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Research paper

# Effects of in-service programs on childcare teachers' interaction quality: A meta-analysis

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ABSTRACT

Childcare teachers' warm and sensitive responses play a critical role in infant development. Korean in-service systems do not sufficiently support the interaction quality of childcare teachers. This study examined previous in-service programs shown to improve the interaction quality of teachers and calculated the effect sizes of 38 in-service programs reported in Korean and English-language research, and explored their moderating factors. In-service programs had moderate effects on interaction quality, and mixed *workshop-coaching* programs had the largest effect size. Programs shorter than 1 month, or with more than 20 sessions or 4–6 h per session effectively improved interaction quality.



## 1. Introduction

Newborn babies interact with their caregivers through crying, and as they grow, they use diverse behaviors to communicate, such as eye gaze, gestures, and preverbal vocalization (Lee & Sung, 2015; Vallotton, 2009). When caregivers accurately interpret the meaning of the infants' signals and respond sensitively, they form a secure attachment and reliable relationship with infants (Ainsworth, 1964; Bowlby, 1969). In this study, we defined high-quality interactions as caregivers' sensitive responses to infants' cues (Howes et al., 1998) and extended the same concept to non-parental caregivers such as childcare teachers (Colwell et al., 2013).

Ahnert et al. (2006) synthesized studies of the attachment securities of care teachers in childcare centers and of parents, finding that the security of children's attachment to care teachers and parents was significantly related, suggesting that children construct intertwined internal working models with significant adults. When the teacher–child ratio or the group size is small, care teachers' sensitivity is significantly associated with children's attachment security. Given that the sensitivity of non-parental caregivers relates to the secure attachment with children, which acts as the foundation for developing self-regulation (Ereky-Stevens et al., 2018; Pallini et al., 2018), professional development (PD) programs should support childcare teachers in strengthening their professional caring ability to respond sensitively and affectionately to infants.

The Korean parents who participated in the Strange Situation (Ainsworth & Wittig, 1969) approached their infants more immediately in the reunion episodes than Western parents, and these response patterns strengthened the dependence of infants even if they were not distressed (Jin et al., 2012). As infants physically depend on caregivers to engage with the environment and manage their interactions (de Schipper et al., 2007; Jamison et al., 2014), childcare teachers play a critical role in their learning and development. Warm, responsive, and stimulating interactions help infants explore and learn about the world and obtain information about themselves (Blair et al., 2012; Jamison et al., 2014). Pinto et al. (2019) investigated the associations between the quality of teacher–infant interactions and infant outcomes during the first month in an institutional environment. They assessed the quality of teacher–child interactions using a composite of the Infant/Toddler Environment Rating Scale, Revised (ITERS-R), Caregiver Interactions Scale (CIS), and Classroom Assessment Scoring System

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(CLASS). Trained observers assessed infants' engagement during play activities after one month, and teachers rated infants' adaptive behavior after six months in the institution. It was found that high-quality teachers' interactions were positively related to infants' active engagement in the first month and infants' high adaptive behaviors six months later.

Teachers' responsivity is a core component across CLASS domains[2] (Hamre et al., 2014) and is even more important for infants. Infancy is a critical time for establishing a neurobiological foundation (Knudsen et al., 2006) and sensitivity to environmental influences (Lenroot & Giedd, 2011). Given that infants worldwide increasingly spend time with childcare teachers (Balladares & Kankaraš, 2020), their responsiveness, which is related to infants' later developmental outcomes (Colwell et al., 2013), becomes extremely important. The sensitive responses of childcare teachers help infants actively explore and develop their autonomy in a secure environment (Ereky-Stevens et al., 2018; Hamre et al., 2014; Jamison et al., 2014). However, previous studies have reported that the quality of caregiving is lower in classrooms with infants than that of caregiving for older children in Bangladesh (Helmerhorst et al., 2021) and in the Dutch childcare context (de Schipper et al., 2007; Helmerhorst et al., 2015). As infants and toddlers are less able to express their needs and preference than older children, caregivers may have difficulty sensitively interacting with them (Degotardi, 2010). As a note, this study focuses on childcare, which refers to the care given to infants/toddlers by professional and well-trained caregivers rather than the instructional approach followed in kindergarten.

### 1.1. Social and cultural contexts of childcare in South Korea

South Korea is one of the fastest-growing developed countries in the world (B. Howe, 2020). It has rapidly transformed from an agriculture-based economy in the 1960s to the 10th largest economy globally today (The World Bank, 2020). Moreover, with women actively joining the workforce, the traditional role of mothers has changed. To support maternal employment, the Korean government has invested in childcare services and staff quality and expanded the budget for childcare policy (Choi, 2016). Thus, the number of kindergartens and childcare centers and the number of children attending early childhood institutions have increased (Moon & Landsberg, 2018). A recent survey reported that about 76% of infants[3] in Korea attended childcare centers (Ministry of Health and Welfare [MHW], 2022) and spent an average of 7 h and 24 min a day in childcare settings (MHW, 2019a). About 94% of 2-year-old infants were registered in childcare centers. On average, 36% of children aged 0–2 years in the Organisation for Economic Co-operation and Development (OECD) countries are enrolled in Early Childhood Education and Care (ECEC), and the enrollment rate in Korea was found to be the highest (OECD Family Database, 2021).

However, Korean parents are not very satisfied with private and home childcare centers, which correspond to 76% of all childcare center types (MHW, 2019a). Childcare teachers working at private and home childcare centers live in poorer conditions (due to low salaries) than those in other types of centers (MHW, 2019b). Owing to cases of extreme maltreatment of infants by childcare teachers, questions are being raised regarding childcare quality (Lee & Sung, 2022). Some studies also report that Korean childcare teachers have difficulties interacting with children. For instance, Y. E. Kim (2018) interviewed childcare teachers with different working experiences. Regardless of the work experience, all the teachers experienced difficulties while interacting with children who had special needs or showed problematic behaviors. Lim et al. (2018) observed teachers' interactions with infants in the classroom and reported that teachers faced difficulties due to the differences between theory and practice. While teachers recognized the importance of sensitively responding to infants, they could not put it into practice effectively.

A cross-cultural study comparing the preschool quality of Korea and Sweden revealed that Swedish childcare programs were rated higher on the entire Early Childhood Environment Rating Scale (ECERS) and all the individual subscales than Korea (Sheridan et al., 2009). Byun et al. (2022) investigated the cultural difference in the responsiveness between Korean and American teachers in ECEC centers. The latter demonstrated more positive responsiveness and social guidance than the former; the Korean teachers often reacted negatively to children's negative emotions. As Korean culture is based on Confucian values, in which teachers have the authority to discipline children, teachers are more likely to direct children and use strict discipline (Y. H. Kim & Stormont, 2016). Korean teachers, therefore, need to be better trained to interpret infants' needs accurately and interact positively with them.

