child safety, permanency, and foster care reentry; d) reporting necessary statistics for effect size calculation; and e) published in a peer-reviewed journal in English.

The search through the academic databases resulted in 1215 records, which yielded 922 records after removing duplicates. Through title and abstract screening, 797 records were excluded and 125 articles were retrieved for full-text review. Additionally, 21 full-text articles were identified through a search in Google Scholar and article references, resulting in a total of 146 articles for full-text review. Two researchers independently reviewed the full-text studies, and finally, 15 eligible studies were identified and included in the meta-analysis.

2.2. Data extraction

An electronic form was developed for data collection from the eligible studies. Two researchers conducted the data extraction independently. When there were discrepancies in the extracted information, the source data were further reviewed to reach an agreement on the data. Among the 15 studies, 10 studies' effect sizes were derived from means (Bartlett et al., 2016; Crosby et al., 2019; Day et al., 2015; Hodgdon et al., 2013; Howard et al., 2014; Lotty et al., 2020; Purvis et al., 2015; Strolin-Goltzman et al., 2018;

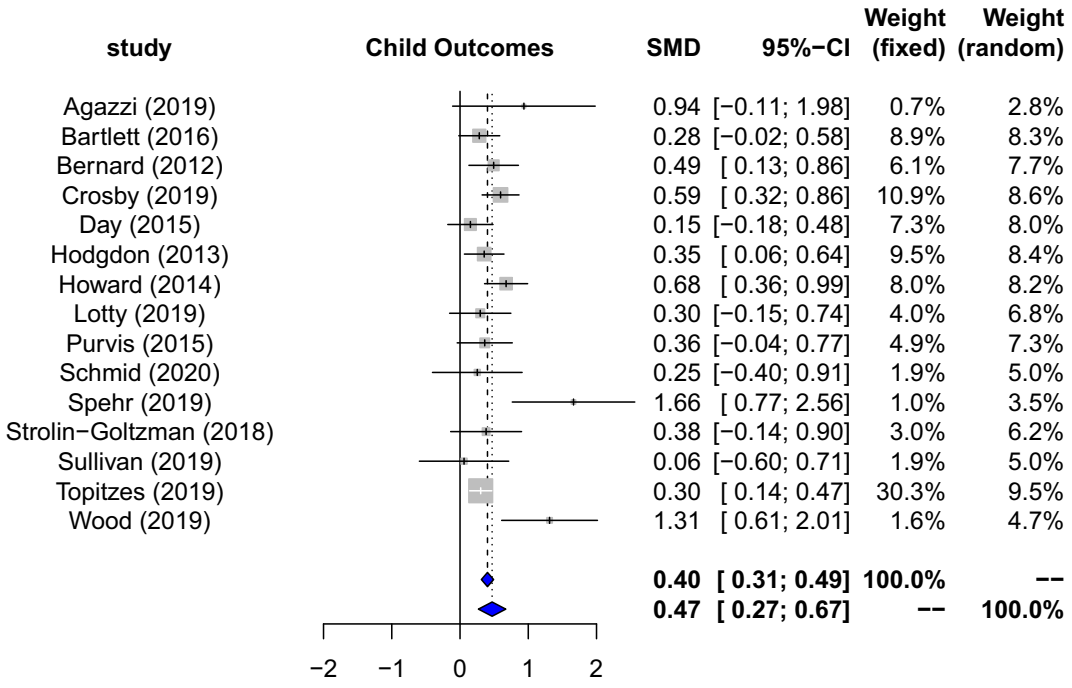

Fig. 1. Intervention effect estimation Note. Studies were presented with the first author and publication year for conciseness.

Table 1
Narrative summary of intervention and study characteristics[a].