### 1.2. Necessity of effective in-service programs for childcare teachers in South Korea

Disparities exist between childcare centers and kindergartens in Korea,[4] with childcare teachers having a low entry qualification system and less training than kindergarten teachers (Moon & Landsberg, 2018). A childcare teacher is only required to complete certain requisite units regardless of major; therefore, the pathway for qualifying as a childcare teacher is diverse (Korea Childcare Promotion Institution [KCPI], 2022). The certification is divided into three levels, and the lowest level of certification can be acquired by completing 1 year at the teacher training center after high school graduation. To supplement this low entry qualification for childcare teachers, effective in-service programs should be frequently implemented to improve the quality of childcare. Given the short term of the childcare practicum (e.g., 240 h) during the pre-service program, the in-service programs should include practical interactions with children (M. S. Kim, 2014).

Several studies suggest that ongoing in-service programs effectively improve the interaction quality of teachers working in the field of ECEC (Egert et al., 2018; Norris, 2001; Perren et al., 2017; Schachter, 2015). Although formal and mandated in-service programs have been implemented in Korea, experts have pointed out that the current in-service system cannot meet the educational needs of Korean childcare teachers (Chung, 2019; M. S. Kim, 2014, 2015; Y. E. Kim, 2018). The formal in-service system is divided into courses for directors and general teachers, and in the case of teachers, it includes courses related to the incumbent's work and courses for promotion. The two types of courses are usually operated through group lectures, and teachers gather in a classroom for

[2] The CLASS measure has different domains according to the versions. This study focuses on the teachers' warm and sensitive features among the domains, for example, "*Teacher Sensitivity*" among domains of the Infant version, "*Emotional and Behavior Support*" of the Toddler version, and "*Emotional Support*" of the Pre-K version.

[3] Both infants (0–24 months) and toddlers (24–36 months) are called "*younga*," which refers to children under the age of three in the national childcare curriculum and Infant Care Act in South Korea. This study uses the term "infant" to mean children aged 0–36 months to avoid confusion.

[4] The childcare system in Korea is separated from the early childhood education system. The Ministry of Education is in charge of kindergartens for young children aged 3–5 years, while the Ministry of Health and Welfare manages childcare centers for infants and young children aged 0–5 years.

lessons. This uniform and undifferentiated group-lecture-type system does not meet teachers' individual educational needs (Chung, 2019); thus, childcare teachers cannot sufficiently learn what teachers need to learn to enhance their interactional competency. It is recommended that the formal and mandatory in-service system of one-off education within a specific period be changed to a long-term plan.

### 1.3. Necessity of a meta-analytic study of the effects of in-service programs

It is necessary to review previously validated in-service programs to suggest the direction of in-service programs based on empirical evidence. Owing to insufficient evidence on the effects of in-service programs for ECEC teachers in Korean literature, we include international evidence to draw implications for the Korean childcare field. Previous meta-analytic studies have demonstrated the effectiveness of ECEC teachers' in-service programs (Egert et al., 2018; Werner et al., 2016). However, they set broad definitions as the criteria for interactions, such as the general quality of childcare settings at the classroom level (Egert et al., 2020; Werner et al., 2016). This study reviews the interaction quality, especially focusing on the warmth and responsiveness of childcare teachers, who are critical for infants' development (Hamre et al., 2014).

Fukkink and Lont (2007) and Egert et al. (2020) explored the effects of specialized training for caregivers working in childcare, similar to the focus of the current study; however, they did not draw consistent results regarding the effective components in delivery formats and instructional design of in-service programs. This lack of guidance regarding effective in-service programs poses a concern for those trying to select beneficial in-service programs for ECEC teachers (Schachter et al., 2019). In addition, since each country has a different teacher training education system, it is unclear whether the method of other countries' in-service PD programs is suitable for Korean in-service teachers or is effective. To confirm whether the effect size of in-service programs for childcare teachers in charge of infants is significant when the domestic literature is considered, this study aimed to synthesize previous intervention studies, including literature in English and Korean.

### 1.4. Previous meta-analytical research

#### 1.4.1

Several studies have been conducted on PD programs targeting childcare teachers in Korea (H. J. Kim & Cho, 2009; J. Kim & Jeong, 2016; Park, 2018). However, little is known regarding their impact, particularly whether they significantly improve the interaction quality of childcare teachers in Korea. To the best of our knowledge, no studies in Korea have explored the effectiveness of methods used in in-service programs or to what extent the intensity of an in-service program effectively improves childcare teachers' interaction quality.

Contrariwise, several meta-analytic studies have been conducted on programs targeting childcare and preschool teachers in other countries. They have reported medium effect sizes of in-service training on process quality (Egert et al., 2018), childcare quality (Werner et al., 2016), and teachers' general competencies, including knowledge, skills, and attitude (Fukkink and Lont, 2007). In-service PD programs also significantly improved caregiver–child interactions (Werner et al., 2016) and teachers' interaction quality as rated by the CLASS measure (Egert et al., 2020), reaching medium effect sizes. Given the positive training effects on the teachers' competencies and process quality, significant positive impacts of in-service programs are expected in this study, even when Korean research is included with English research.

Owing to the program intensity, extent, or delivery format differences, there are considerable variations in the training effects (Lonigan et al., 2011; Shidler, 2009). Although previous studies have explored the most effective component in delivery formats of in-service programs for ECEC teachers, there are difficulties in reaching consistent conclusions because of the different focus of outcome measures. Even previous studies that explored the moderator of the program effects focusing on teachers' sensitive responses, which is the current study's focus, showed inconsistent results (e.g., Egert et al., 2020; Werner et al., 2016). Because there is insufficient evidence for the effective delivery format of in-service programs improving teachers' interaction quality, this study reviewed previous studies, including other literature that set the outcomes as teachers' instructional style or a broader concept of classroom quality.

The program features were studied by distinguishing the delivery format and intensity of each in-service program. The delivery formats of in-service training can be divided into five types: (a) workshops, (b) coursework, (c) coaching, (d) consulting, and (e) mentoring. Egert et al. (2018) investigated the effects of delivery formats as moderators of process quality and found that interventions using onsite support only (i.e., coaching or consulting) or onsite support in combination with other delivery formats, such as workshops or courses, did not show better results among delivery formats. However, an in-service program that used coaching alone as a training strategy was nearly three times more effective than programs using other delivery formats in classroom quality ratings. Neuman and Wright (2010) reported that onsite coaching was more effective as a form of PD in early language and literacy knowledge for prekindergarten teachers than the coursework.