Study[b]	Sample	Intervention & outcome[c]	Limitation	Implication
Agazzi et al. (2019)	Parent-child dyads (n = 8) in a child welfare program receiving early intervention services from five providers who were under training and supervision of the trauma-informed behavioral parenting practices.	IV: Trauma-Informed Behavioral Parenting, which first provided 9-hours training through video watching, content review, and role-play to early intervention providers; next, the early intervention providers attended monthly 1-hour live supervised training. OC: PTSD; child behavioral problems	Small sample; recruitment difficulty due to newness of the program; inclusion of children younger than 1.5 years old may affect outcome assessment validity; participants may have selection bias due to low response rate.	The need of a randomized controlled trial with a large sample to assess the program effect; testing the program effect on children with prominent psychological and behavioral problems; use of more extensive child behavioral measures; a longer start-up phase in program implementation to improve enrollment.
Bartlett et al. (2016)	Children and their caregivers received the interventions (n = 326).	IV: The Massachusetts Child Trauma Project (MCTP) is a 5-year statewide systems-improvement initiative with a focus on (1) training in child welfare; (2) Evidence-based treatment dissemination; and (3) systems integration. OC: PTSD; behavioral problems	No appropriate tool to assess systemic improvements based on TIC intervention; some outcome measures may be subject to respondent bias; fidelity data not collected to assess model adherence; no precise measure of evidence-based referral by child welfare workers because of child welfare labor union restriction.	The TIC approach necessitates and strengthens the collaboration across child welfare, mental health, and other systems; the need for policies and programs to address barriers to TIC, including secondary stress, burnout, and turnover in both child welfare and mental health systems; further enhanced collaboration across relevant federal agencies; development of effective tools to measure systemic improvements.
Barto et al. (2018)[d]	Children in the state child welfare system (n = 91,253) during October 2012 to September 2013; 55,145 children received the intervention and 36, 108 were in the comparison group.	IV: The Massachusetts Child Trauma Project (MCTP) OC: Child maltreatment; out-of-home placements; and permanency	Propensity score matching reduced inequivalence between the intervention and comparison groups, but not all relevant variables can be controlled; cannot distinguish children who received clinical treatment from those who did not to assess outcomes on the treatment group; cannot identify specific components' contribution to the outcomes.	TIC intervention is essential to improve the wellbeing of children in child welfare; the intervention promotes strong collaboration across child welfare and other systems, and led to practice change at multiple levels; the need of an effective tool to assess system change outcomes; the need to identify individual program components' effectiveness.
Bernard et al. (2012)	Children (n = 120) between 1.7 and 21.4 months of age at time of participation and their parents (n = 113) who were randomized into the intervention (n = 60) and control groups (n = 60).	IV: The comparison of Attachment and Biobehavioral Catch-up (ABC, intervention) relative to Developmental Education for Families (comparison). ABC is aimed to promote positive parenting among parents with child maltreatment risks, and both interventions consisted of ten 1-hour weekly sessions. OC: Secure attachment; disorganized attachment	No child maltreatment history information that may affect effectiveness; the Strange Situation Procedure used to assess attachment for children beyond 2 years old extends beyond its validity range.	The intervention is effective in promoting organized and secure attachment outcomes among the targeted at-risk children.
Crosby et al. (2019)	Court-involved girls who were 14 to 18 years old who were in out-of-home placement and enrolled in a public charter high school affiliated with a large child welfare agency in 2012 to 2015; sample was limited to those who completed both pre- and post-tests (n = 109).	IV: Training of schoolteachers and staff members based on an adapted curriculum of The Heart of Learning and Teaching: Compassion, Resiliency, and Academic Success (HLT). The intervention was initiated with a half-day training, followed by a 2-hour/monthly booster trainings throughout the academic year. In addition, a Monarch Room was used as an alternative to disciplining to increase seat time and attendance. OC: PTSD	Small sample; not being able to trace students for more than one year because of high turnover; large variability across groups in each academic year, and no relevant information was available to account for the heterogeneity in the models; fidelity data were not appropriate for analyses.	Attention to these at-risk girls social and emotional wellbeing is paramount for their learning and other wellbeing; TIC training is generally absent from the curriculums for teachers teaching the at-risk youth, which should be enhanced; the need of cross-system support in the school to identify and refer the youth to needed services.

(*continued on next page*)

Table 1 (*continued*)

Study[b]	Sample	Intervention & outcome[c]	Limitation	Implication
Day et al. (2015)	Court-involved girls who were 14 to 18 years old who were in out-of-home placement and enrolled in a public charter high school affiliated with a large child welfare agency during 2012 to 2013; sample was limited to those who completed both pre- and post-tests ($n = 70$).	IV: Same as that of the Crosby, but the implementation period was 2012 to 2015. OC: PTSD	Small sample and no comparison group; data was collected by school counselor due to budget limitation, which may bias responses; the transient nature of court-involved youth resulted in small pre-post- match ups.	TIC training can help educators and school staff help mediate these youths' struggles living with unprocessed traumatic memories; Trauma sensitivity should be integrated into teaching.
Hodgdon et al. (2013)	Female youth ($n = 126$) who received services from one of two residential programs (described in the next column).	IV: Attachment, Self-regulation and Competency (ARC) framework implemented at two residential treatment settings serving female youth aged 12 to 22 years old. One setting implemented ARC through individual sessions and 16 "Grow Strong" group sessions. The other setting implemented ARC through 1-h individual sessions and 22 "Stepping Stones" group sessions. The main goal of the project was to teach youth and staff about the impact of trauma in order to create a trauma informed service environment. OC: PTSD; behavioral problems	Change in outcomes was modest in clinical perspective; naturalistic rather than experimental design may weaken the power in detecting intervention effect; fidelity can be a concern, as the intervention was not implemented universally across all clients.	TIC training may contribute to the positive child outcomes, and may also result in substantial reduction in controversial practices (e.g., use of physical restraint and seclusion); future research can compare the intervention model with other TIC models for their efficacy.
Howard et al. (2014)	Parents of children of an open case in an adoption preservation program ($n = 82$).	IV: Trust-Based Relational Intervention (TBRI) that focuses on trauma-informed practice in addition to traditional postadoption services; therapy consisted of 15 to 20 weekly/bi-weekly in-home sessions for 1 or 2 h. OC: Psychiatric rating; global assessment	One group pre- and post-test design without a comparison group may threat internal validity; not measuring the level of parental investment in children and how that was related to outcomes.	The intervention can be integrated into post-adoption service programs; future research should assess how the intervention contributes to parental investment in children.
Lotty (2020, Ireland)	Foster parents from two child welfare agencies in Ireland, with one for intervention ($n = 42$), and another for control ($n = 24$); the parents reported perceived child outcome change.	IV: Fostering Connections (aligned with NCTSN) is a manualized trauma-informed psychoeducational intervention, which is facilitated by two trained practitioners and one trained foster caregiver over 6 weekly sessions (3.5 h/session) in a community setting. OC: Difficulty scale including emotional problems, conduct problems, hyperactivity, and peer problems; prosocial behavior	Small sample and may have selection bias; lack of a matched comparison group in the design may reduce internal validity; substantial participant attrition; caregiver self-report data may have bias; program contents may be more suitable for parents of younger children.	Findings evidence the effectiveness of the TIC intervention program based on NCTSN curriculum in the context of Ireland child welfare system.
Purvis et al. (2015)	Adopted children of adoptive parents ($n = 96$) who responded to a research recruitment notice concerning educating responsive strategies of adoptive children with adversary histories. Participants were randomized into an intervention (n = 48) and control group ($n = 48$), with the control group receiving delayed intervention.	IV: Trust-Based Relational Intervention (TBRI), a trauma-informed, attachment-based parent training intervention aimed at reducing behavioral problems and trauma symptoms in at-risk adopted children. The intervention consisted of 4-day parent training (6 h/day) to improve behaviors of children with trauma histories. OC: PTSD; behavioral and emotional difficulties	Participants consisted of volunteers interested in learning strategies to improve outcomes for adopted children; sample may not be representative because participants need to have time and means to travel to the training for 4 days for training; caregivers' report of child behavior may have bias; assessing short-term rather than long-term change.	Future research can consider measuring child behavior with more improved methods; long-term follow-up of child outcomes.
Schmid (2020, Switzerland)	Children in 14 youth welfare institutions, reported by workers of these institutions	IV: Training to implement and support TIC in youth welfare institutions over three consecutive	Small sample; large attrition due to work turnover or other reasons in four years (67%	TIC practices reduced physiological stress and client physical