There is also the possibility that coaching combined with other formats is more effective for in-service programs of ECEC teachers than coaching alone. For example, Markussen-Brown et al. (2017) revealed that PD programs that used only coaching to improve educator–child interactions, including both global or more domain-specific levels, were less effective than when using coaching accompanied by other formats. Diamond and Powell (2011) developed a PD program that could be delivered by a workshop combined with individualized coaching sessions to improve the use of effective early literacy instruction for Head Start teachers. They suggested that PD programs with a single format may encounter more difficulties than dynamic programs with several formats, as more formats could create multiple channels for teachers to learn and practice more contextualized content. Based on previous studies targeting PD programs of ECEC teachers, it was expected that the coaching format would have the largest effect on in-service programs. Little is known regarding which types of formats are effective when combined with coaching; therefore, this study explored the effectiveness of the types of combination of delivery formats on the interaction quality of childcare teachers.

The intensity of a program should be considered to convey its content well. Frequency, duration, and quantity should be matched to deliver the program contents effectively (Buysse et al., 2009). Although there are no rules about the intensity of in-service programs, some studies have demonstrated that long-period training formats (e.g., 12 or more months) improved classroom quality (Grace et al., 2008; Roehrig et al., 2011). Hindman and Wasik (2012) found that a two-year coaching-based language and literacy intervention had additional gains in the quality of instructional interactions compared to one-year gains, indicating that multiple

years of intensive coaching are linked to a more substantial effect, especially when the program's focus is broad (Hamre & Hatfield, 2012).

Contrary to comprehensive programs, a short intervention period would suffice when specific skills are the target of a program, such as an aspect of classroom quality or interaction quality of ECEC teachers (Englund, 2010; N. Howe et al., 2012). However, no moderator effects regarding quantity were found in Werner et al., 2016 study; for example, programs with less than 10 h were not significantly different in their effectiveness than programs with 10 or more hours of training. Egert et al. (2018) reported that programs shorter and longer than 45–60 h demonstrated fewer positive results; however, programs with 45–60 h, a medium dosage, led to a significant improvement in the overall childcare quality. This result raises the possibility of a curvilinear relationship between hours of training and teachers' performance.

Moreover, Egert et al. (2020) revealed that the intensity of training, defined as hours spent in group training per month, marginally influenced teachers' overall interaction quality but was negatively related to teachers' emotional support. Further evidence may be required to clarify the relevance of the scope of the objective (i.e., broad or specific goal) and the program intensity with program effects. This study explored the influence of the programs' intensity on the effect size of service programs to accumulate further evidence regarding the inconsistent results after classifying the programs' intensity into frequency (number of sessions), duration (whole period of the program), and quantity (hours per session).

### 1.5. Research objectives

The first objective was to examine the average effect size of in-service programs after systematically reviewing the previous studies published from 1991 to 2020 in Korean and English databases. The included studies were limited to in-service programs that aimed to improve childcare teachers' interaction quality in authorized childcare, including family home and center-based care. The targeted childcare teachers were officially qualified and employed to care for groups of infants/toddlers. We also included preschool teachers, as there are toddlers attending preschools. The second objective was to conduct moderator analyses to investigate the effective moderator of in-service programs with a specific goal (i.e., improving the warmth and responsiveness of teachers' interactions). We explored the differential effects of in-service programs depending on the delivery format, such as workshops, coursework, consulting, mentoring, and coaching. Additionally, we examined the differential effects of in-service programs depending on their intensity, including frequency (number of sessions), duration (whole period of the program), and quantity (hours per session).

## 2. Methodology and methods

### 2.1. Systematic literature search

The systematic literature search was coded using the following criteria. First, an electronic search was conducted separately in the Korean and English databases. Second, individual studies were searched in bibliographies and peer-reviewed articles to identify if there was additional research that was not included in the systematic electronic searches. We searched the Korean-language literature in the Research Information Sharing Service (RISS), Korean Studies Information Service System, DBpia, Korean National Assembly Library, and Korean National Library website. Among English-language databases, the Education Resources Information Center (ERIC), Elton B. Stephens Company (EBCOAST), Psychological Information Database (PsycINFO), ProQuest Dissertations and Theses, and Google Web were used. The search included keywords related to the in-service program (i.e., PD, in-service program, coaching, consulting, mentoring, teacher training, or teacher education); outcome measure (i.e., interaction quality, sensitivity, responsiveness, or teacher behavior); and type of educational institution (i.e., family home care, public childcare center, and preschool). Reference lists in the meta-analysis and systematic review studies were checked to identify research that satisfied the criteria.

After the systematic search, we identified 432 studies and followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines for a systematic review (Moher et al., 2009). Out of the 432 studies, we excluded 45 duplicates. The abstracts of the remaining 387 studies were examined to determine whether they met the following criteria: (a) a quantitative research design and (b) the inclusion of the definition of an in-service program. A total of 175 studies were thereby excluded. Subsequently, we examined whether the remaining 212 studies matched the following inclusion criteria: (c) the sample included preschool teachers and childcare teachers working in center-based care; (d) included outcome measures; and (e) reported sufficient statistical information to compute the effect sizes. After excluding 174 studies that did not meet the additional criteria, 38 studies (8 Korean, 30 English) were finally analyzed. The ratio of Korean to English literature was 2.67–7.33. The detailed inclusion criteria for Korean and English literature are presented in Table 1, and the PRISMA diagram for selecting studies is presented in Fig. 1.

### 2.2. Coding procedures

All studies were double-coded by the first author and two research assistants following the guidelines of The Campbell Collaboration (2020). First, we coded research using a short screening method to evaluate the quality of studies and whether they had sufficient statistical data. The short screening method included coding of study design (e.g., control-group design and randomization), instructional features of training, and sufficient statistical information. Second, we coded relevant research with an extended coding scheme gathered from additional information on study methodology, socio-demographic information of childcare teachers, in-service programs, and potential effect moderators. For clarity in the code, we defined the meaning of the intervention program and session. A session is a single meeting, while an intervention program is a complete training procedure including a set number of sessions. Inter-rater reliability of initial scores for the independent coding procedure was estimated between coders using Kappa coefficients. At first, when 20% of the studies were coded, the reliability between raters was $\kappa = 0.74$. Coder disagreements were resolved through discussion, and a consensus was reached; consequently, the final codes reached a $\kappa$ value of 1. The studies included and their coding details are presented in Table 2.

### 2.3. Data analysis

A meta-analysis was conducted using Comprehensive Meta-Analysis Software V3 (Borenstein et al., 2013). First, we checked the publication bias using a funnel plot, a visual tool. Second, we calculated the aggregated effect size for each in-service program. The standardized mean difference (SMD) effect sizes were calculated using three types of study design (i.e., experimental design, quasi-experimental design, and non-experimental design with pre- and post-test of the intervention group) because the effect sizes have the same meaning irrespective of the study design (Borenstein

**Table 1**
Inclusion criteria for meta-analysis and rationale.

| | Published in English | Published in Korean | Rationale |
|---|---|---|---|
| Database | ERIC, EBCOAST, PsycINFO (EBSCO), ProQuest Dissertation Thesis, and Google search | RISS, KISS, DBpia, Korean National Assembly Library, and Korean National Library | |
| Years | From 1991 to 2020 | | The current childcare system in South Korea was founded in 1991 with the enactment of the Infant and Child Care Act. |
| Publication Types | Doctoral dissertation, Master's thesis, SSCI, SCOPUS, and Report | Doctoral dissertation, Master's thesis, and KCI | This study reviewed and analyzed published journals as well as unpublished studies to avoid publication bias. |
| Definition of In-Service Program | Studies covering an in-service program for teachers working in authorized childcare settings, with the precise goal of enhancing their knowledge, skill, and expertise, were included. The in-service programs do not include a course to achieve a credential or certification, formal refresher and promotion education, or personalized PD plans. | | |
| Study Design | Intervention studies with and without control conditions (e.g., randomized, quasi-experimental, and non-experimental) were included. | | The effect sizes from different designs have the same meaning regardless of the study design (Borenstein et al., 2009). |
| Type of Center | Authorized childcare (family home care and center-based care) and preschool | Childcare center | This study aims to gain information on in-service programs for childcare teachers caring for infants/toddlers. Considering the toddlers who attend preschool, we included the preschool if only qualitative features of teachers' interactions were measured. |
| Teacher Outcome | Studies that provide information about childcare teachers' interaction quality were included. The interactions should be indicated by teachers' practice and measured by individual teachers. In the case of the CLASS measure, *Teacher Sensitivity* among domains of the Infant version, *Emotional and Behavior Support* of the Toddler version, and *Emotional Support* of the pre-K version was selected. The sensitive interaction among CIS subfactors was used for analysis. | | The qualitative aspects of teachers' behaviors, especially the sensitive responses to infants' cues, are critical for infants' developmental process. |

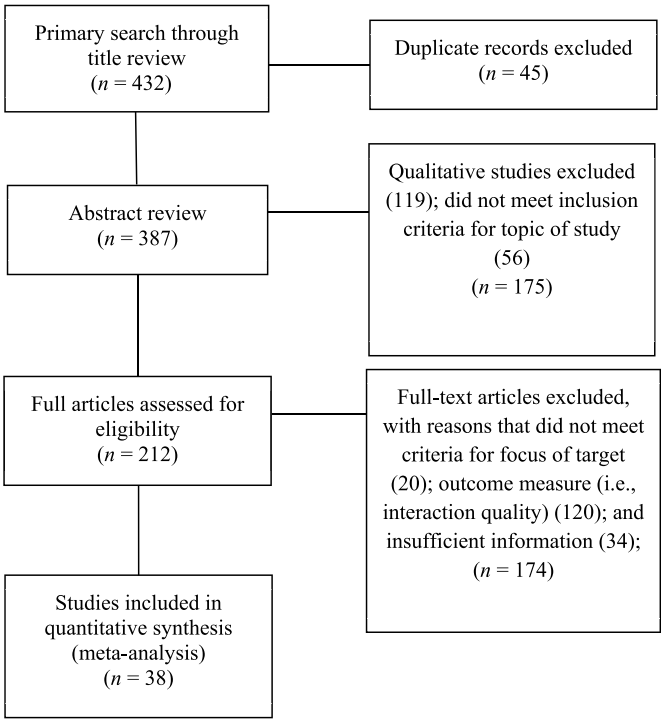


**Fig. 1.** PRISMA flow diagram of the literature search and selection process.

et al., 2009). We used weighted analysis to impose more weight on the effect sizes of larger sample groups based on the assumption that the larger samples provide an approximation of the actual effects (Cooper, 2010; Hedges & Olkin, 1985). Statistical significance was determined by calculating the 95% confidence interval (CI) of the weighted effect sizes (Cooper, 2010).

Third, we tested the homogeneity of effects using *Q*-statistics and $I^2$ (Higgins et al., 2003) and determined the types of models (i.e., fixed-effects model or random-effects model) based on the result of the homogeneity test. The fixed-effects model enables the generalization of the study sample, whereas the random-effects model provides information on the distribution of mean effect sizes with the hypothesis that each study has a different population (Sirin, 2005). The homogeneity test was performed using the following formula:

$$Q = \sum_{i=1}^{k} \frac{(g_i - g_\cdot)^2}{v(g_i)} = \sum w_i (g_i - g_\cdot)^2,$$

where $w_i = 1/v(g_i)$, and $w_i$ is an inverse variance weight. Finally, we examined potential moderators by analyzing subgroups for categorical variables and applying the random-effects model. The resultant effect sizes were interpreted following Cohen's (2013) criteria: 0.2 as small, 0.5 as medium, and 0.8 as large.

## 3. Results

### 3.1. Publication bias

The funnel plot with 40 in-service programs indicated that the effect sizes were distributed asymmetrically, slightly over-representing studies with relatively large effect sizes. We used the trim-and-fill method to correct the asymmetric distribution into a symmetric one (Duval & Tweedie, 2000). When publication bias is present, the trim and fill method can produce less biased estimates than the usual meta-analysis models by considering the remaining studies minimally impacted by the publication bias (Peters et al., 2007). The adjusted estimate is shown as a filled diamond at 0.312 (CI: 0.093–0.531). The adjusted effect size is smaller than the original estimate (0.750, CI: 0.546–0.954).

Given that the difference between the original effect size and the adjusted effect size was large, we corrected the overestimation of the original estimate by eliminating outliers. Among the studies used in the meta-analysis, the effect sizes of Breffni's (2011) and N. Howe et al's (2012) studies were outliers with $g' = 3.22$ and 4.81, respectively. These large effect sizes may be because both interventions provided highly complex programs, including multiple contents, to deliver a specific curriculum. As large effect sizes may confound the results when analyzing moderators, we deleted the two outliers and conducted the subsequent analyses without the two values. The final funnel plot is shown in Fig. 2.