(*continued on next page*)

Table 1 (*continued*)

Study[b]	Sample	Intervention & outcome[c]	Limitation	Implication
	who had completed data (n = 18 for intervention, and n = 29 for control).	years (six 3-day trainings for the management and counsellors, eight 2.5-day trainings for the youth welfare staff), and full implementation of TIC procedures by the third year. OC: Physical aggression	attrition rate); imbalance between intervention and comparison groups (e.g., gender difference); fidelity of implementation was uncertain.	aggression toward workers; child welfare agencies should invest in staff TIC training; the intervention model may be extended to broader youth population; TIC individual components' contributions to the outcomes should be studied.
Spehr et al. (2019)	All children from one month to three years old who entered out-of-home care three months before and after the project was implemented (n = 94); 52 children were in the pre-protocol group and 42 children were in the post-protocol group.	IV: The Ages and Stages Questionnaire: Social Emotional-2 (ASQ:SE-2) screening tool was implemented in a child welfare agency for three months in order to improve the identification of social-emotional problems in children at risk for child trauma, which was expected to increase referral to mental health services. OC: Social–emotional concerns	Small sample that lacked generalizability; parent consent can be a barrier to child health outcome assessment; assessment was based on a single nurse practitioner working in the child welfare agency.	TIC training to pediatric nurse practitioners positioned in the child welfare system is beneficial; protocol should be set to screen children involved in the child welfare system for social-emotional concerns regardless of age; enhancing collaboration across child welfare, medical and mental health system; large scale evaluation study needed.
Strolin-Goltzman et al. (2018)	Foster children cared by resource parents (n = 60) who participated in a trauma informed parenting training pilot program.	IV: Training based on the curriculum of Resource Parent Management Training (RPC+). The RPC+ is a trauma informed and skills-based training focused on ameliorating child behavior problems that are frequently the source of parenting stress and placement instability. The RPC+ consisted of 10 weekly sessions (2.5 h/session). OC: Child behavioral problems	Small sample; lack of a comparison group may threat internal validity of the intervention effect assessment; about 50% attrition in the post-test; child outcome report based on caregivers, which may have bias.	The findings warrant continued investigation into the intervention effectiveness; more robust research design to assess the intervention effect.
Sullivan et al. (2019)	Children of forty-five resource caregivers (foster, adoptive, kinship caregivers) in intervention (n = 20) or a comparison group (n = 25).	IV: Trauma-Informed Parenting Skills training in addition to training based on technology enhanced NCTSN's Resource Parent Curriculum. OC: Emotional, conduct, hyperactivity/inattention, and peer problems; prosocial behavior	Not randomized control trial design which weakens the causal inference; inequivalence between the intervention and comparison groups; fidelity was measured but was low, particularly for assigning homework; child behavior change may be underreported because the measurement manner may cause some confusion.	The supplemental training added to the parent training is promising – in addition to raising caregivers' TIC awareness and skills; regular use of the smartphone app as an intervention tool likely facilitate training; the need of improving implementation fidelity especially homework assignment.
Topitzes et al. (2019)	Children in out-of-home care during 2014 and 2016 and served by a state child welfare agency's trauma-responsive program (n = 321) and a comparison as usual program (n = 277).	IV: Intervention involved four components: trauma-informed training for workers, application of trauma-informed assessments to service-involved children, trauma-informed case planning, and specialized supervision and consultation. OC: Maltreatment recurrence; out-of-home placement; permanent placement; case closure; child welfare service length in days	Quasi-experimental design and potential inequivalence between intervention and comparison groups; program team members interacted with each other which may cause compensatory demoralization and contagion that can affect results; children had different observation periods in the one-year sample because of the variation in entering the child welfare system.	Future research should collect data at follow-up periods to understand long-term intervention effect; standardizing the intervention with manual for implementation fidelity; enhancing cross system collaboration and engage workers from multiple systems for the training.
Wood et al. (2019)	Children who newly entered two foster care agencies and whose caregivers were exposed to intervention (n = 19), and children from the same agencies before the intervention for comparison (n = 27).	IV: Child–Adult Relationship Enhancement (CARE), a trauma-informed 6-hour training aimed to decrease child behavioral problems, was implemented at the agencies. OC: Child behavioral problems (CBCL)	Small sample; sample only consisted of children newly entered into the child welfare system and may be less representative; intervention and comparison group may be inequivalent; baseline child behavior assessment indicating mostly mild behavior problems, which may not sufficiently reflect intervention effect; some caregiver change may result in interrater reliability issue.	Intervention is promising by substantially reducing externalizing and internalizing behaviors, and child placement disruptions; further assessing intervention effect by age and severity of behavior problems; a concern with the intervention is that it may discourage child welfare agencies from investing in more intensive evidence-based interventions or referring to such interventions.

[a] All studies applied one group or two-group pretest and posttest or additional follow-up tests. For consistency, only intervention group's pretest and posttest or follow-up tests were used; a follow-up rather than post-test would be used if the attrition is minimal.
[b] Studies were presented by the first author and publication year for conciseness; all studies were conducted in the U.S. except for Lotty et al. (2020, Ireland) and Schmid et al. (2020, Switzerland).
[c] Here only child relevant outcomes were included. IV = intervention; OC = outcome.
[d] Barto et al. (2018) study was not included in the meta-analysis because the sample is excessively large compared with that of other studies.

Sullivan et al., 2019; Wood et al., 2019), four from events/odds ratios (Bernard et al., 2012; Schmid et al., 2020; Spehr et al., 2019; Topitzes et al., 2019), and one from Cohen's *d* (Agazzi et al., 2019). All of the studies' effect sizes were converted to Hedges' *g* for meta-analyses (Borenstein et al., 2009). In the case that multiple indicators were used to measure one focusing outcome (e.g., PTSD or behavioral problems), these multiple indicators were considered to calculate an aggregated effect size (Borenstein et al., 2009).

In addition to collecting statistics for effect size estimation, we collected information on sample characteristics, intervention features, research design, outcomes, location, publication year, and study limitations and implications. We further recoded some of the information as moderators to test if the TIC intervention effects vary across intervention and study characteristics.

2.2.1. Child wellbeing indicators

Among the included studies, child psychological and behavioral outcomes were most commonly measured to evaluate the TIC interventions' effect on child wellbeing. If a study specifically measured child PTSD symptoms or child behavioral problems, the child wellbeing indicators would be categorized as PTSD reduction or child behavioral problem reduction. Other child psychological wellbeing measures (e.g., secure attachment, psychiatric rating, prosocial behavior, behavioral and emotional difficulties) would be counted as a separate category "other psychological wellbeing improvement" (see Fig. 1). In addition, a few studies assessed TIC interventions' effects on child welfare system performance outcomes such as child safety, permanency, and foster care reentry (Barto et al., 2018; Topitzes et al., 2019). Because Barto et al.'s study was excluded due to an excessive weight, no subgroup meta-analysis was done for this category.

2.2.2. Female child proportion

Based on the proportion of female children in the study samples, a dichotomous variable was created to indicate whether a study had a sample with 50% or more (vs. less than 50%) female children. For three studies that did not report child sex information, we referred to plausible information (e.g., the local or state corresponding population [e.g., foster care children]'s demographic information) to impute the missing data. This imputation method was used for all missing data henceforth.

2.2.3. Child mean age

This was based on a study sample's age information. Two studies did not report age information.

2.2.4. Minority child proportion in a sample

In the U.S. studies, the proportion of children with minority status referred to the proportion of children who identified as anything other than non-Hispanic white in a sample. Four studies using the U.S. samples did not report child race/ethnicity information. In the two studies in Ireland and Switzerland (Lotty et al., 2020; Schmid et al., 2020), the information was based on the nation's proportion of non-Irish (15%) or non-Swiss (30%) ethnic population. The variable was dichotomized to indicate whether a study had a sample with less than 60% (vs. 60% or more) of children of minority group status.

2.2.5. Intervention setting/target participant

TIC interventions usually target service workers in a specific setting (e.g., system, agency) or resource parents (e.g., foster parents and adoptive parents) for training or other interventions. The target settings or participants were categorized into three types: child welfare system/agency, non-child welfare agency, and resource parents.

2.2.6. Maximal length of observation

This referred to the maximal length between TIC implementation and the post-test or follow-up test. It was categorized into three periods: $\leq$6 months, 7 to 12 months, and $>$ 12 months.

2.2.7. Sample size

This was based on the sample size used in the post-test or follow-up test. Some TIC intervention participants may not participate in both the pre- and post-test or follow-up test, so the final sample size may be smaller than the initial sample size. The sample size was categorized into three levels: $<$30 participants, 30 to 100 participants, and $>$ 100 participants.

2.2.8. Location and publication year

Location was coded as U.S. vs. non-U.S., and publication year was coded as 2012 to 2018 vs. 2019 and later.

2.3. Analytical methods

We first presented descriptive information of the included studies in Table 1. Secondly, we conducted meta-analyses to estimate the pooled effect of TIC interventions based on the compound child wellbeing indicator using both fixed-effect and random-effects models. The fixed-effect model assumes that there is a common true effect underlying the distribution of individual effects, while the random-effects model assumes that each individual effect reflects the distribution of a unique true effect and estimates the average of the unique effects (Borenstein et al., 2009). When between-study heterogeneity is substantial, a random-effects model is recommended (Borenstein et al., 2009; Higgins & Green, 2019). Our findings relied on results from random-effects models, but we also offered results from fixed-effect models as a reference when estimating the effect based on the compound child wellbeing indicator. Thirdly, we performed a series of subgroup analyses to assess whether TIC intervention effects varied by specific outcome indicators as well as intervention and study characteristics. Finally, we used a funnel plot and Egger's test to assess whether there was a publication bias among the included studies. Barto et al.'s (2018) study is a rare one that assessed a TIC intervention's effect on child welfare system performance outcomes, but the study's large sample size reesulted in a large weight (~ 60%) in the meta-analysis models. The study was presented in Table 1 but was excluded from meta-analyses to avoid estimation bias.