**Table 2**
Characteristics of included studies.

| Author (year) | Effect Size | Program Focus | Type of Center | Teachers' Education Level | | Delivery Format | Video used | Frequency | Duration (m) | Quantity (h) | Outcome Measure |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | I | C | | | | | | |
| Ansari and Pianta (2018) | 0.68 | IQ | Preschool | | | Coaching | Y | 10 | 12 | – | CLASS |
| Barnett et al. (2008) | 0.95 | CI | Preschool | – | | Multiple | – | 58 | 12 | – | CLASS |
| Bloom and Sheerer (1992) | 1.39 | OP | Preschool | – | – | Coursework | – | 77 | 16 | 4 | Others |
| Breffni (2011) | 3.22 | CI | Preschool | – | – | Coursework | – | – | 2 | 4 | CLASS |
| Campbell and Milbourne (2005) | 0.15 | QC | Childcare center | 0.08 | 0.10 | Consulting | – | 5 | 3 | 3 | CIS |
| Cassidy et al. (1995) | −0.29 | OP | Childcare center | – | – | Coursework | – | 4 | 12 | – | ECERS/ITERS |
| Eadie et al. (2019) | 1.11 | LA | Preschool | 0.09 | | Coursework+ Coaching | Y | 14 | 3.5 | 2 | CLASS |
| Early et al. (a) (2017) | 0.40 | IQ | Preschool | 0.92 | 0.91 | Workshop | – | 10 | 4 | 2.5 | CLASS |
| Early et al. (b) (2017) | 0.20 | IQ | Preschool | 0.91 | 0.91 | Coaching | Y | 8 | 7 | – | CLASS |
| Fukkink and Tavecchio (2010) | 1.09 | IQ | Childcare center | – | – | Coaching | Y | 4 | – | – | CIS |
| Girolametto et al. (2003) | 0.39 | LA | Childcare center | 0 | | Workshop + Coaching | Y | 20 | 3.5 | – | Others |
| Groeneveld et al. (2016) | −0.26 | IQ | Home Childcare center | – | – | Coaching | Y | 6 | 6 | 1.6 | Others |
| Hamre et al. (2012) | 0.40 | IQ | Preschool | 0.58 | 0.62 | Coursework | – | 14 | 3.5 | 3 | CLASS |
| Helmerhorst et al. (2017) | 0.76 | IQ | Childcare center | 0.07 | | Coaching | – | 5 | 1.25 | 2 | CIP |
| Hindman and Wasik (2012) | 1.17 | LA | Preschool | 0.81 | 0.50 | Workshop + Coaching | Y | 48 | 24 | 3 | CLASS |
| Howe et al. (a) (2012) | 4.81 | CI | Childcare center | 0.15 | | Consulting | – | 15 | 3.75 | 3 | ECERS |
| Howe et al. (b) (2012) | 0.52 | CI | Childcare center | 0.15 | Workshop | – | – | | 3.75 | 2 | ECERS |
| Jilink et al. (2018) | 0.29 | IQ | Childcare center | – | – | Coaching | Y | 4 | 4 | 0.5 | CIP |
| Johnson et al. (2017) | 0.18 | IQ | Preschool | 0.50 | | Multiple | – | 11 | 2 | – | CLASS |
| Kang (2003) | 0.56 | IQ | Childcare center | – | – | Workshop | – | 5 | 1.25 | 1 | Others |
| Kim and Yu (2015) | 0.76 | IQ | Childcare center | 0.07 | 0 | Workshop | – | 8 | 2 | 2 | Others |
| Kim, I. B. (2017) | 1.56 | IQ | Childcare center | 0.2 | 0.25 | Workshop + Coaching | – | 8 | 1 | 1.5 | Others |
| Kim, S. R. (2017) | 0.68 | IQ | Childcare center | 0.42 | | Workshop | – | 12 | 3 | 1.5 | K-MBRS |
| Kim and Jeong (2016) | 1.47 | IQ | Childcare center | | | Workshop | – | 10 | 1 | 2.5 | K-MBRS |
| Kontos et al. (1996) | −-0.07 | QC | Home Childcare center | 0.18 | 0.21 | Coursework | – | – | – | – | CIS |
| Landry et al. (2014) | 1.36 | QC | Childcare center | 0.08 | | Workshop + Coaching | – | 19 | 10 | – | Others |
| Lim (2019) | 1.14 | RE | Childcare center | 0.42 | – | Consulting | – | 8 | 3 | 2.5 | Others |
| Masterson (2008) | 1.58 | IQ | Preschool | – | – | Coursework | – | – | 0.75 | 1.5 | CLASS |
| Merz et al. (2016) | 0.62 | IQ | Home childcare center | 0.19 | 0.46 | Coursework + Mentoring | – | 40 | 5 | 1 | Others |
| Moreno et al. (2015) | −0.12 | QC | Childcare center | 0.35 | | Coursework + Coaching | – | – | 5.5 | – | CLASS |
| Piasta et al. (2012) | 1.07 | LA | Preschool | 0.72 | 0.54 | Workshop + Coaching | Y | 8 | 6 | 4 | Others |
| Pronchenko-Jain (2012) | 0.82 | RE | Preschool | 1 | 1 | Workshop + Coaching | Y | 40 | 5.75 | 1 | CLASS |
| Radnai-Griffin (2011) | 0.77 | LA | Preschool | 0.25 | 0.17 | Multiple | Y | 7 | 4 | – | ITERS |
| Rhodes and Hennessy (2000) | 1.54 | IQ | Childcare center | – | – | Coursework | – | 48 | 6 | 2 | CIS |
| Sandilos et al. (2018) | 0.47 | IQ | Preschool | 0.68 | | Coursework | – | 14 | 3.5 | 3 | CLASS |
| Seo (2019) | 0.41 | IQ | Preschool | 0.35 | 0.3 | Mentoring | – | – | 24 | 2.5 | CLASS |
| Song (2016) | 0.34 | QC | Childcare center | – | – | Workshop+ Consulting | – | 7 | 3 | 2 | Others |
| Sula et al. (2019) | 1.75 | IQ | Preschool | – | – | Workshop | – | 15 | 12 | 6 | Others |
| Werner et al. (2018) | 0.03 | IQ | Childcare center | 0.14 | 0.12 | Coaching | Y | 6 | 6 | 1.5 | CIP |
| Zan and Donegan-Ritter (2014) | 0.51 | QC | Preschool | – | – | Multiple | Y | 20 | 8 | – | CLASS |

*Note.* IQ = interaction quality; OP = overall practice; LA = language; CI = curriculum implementation; QC = quality of care; RE = relationship; I = intervention group; C = control group; teachers' education level corresponds to the ratio of a bachelor's degree or higher; CLASS = Classroom Assessment Scoring System; ECERS = Early Childhood Environment Rating Scale; ITERS = Infant/Toddler Environment Rating Scale; CIS = Caregiver Interactions Scale; CIP = Caregiver Interactions Profile Scale; K-MBRS = Korean Maternal Behavior Rating Scale; Others = measures used only once.

### 3.2. Overall analysis of interaction quality

#### 3.2.1. Homogeneity test

Before calculating the overall effect size, we examined whether the effect sizes were homogeneous under the homogeneity test. These statistical tests provide information on whether the effects found by the different studies are caused by a sampling error or by a systematic difference between the studies and a sampling error (Hedges & Olkin, 1985). The results indicated significant variance between studies ($Q^2 = 220.931$, $df = 37$, $p < 0.001$), showing that systematic differences between studies lead to heterogeneity. Given the considerable heterogeneity ($I^2 = 83.253$), we used the random-effects model and conducted a subgroup analysis to explore the moderators of effect size.