3. Results

3.1. Intervention and study characteristics

Table 1 presents intervention and study characteristics as well as limitations and implications for each included study, while Table 2 presents their quantitative summary. Among the 15 studies, two thirds (67%) had a sample with less than half male participants, the majority (60%) had a sample with children younger than 10 years old, and nearly half (47%) had a sample with minority children accounting for 60% or more. When examining the intervention settings or target participants, over half (54%) of the interventions targeted child welfare systems or agencies, about one quarter targeted non-child welfare service agencies such as community mental health agencies, and one fifth (20%) targeted resource parents. Over half (53%) of the studies had a maximal observation period up to 6 months, one quarter (27%), 7 to 12 months, and one fifth (20%), longer than 12 months. Slightly less than half (40%) of the studies had a sample size less than 30 children, one third (33%), 30 to 100 children, and one quarter (27%), more

Table 2
Intervention and study characteristics for subgroup meta-analyses[a].

Variable	N	%	Sample size (pre-test)[b]	Sample size (post-test)[b]
Boy %[c]				
<50%	10	67	426	337
≥ 50%	5	33	648	663
Age (year)				
<10	9	60	512	391
≥ 10	6	40	562	609
Minority %				
<60%	8	53	801	724
≥ 60%	7	47	273	276
Intervention setting/target participant				
Child welfare system/agency	8	54	790	716
Non-child welfare agency	4	27	168	168
Caregiver	3	20	116	116
Maximum length of observation				
≤6 months	8	53	535	417
7 to 12 months	4	27	206	206
>12 months	3	20	333	377
Sample size[d]				
<30	6	40	120	123
30 to 100	5	33	299	299
>100	4	27	655	578
Nation				
Non-U.S.	2	13	57	57
U.S.	13	87	1017	943
Publication year				
2012 to 2018	7	47	559	438
2019 to 2020	8	53	515	562

[a] Barto et al. (2018) study was not included in the meta-analysis because the sample size was excessively large compared with that of other studies, which may bias the estimation.

[b] For consistency, only the intervention group's pre- and post-tests will be used for the effect size calculation in the meta-analysis, even though a study may use a two-group pre-and post-test design.

[c] If children's demographic information on male proportion, age, and minority proportion was not available, the missing value was imputed based on the best available information, such as caregivers' race/ethnicity, or the population's characteristics in a relevant region.

[d] The sample size here refers to the sample size of the posttest or follow-up test.

than 100 children. Except for two studies, all other studies (87%) were conducted within the U.S., and more than half (53%) were published in or after 2019 (Table 2).

3.2. Meta-analysis results

3.2.1. Meta-analyses based on the compound child wellbeing indicator

Fig. 1 displays the effect of TIC interventions based on the compound child wellbeing indicator. Among these 15 studies, 6 had an effect size that is statistically significant. Both fixed-effect model (standardized mean difference [SMD] = 0.40, 95% confidence interval [CI] = [0.31, 0.49], $I^2 = 0.46$) and random-effects model (SMD = 0.47, 95% CI = [0.27, 0.67]) generated a similar pooled effect estimate. The effect sizes were moderate and statistically significant.

3.2.2. Subgroup analyses based on the compound child wellbeing indicator

Table 3 shows how intervention and study characteristics may moderate intervention effects based on subgroup analyses. Studies having more male children (SMD = 0.58, 95% CI = [0.24, 0.91], $I^2 = 0.43$ for ≥ 50% male; SMD = 0.40, 95% CI = [0.19, 0.6], $I^2 = 0.43$ for <50% male), younger children (SMD = 0.53, 95% CI = [0.24, 0.82], $I^2 = 0.48$ for <10 years old; SMD = 0.41, 95% CI = [0.23, 0.59], $I^2 = 0.53$ for ≥ 10 years old), and more minority children (SMD = 0.65, 95% CI = [0.22, 1.09], $I^2 = 0.75$ for minority ≥ 60%; SMD = 0.38, 95% CI = [0.26, 0.51], $I^2 = 0$ for minority <60%) had larger effect sizes. TIC interventions implemented in the child welfare system/agency (SMD = 0.53, 95% CI = [0.19, 0.87], $I^2 = 0.66$) had a larger effect size than those implemented in a non-child welfare agency (SMD = 0.42, 95% CI = [0.17, 0.67], $I^2 = 0.21$) and with resource parents (SMD = 0.48, 95% CI = [0.26, 0.69], $I^2 = 0$). Studies with a maximum observation period of 7 to 12 months (SMD = 0.65, 95% CI = [0.17, 1.14], $I^2 = 0.71$) had a larger effect size than those with a shorter (≤ 6 months; SMD = 0.47, 95% CI = [0.21, 0.74], $I^2 = 0.43$) or longer (>12 months; SMD = 0.30, 95% CI = [0.28, 0.32], $I^2 = 0$) observation period. Studies with a smaller sample size had a larger effect size than those with a larger sample size (SMD = 0.71, 95% CI = [0.24, 0.32], $I^2 = 0.65$ for <30 participants; SMD = 0.41, 95% CI = [0.21, 1.22], $I^2 = 0.28$ for 30 to100 participants; SMD = 0.37, 95% CI = [0.22, 0.59], $I^2 = 0.17$ for more than 100 participants). Studies out of the U.S. (SMD = 0.28, 95% CI = [0.24, 0.51], $I^2 = 0$) had a smaller effect size than those in the U.S. (SMD = 0.50, 95% CI = [0.29, 0.71], $I^2 = 0.53$). Studies published during 2012 to 2018 (SMD = 0.38, 95% CI = [0.26, 0.51], $I^2 = 0$) had a smaller effect size than those published in or after 2019 (SMD = 0.60, 95% CI = [0.23, 0.97], $I^2 = 0.65$).