#### 3.2.2. Meta-analysis of interaction quality

After the two outliers were excluded, 38 effect sizes could be extracted from contrasts of intervention and control groups at post-test or change of scores from pre- and post-tests. We measured the overall effect size using a random-effect model according to the homogeneity results. The precision of each intervention can be identified using the length of the CI in the forest plot (Fig. 3).

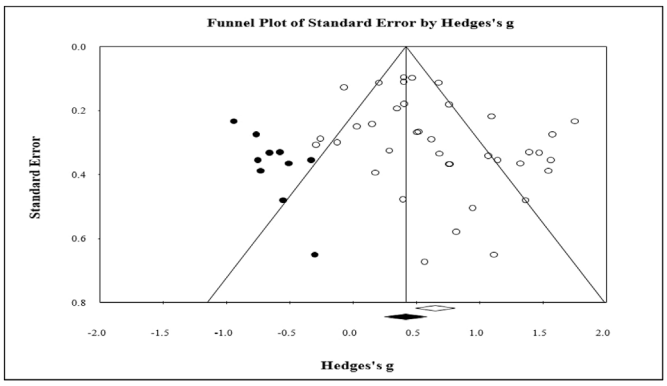


**Fig. 2.** *Funnel Plot Without Outliers.*

Effect sizes ranged from negative ($g' = -0.29$) to positive ($g' = 1.75$). When the control group had higher post-test scores than the treatment group, the effect size had a negative value (e.g., Cassidy et al., 1995; Groeneveld et al., 2016; Kontos et al., 1996; Moreno et al., 2015). The meta-analysis demonstrated a significant medium-weighted summary effect size ($g' = 0.65$; $SE = 0.08$; $CI = 0.49–0.80$; $Z = 8.15$; $p < 0.001$; relative weight per treatment 1.04%–3.93%).

### 3.3. Subgroup analysis of the interaction quality

#### 3.3.1. Study characteristics

The results of the subgroup analysis based on the study characteristics are presented in Table 3. Considering the increased interest in ECEC teachers' PD programs since 2000, this study ascertained whether there were any differences before 2000 and from 2000 to 2020. The results revealed no significant difference in effect size between the two periods ($Q = 0.65$, $p = 0.42$).

There were significant differences in effect size according to the sample country ($Q = 32.83$, $p < 0.001$). The effect size of in-service programs conducted in Albania was the largest ($g' = 1.75$), followed by the United Kingdom ($g' = 1.54$), Australia ($g' = 1.11$), South Korea ($g' = 0.93$), the United States ($g' = 0.52$), Canada ($g' = 0.49$), and the Netherlands ($g' = 0.41$).

There was no significant difference in effect size depending on

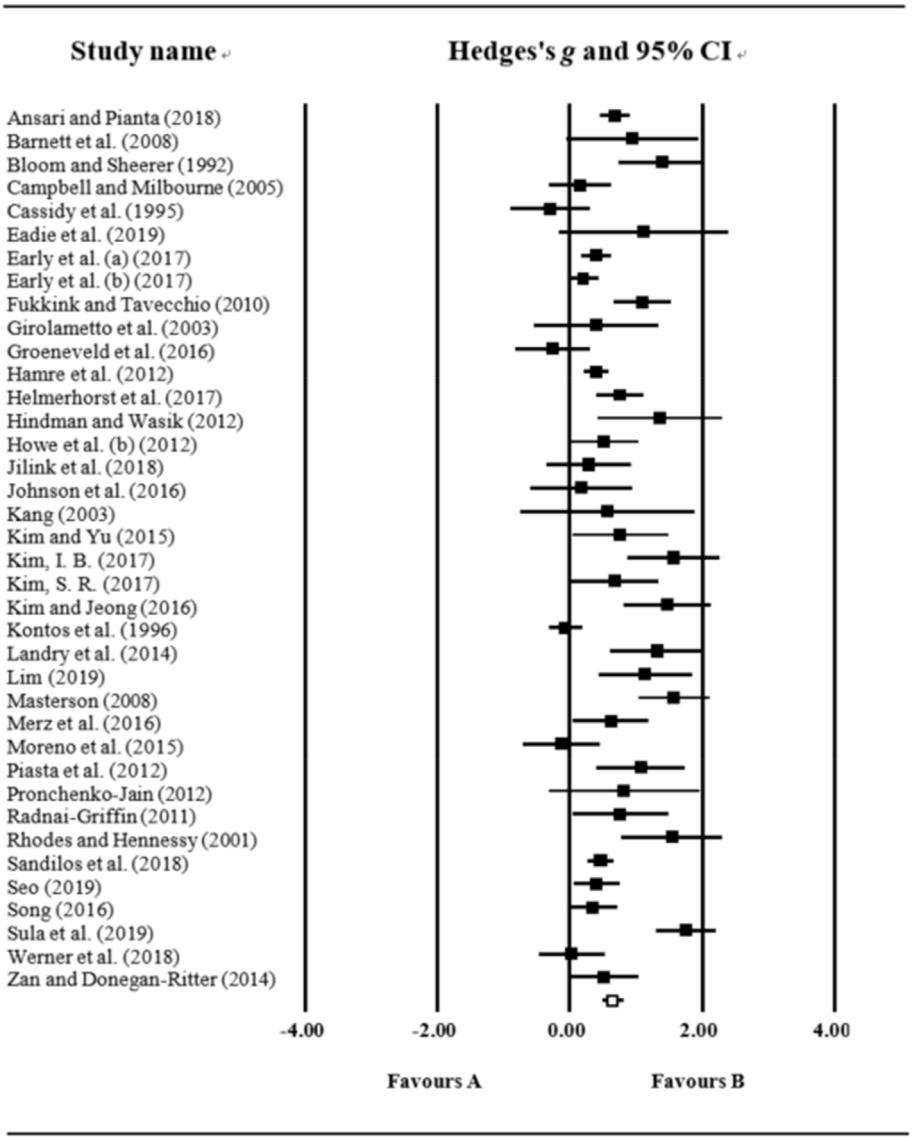


**Fig. 3.** Forest plot for effect sizes.

**Table 3**
Effect sizes by subgroups (study characteristics).

| Variable | Subgroup | $K^a$ | ES (Hedges $g'$) | SE | CI | Q | $p$ |
|---|---|---|---|---|---|---|---|
| Year | 1991–2000 | 3 | 0.32 | 0.44 | −0.55–1.18 | 0.65 | 0.42 |
| | 2000–2020 | 35 | 0.68 | 0.68 | 0.52–0.83 | | |
| Total | | 38 | 0.67 | 0.08 | 0.52–0.82 | | |
| Sample Country | Albania | 1 | 1.75 | 0.23 | 1.30–2.21 | 32.83 | 0.00 |
| | Australia | 1 | 1.11 | 0.65 | −0.16–2.39 | | |
| | Canada | 2 | 0.49 | 0.23 | 0.03–0.94 | | |
| | South Korea | 7 | 0.93 | 0.21 | 0.52–1.33 | | |
| | The Netherlands | 5 | 0.41 | 0.25 | −0.08–0.89 | | |
| | United Kingdom | 1 | 1.54 | 0.39 | 0.78–2.31 | | |
| | United States | 21 | 0.52 | 0.09 | 0.35–0.70 | | |
| Total | | 38 | 0.70 | 0.07 | 0.56–0.83 | | |
| Publication Type | Doctoral dissertation | 6 | 1.97 | 0.27 | 0.45–1.50 | 1.89 | 0.39 |
| | Master's thesis | 2 | 0.69 | 0.39 | −0.09–1.46 | | |
| | Published journal | 30 | 0.59 | 0.08 | 0.42–0.76 | | |
| Total | | 38 | 0.62 | 0.08 | 0.47–0.79 | | |
| Study Design | One group Pre-post test | 3 | 1.15 | 0.20 | 0.75–1.55 | 5.90 | 0.06 |
| | Quasi-experiment with matching group | 10 | 0.61 | 0.20 | 0.23–0.99 | | |
| | Randomized Control trial | 25 | 0.62 | 0.09 | 0.44–0.79 | | |
| Total | | 38 | 0.69 | 0.08 | 0.54–0.83 | | |
| Type of Center | Childcare center | 18 | 0.66 | 0.13 | 0.40–0.91 | 7.42 | 0.02 |
| | Home childcare center | 3 | 0.07 | 0.22 | −0.37–0.51 | | |
| | Preschool | 17 | 0.74 | 0.11 | 0.53–0.94 | | |
| Total | | 38 | 0.63 | 0.08 | 0.48–0.78 | | |

*Note.* $K$ = number of effect sizes; ES = effect size; SE = standard error; CI = confidence interval.

the publication type ($Q = 1.89$, $p = 0.39$). The study design was a significant moderator ($Q = 5.90$, $p = 0.06$) for the effect sizes of in-service programs. The effect sizes according to the study design were in the following order: one group pre- and post-test ($g' = 1.15$), randomized control trial ($g = 0.62$), and quasi-experiment with a matching group ($g' = 0.61$).

We identified a significant difference in the effect size according to the type of center targeted by the study. The studies conducted in preschools had the largest effect size ($g' = 0.74$), followed by the effect size of studies performed in childcare centers ($g' = 0.66$). Studies targeting home childcare centers had the smallest effect size ($g' = 0.07$).

### 3.3.2. Characteristics of in-service programs

Table 4 presents the results of the subgroup analysis according to the characteristics of in-service programs. There was no significant difference in effect size by intervention focus ($Q = 8.28$, $p = 0.14$). The number of delivery formats was also not a significant moderator of the effect sizes of in-service programs ($Q = 0.99$, $p = 0.61$).

We found significant differences in the type of delivery format ($Q = 17.03$, $p = 0.04$). When the in-service programs combined workshops and coaching, the effect size was the largest ($g' = 1.16$), followed by workshops ($g' = 0.89$), coursework ($g' = 0.64$), coursework + mentoring ($g' = 0.62$), consulting ($g' = 0.61$), multiple formats ($g' = 0.55$), coaching ($g' = 0.43$), mentoring ($g' = 0.41$), coursework + coaching ($g' = 0.36$), and workshop + consulting ($g' = 0.34$).

The analysis of whether the effect sizes of in-service programs differed according to the use of coaching showed no significant result ($Q = 2.45$, $p = 0.12$), nor did the effect sizes of in-service programs significantly differ by the use of individual videos ($Q = 0.83$, $p = 0.36$).

There was a significant difference in the effect size by the frequency of in-service programs. The in-service program that presented an intervention with the most frequent sessions (i.e., over 20) was the most effective for improving teachers' interaction quality ($g' = 1.10$) at a marginally significant level ($p = 0.05$), followed by the frequency 10–20 with the next largest effect size ($g' = 0.73$), followed by 5–10 ($g' = 0.60$), and 1–5 ($g' = 0.50$).

Regarding the duration of in-service programs, the effect size of the programs lasting less than one month was the largest ($g' = 1.54$). The effect sizes of the other duration criteria were as follows: over 12 months ($g' = 0.99$), 9–12 months ($g' = 0.88$), 1–3 months ($g' = 0.55$), 3–6 months ($g' = 0.44$), and 6–9 months ($g' = 0.26$).

There was a significant difference in the effect sizes of in-service programs by the quantity (hours per session). The effect size was the largest when the sessions provided 4–6 h per session ($g' = 1.75$). Sessions providing 3–4 h had the next largest effect size ($g' = 1.24$). The effect sizes for 1–2 h and 2–3 h were 0.74 and 0.54, respectively, and in-service programs providing 0–1 h per session had the smallest effect size ($g' = 0.52$).

## 4. Discussion

### 4.1. Effect size of in-service programs for childcare teachers on interaction quality

The meta-analysis using the random-effect model reported that the average effect size of the 38 in-service programs was medium ($g' = 0.65$) according to Cohen's criteria. When Korean research was added to international research in the current meta-analysis, the results obtained were similar to previous findings that only used an English database. Fukkink and Lont (2007) found that the participation of caregivers working in childcare in specialized training had a moderate effect on caregivers' competence, which is a composite of attitude, skill, and knowledge ($g' = 0.45$). Likewise, Werner et al., 2016 reported that randomized controlled intervention for childcare professionals had a moderate effect on caregivers' interaction quality ($g' = 0.44$), similar to the findings of Markussen-Brown et al. (2017) and Egert et al. (2018), who identified a medium effect size of in-service programs on process quality (i.e., $g' = 0.59$ and 0.68, respectively). The results align with the previous findings that in-service programs for ECEC teachers could enhance classroom quality (Buysse et al., 2009) and support their professional skills,