3.2.3. Meta-analyses based on specific child wellbeing indicators

Fig. 2 displays meta-analysis results based on specific child wellbeing indicators including child PTSD symptom reduction,

Table 3
Subgroup meta-analysis of tic interventions' effects[a].

Group variable	k	SMD	95% CI	Q	I^2
Boy %					
<50%	8	0.40	[0.19, 0.6]	12.37	0.43
≥ 50%	7	0.58	[0.24, 0.91]	10.51	0.43
Age (year)					
<10	10	0.53	[0.24, 0.82]	17.27	0.48
≥ 10	5	0.41	[0.23, 0.59]	8.46	0.53
Minority %					
<60%	9	0.38	[0.26, 0.51]	6.08	0
≥ 60%	6	0.65	[0.22, 1.09]	19.80	0.75
Intervention setting/target participant					
Child welfare system/agency	8	0.53	[0.19, 0.87]	20.29	0.66
Non-child welfare agency	4	0.42	[0.17, 0.67]	3.82	0.21
Caregiver	3	0.48	[0.26, 0.69]	1.05	0
Maximal length of observation					
≤6 months	8	0.47	[0.21, 0.74]	12.24	0.43
7 to 12 months	4	0.65	[0.17, 1.14]	10.51	0.71
>12 months	3	0.30	[0.28, 0.32]	0.02	0
Sample size[b]					
<30	6	0.71	[0.24, 0.32]	14.10	0.65
30 to 100	5	0.41	[0.21, 1.22]	5.54	0.28
>100	4	0.37	[0.22, 0.59]	3.61	0.17
Nation					
Non-USA	2	0.28	[0.24, 0.51]	0.01	0
USA	13	0.50	[0.29, 0.71]	25.50	0.53
Publication year					
2012 to 2018	7	0.38	[0.26, 0.51]	6.00	0
2019 to 2021	8	0.60	[0.23, 0.97]	19.80	0.65

[a] If children's demographic information on male proportion, age, and minority proportion was not available, the missing value was imputed based on the best available information, such as caregivers' race/ethnicity, or the population's characteristics in a relevant region.
[b] The sample size here refers to the sample size of the posttest or follow-up test.

behavioral problem reduction, and other psychological wellbeing improvement. Six studies contained PTSD measures, and the meta-analysis yielded a pooled effect which is moderate and statistically significant (SMD = 0.37, 95% CI = [0.03, 0.71], $I^2 = 0.42$). Seven studies contained behavioral problem measures, and the meta-analysis yielded a pooled effect which is moderate and statistically significant (SMD = 0.52, 95% CI = [0.24, 0.80], $I^2 = 0.22$). Seven studies contained other child psychological wellbeing measures than specified PTSD and behavioral problems, and the meta-analysis yielded a pooled effect which is moderate and statistically significant (SMD = 0.45, 95% CI = [0.02, 0.88], $I^2 = 0.61$).

3.3. Publication bias assessment results

Fig. 3 presents the funnel plot for publication bias assessment. The funnel plot appears to have an asymmetrical distribution which may indicate publication bias. To further assess the publication bias, we conducted Egger's modified test. The test results show that the null hypothesis, that there is no small study effect (publication bias), is rejected ($t = 6.31$, $p < 0.001$), indicating that publication bias is possible.

4. Discussion

This meta-analysis study is the first one to synthesize TIC interventions' effect on the wellbeing of children involved with the child welfare system. The findings indicate that TIC interventions yield a moderate effect on child wellbeing, and this effect is generally robust when examined with specific indicators including PTSD symptom reduction, behavioral problem reduction, and other psychological wellbeing improvement. Furthermore, subgroup meta-analyses show that intervention and study characteristics moderate the intervention effect.

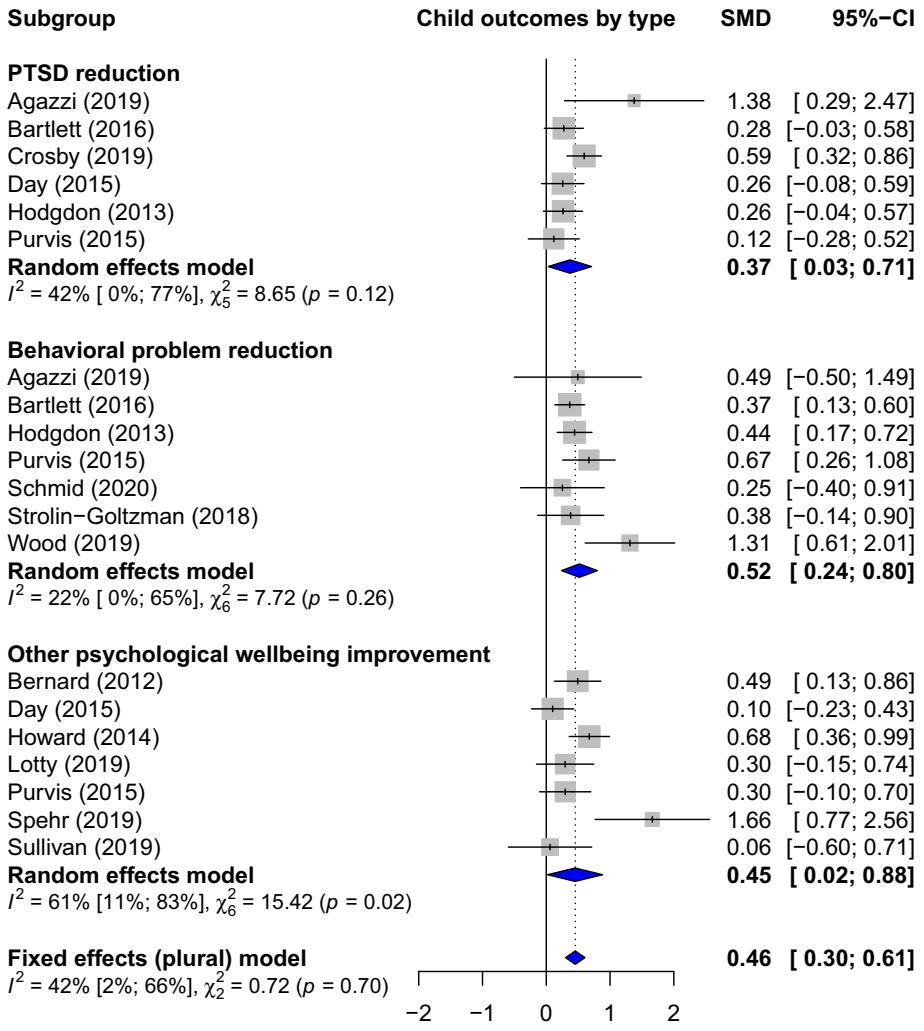

Fig. 2. Intervention effect estimation by type of measures Note. Studies were presented with the first author and publication year for conciseness.

4.1. Study and intervention characteristics

A small sample size is common among the included studies and is well recognized (Agazzi et al., 2019; Crosby et al., 2019; Day et al., 2015; Spehr et al., 2019; Strolin-Goltzman et al., 2018; Wood et al., 2019). Nearly half of the included studies had a sample size fewer than 30 participants, and only one quarter had more than 100 participants. Small samples may raise concerns about selection bias and a lack of generalizability and may fail to detect an intervention effect due to low statistical power. TIC interventions' experimental nature may be the major reason for the small samples. Except for one study that examined a statewide intervention (Bartlett et al., 2016; not included in the meta-analysis due to the excessive weight), other included studies typically focused on an intervention at the county or agency level. Furthermore, intervention participants' low participation rates in the evaluation studies and high attrition rates at the post-test or follow-up test reduced the possible sample size (e.g., Lotty et al., 2020; Schmid et al., 2020; Strolin-Goltzman et al., 2018), which may also introduce selection bias. The current meta-analysis aggregated individual studies' statistical power and somewhat made up the sample shortcoming to reach a more generalizable conclusion.

The samples' characteristics— child sex, age, and race/ethnicity—varied substantially. The examined TIC interventions were implemented in both child welfare systems/agencies and non-child welfare agencies, while some others targeting resource parents. However, it is more likely that each of these focuses reflected one aspect of the TIC interventions that typically require cross-system collaborations (Bartlett et al., 2016; Barto et al., 2018).

The maximal length of observation also varied substantially. Worker and/or resource parent training is often the core of TIC interventions, which may be completed in one or a few days' workshops (The National Child Traumatic Stress Network, 2020). In this case, a post-test assessment was often taken a few months after the intervention implementation to measure concerning outcomes (Lotty et al., 2020; Purvis et al., 2015). However, some interventions spread the training hours over a long period of time and accompanied it with practice consultations (Howard et al., 2014), and a few studies spanned multiple years through a progressive training plan (Schmid et al., 2020), which resulted in a long observation period.

Most included studies measured child wellbeing using psychological or behavioral indicators, such as PTSD symptoms, behavioral problems, or other psychological wellbeing indicators. Only two studies assessed how TIC interventions may influence the child welfare system's performance outcomes (e.g., child safety, permanency, and foster care reentry; Barto et al., 2018; Topitzes et al., 2019), which are important but has not received adequate attention in the evaluations.

The accelerating adoption of TIC interventions can be seen from the publication numbers. Over the period from 2012 to 2018, there were only seven studies eligible for inclusion in the meta-analysis, but there were eight studies since 2019. This calls for timely research efforts to synthesize the findings to strengthen the evidence base for TIC interventions' advancement.

4.2. Intervention effect estimation based on meta-analyses

Overall, the pooled intervention effect of 0.47 is approaching the cutoff of the medium effect at 0.5 (Cohen, 1992). When examining intervention effects by specific child wellbeing indicators, the effect on reducing child behavioral problems was more prominent than the effect on the other two indicators (PTSD symptom reduction and the other psychological wellbeing improvement). Most of the included studies evaluated TIC interventions with less than one year of implementation. It is possible that child behavioral problems

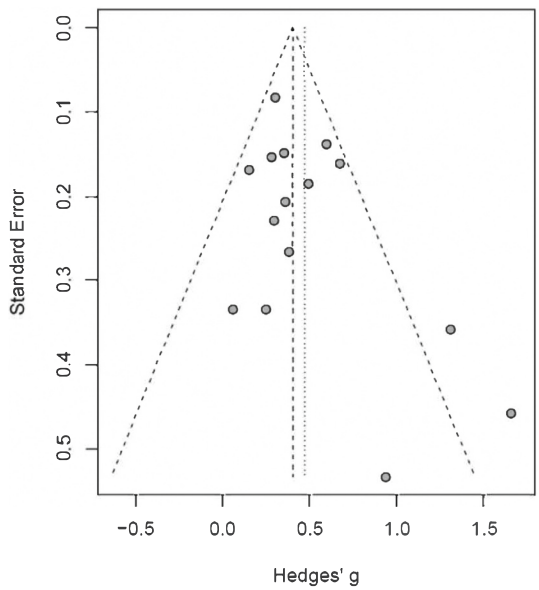

Fig. 3. Funnel plot for publication bias assessment.

are overt and are more likely to be targeted for improvement in a short period of time, while PTSD and other psychological wellbeing aspects may be more profoundly intricate with child trauma experiences so that the treatment and recovery require a longer period of time to achieve a desired outcome (Weber et al., 2021).

Furthermore, the findings based on the subgroup meta-analyses provide a context to understand why and how the effect of TIC interventions may vary. The subgroup meta-analyses show that interventions with a sample characterized by a higher proportion of male, minority, and younger children had a larger effect than interventions with a sample of the counterpart characteristics. This may suggest that male, minority, and younger children are more responsive to TIC interventions than their counterparts. Previous research has shown that some foster care children—especially Black, male, and younger children—are more likely to have unmet mental health service needs than their comparable counterparts (Garland et al., 2003; Leslie et al., 2000). TIC interventions promote trauma awareness, screening, and responsive service delivery. This likely leads child welfare workers and resource parents to pay closer attention to children whose service needs were previously overlooked and subsequently results in more pronounced improvement.

The effect sizes across intervention settings or target participants are similar. It is possible that these study settings/target participants only reflect part of the overall TIC intervention collaboration for children involved with the child welfare system (Bartlett et al., 2016; Barto et al., 2018; The National Child Traumatic Stress Network, 2020). Therefore, the observed effect based on different settings or participants may indeed reflect the collaborative intervention's effect, and thus, is similar.

Interventions that had a maximal observation length of 7 to 12 months have the largest effect size when compared with interventions with a shorter or longer observation period. Possibly the length of 7 to 12 months may allow more adequate time for intervention implementation to achieve a desired outcome than a shorter period, but is not so long as to cause the fadeout of the intervention effect. This may suggest the need to consider follow-up intervention strategies to maintain and enhance intervention effects over time.

The findings show that interventions in the U.S. have a larger effect than interventions in other countries. The small number of studies outside the U.S. in the analysis may not represent the overall intervention effect outside the U.S. It is also possible that TIC interventions in the U.S. have undergone a longer period than those outside the U.S., and the accumulated experiences may contribute to more desired intervention effects.

Finally, the effect size for recently published studies (i.e., 2019 and after) is nearly twice as large as that of earlier published studies (i.e., 2012 to 2018). This is not uncommon for interventions in child welfare or other service areas, likely because the advancement in program development and implementation has contributed to quality improvement over time (Zhang et al., 2019).

4.3. Limitations

There are limitations in the included studies. In addition to the small sample size issue, fidelity was usually not assessed, although, such information is important for understanding TIC interventions' processes and outcomes (Bartlett et al., 2016; Hodgdon et al., 2013; Schmid et al., 2020; Sullivan et al., 2019; Topitzes et al., 2019). Fidelity data collection can be challenging because it requires tackling meticulous practice procedures and may encounter resistance from service workers or the union (Bartlett et al., 2016). Another important limitation is the lack of appropriate measurement instruments, such as instruments used to measure TIC interventions' impacts on child welfare system outcomes (Bartlett et al., 2016; Barto et al., 2018) or young child outcomes (Agazzi et al., 2019; Bernard et al., 2012). Most of the included studies used the one group pre-test and post-test design, which may threaten findings' internal validity (see Table 1).

There are also limitations in the current meta-analysis study. First, although the meta-analysis was able to examine TIC interventions' effects on child emotional and behavioral wellbeing, only two studies (Barto et al., 2018; Topitzes et al., 2019) assessed child welfare system performance outcomes. Barto et al.'s (2018) study was one of them but was excluded from the meta-analysis because of its excessive weight, and therefore we could not conduct meta-analyses on child welfare system performance outcomes. Second, subgroup meta-analyses are informative because it helps to examine moderators and understand intervention effects in context. However, the included studies may report concerning information (e.g., child age, gender, and race/ethnicity) inconsistently, which restricts the construction of moderators. The small number of studies also limit statistical power to test group differences by moderators, which means the group comparison was informal and the effect discrepancies should be interpreted with caution (Higgins & Green, 2019; Thompson & Higgins, 2002). Third, it is noteworthy that a publication bias in favor of positive intervention effects may exist and can bias the effect estimation. Nevertheless, it is also possible that the test results may reflect the distribution of true underlying intervention effect (Egger et al., 1997; Sterne et al., 2000).

5. Conclusion and implication

The meta-analysis study synthesized findings concerning TIC interventions' effects on child wellbeing among children involved with the child welfare system, which allows drawing a more generalizable conclusion to strengthen the evidence base. Findings from the meta-analysis indicate that TIC interventions have a moderate effect on the wellbeing of children involved with the child welfare system. TIC interventions appear to improve all types of examined child emotional and behavioral wellbeing, and the effect on reducing behavioral problems appears to be the most prominent. Additionally, the effect varies across intervention setting/target participant, observation length, sample size, country, and publication year.

The findings have useful implications for research and practice. The small local sample is a common issue in TIC intervention studies. Because a low participation rate coupled by a high attrition rate in research participation is common (Lotty et al., 2020; Schmid et al., 2020; Strolin-Goltzman et al., 2018), future researchers may consider using incentives or other effective strategies to

encourage research participation or collect data from a larger participant pool. To overcome the concern that commonly adopted one-group pre- and post-test design may weaken internal validity when assessing TIC interventions' effects, future studies can further give priority to two or more-group design (Barto et al., 2018). Responding to the lack of fidelity assessment and appropriate measurement instruments in TIC evaluations, TIC resource agencies such as the NCTSN may consider recommending standardized evaluation procedures and measurement instruments to facilitate future research needs. It is also important for future TIC studies to pay more attention to child welfare system performance outcomes such as child safety, permanency, and foster care reentry. Findings from the current study lend support to advancing TIC interventions for children involved with the child welfare system. Future TIC interventions may consider taking into account child characteristics, targeting mental health problems, intervention setting/target participants, and implementation length in program design and implementation.

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