**Table 4**
Effect sizes by subgroups (characteristics of in-service programs).

| Variable | Subgroup | $K^a$ | ES (Hedges $g'$) | SE | CI | Q | $P$ |
|---|---|---|---|---|---|---|---|
| Intervention Focus | Curriculum Implementation | 2 | 0.61 | 0.24 | 0.15–1.07 | 8.28 | 0.14 |
| | Interaction Quality | 21 | 0.69 | 0.10 | 0.50–0.88 | | |
| | Language | 5 | 0.93 | 0.19 | 0.55–1.30 | | |
| | Overall Practice | 2 | 0.54 | 0.84 | −1.10–2.19 | | |
| | Quality of Care | 6 | 0.29 | 0.17 | −0.05–0.63 | | |
| | Relationship | 2 | 1.05 | 0.30 | 0.46–1.65 | | |
| Total | | 38 | 0.67 | 0.07 | 0.53–0.81 | | |
| Number of Delivery Format | Single type | 24 | 0.61 | 0.10 | 0.43–0.80 | 0.99 | 0.61 |
| | Two types | 10 | 0.80 | 0.19 | 0.43–1.16 | | |
| | Three types | 4 | 0.55 | 0.18 | 0.21–0.90 | | |
| Total | | 38 | 0.63 | 0.08 | 0.48–0.78 | | |
| Type of Delivery Format | Coaching | 7 | 0.43 | 0.16 | 0.12–0.74 | 17.03 | 0.04 |
| | Consulting | 2 | 0.61 | 0.49 | −0.36–1.58 | | |
| | Coursework | 7 | 0.64 | 0.20 | 0.26–1.03 | | |
| | Coursework + Coaching | 2 | 0.36 | 0.61 | −0.83–1.54 | | |
| | Coursework + Mentoring | 1 | 0.62 | 0.29 | 0.05–1.19 | | |
| | Mentoring | 1 | 0.41 | 0.18 | 0.05–0.76 | | |
| | Multiple (3 types used) | 4 | 0.55 | 0.18 | 0.21–0.90 | | |
| | Workshop | 7 | 0.89 | 0.24 | 0.41–1.37 | | |
| | Workshop + Coaching | 6 | 1.16 | 0.17 | 0.83–1.49 | | |
| | Workshop + Consulting | 1 | 0.34 | 0.19 | −0.04–0.72 | | |
| Total | | 38 | 0.62 | 0.07 | 0.49–0.75 | | |
| Use of Coaching | No coaching used | 31 | 0.72 | 0.10 | 0.53–0.90 | 2.45 | 0.12 |
| | Only coaching used | 7 | 0.43 | 0.16 | 0.12–0.74 | | |
| Total | | 38 | 0.64 | 0.08 | 0.48–0.80 | | |
| Video Used | No video used | 25 | 0.70 | 0.10 | 0.50–0.90 | 0.83 | 0.36 |
| | Video used | 13 | 0.55 | 0.13 | 0.30–0.80 | | |
| Total | | 38 | 0.64 | 0.08 | 0.48–0.79 | | |
| Frequency | 1 to ≤ 5 | 8 | 0.50 | 0.16 | 0.17–0.82 | 7.63 | 0.05 |
| | 5 to ≤ 10 | 11 | 0.60 | 0.13 | 0.34–0.86 | | |
| | 10 to ≤ 20 | 9 | 0.73 | 0.16 | 0.41–1.05 | | |
| | over 20 | 6 | 1.10 | 0.17 | 0.76–1.43 | | |
| Total | | 34 | 0.71 | 0.08 | 0.56–0.86 | | |
| Duration | 0 to ≤ 1 month | 3 | 1.54 | 0.18 | 1.18–1.90 | 40.11 | 0.00 |
| | 1 to ≤ 3 months | 8 | 0.55 | 0.12 | 0.31–0.78 | | |
| | 3 to ≤ 6 months | 15 | 0.44 | 0.09 | 0.27–0.61 | | |
| | 6 to ≤ 9 months | 2 | 0.26 | 0.12 | 0.03–0.48 | | |
| | 9 to ≤ 12 months | 5 | 0.88 | 0.33 | 0.23–1.53 | | |
| | Over 12 months | 3 | 0.99 | 0.39 | 0.23–1.74 | | |
| Total | | 36 | 0.54 | 0.01 | 0.44–0.65 | | |
| Quantity | 0 to ≤ 1 h | 4 | 0.52 | 0.20 | 0.14–0.90 | 28.15 | 0.00 |
| | 1 to ≤ 2 h | 11 | 0.74 | 0.18 | 0.38–1.09 | | |
| | 2 to ≤ 3 h | 8 | 0.54 | 0.10 | 0.34–0.74 | | |
| | 3 to ≤ 4 h | 2 | 1.24 | 0.24 | 0.77–1.70 | | |
| | 4 to ≤ 6 h | 1 | 1.75 | 0.23 | 1.30–2.21 | | |
| Total | | 26 | 0.75 | 0.07 | 0.61–0.90 | | |

*Note.* $K$ = number of effect sizes; ES = effect size; SE = standard error; CI = confidence interval.

particularly interaction quality, as measured by CLASS (Egert et al., 2020). In a situation where the interaction quality is not sufficiently guaranteed by acquiring childcare teachers' certificates and formal in-service training, as in Korea, it is recommended that continuous in-service programs be implemented that have been verified as effective through meta-analysis.

### 4.2. Moderators of the effect sizes of in-service programs

#### 4.2.1. Delivery format of in-service programs

When we explored the differences in effect sizes of in-service programs considering their delivery format (i.e., consulting, coursework, coursework + coaching, coursework + mentoring, mentoring, multiple formats, workshop + coaching, and workshops), the mixed format of workshop and coaching was the most effective for improving interaction quality. Furthermore, we analyzed the differences in effect size by the coaching type used, based on the robust previous finding that the effect size using a coaching strategy alone was nearly three times greater for process quality than other programs (Egert et al., 2018). Contrary to Egert et al. (2018), the use of coaching alone was not a significant moderator of the effectiveness of in-service programs.

Rather, we found that the in-service programs using the mixed-format program of coaching and workshops as training strategies ($g' = 1.16$) were nearly twice as effective as those using only coaching ($g' = 0.43$). This result supports the finding of Markussen-Brown et al. (2017) that the effect of coaching alone on the process and structural quality was smaller than for coaching accompanied by other formats.

There is a plausible explanation for such a result (i.e., the effectiveness of workshops and coaching): In-service programs for enhancing interaction quality must first provide teachers with general information about the program itself, specific principles, and interaction examples at the workshop. After acquiring general knowledge, teachers need to receive feedback on their new practices from a professional coach, allowing them to practice interaction skills more proficiently after deeply understanding the principles of interactions (Diamond & Powell, 2011; Markussen-Brown et al., 2017). However, caution is necessary here, as a more detailed analysis with more samples is required; the boundary

between delivery formats was unclear because of insufficient information about how the in-service programs were delivered.

#### 4.2.2. Intensity of in-service programs

We considered the intensity of programs as a moderator, including the frequency (number of sessions), duration (whole period of the program), and quantity (hours per session). Considering that no rules were set for the intensity of programs and inconsistent results were reported on intensity, we only explored the differences in the intensity of teachers' outcomes without proposing any hypotheses. Regarding the frequency at which teachers participated in the in-service programs, in-service programs that performed the intervention with the most frequent sessions (i.e., over 20) were the most effective ($g' = 1.10$). Interestingly, the in-service programs with 4–6 h per session had the largest effect size ($g' = 1.75$). These findings suggest that teachers will demonstrate a higher interaction quality if the sessions of an in-service program are implemented more frequently or if there are more hours per session.

In terms of the duration of in-service programs, the effect size of programs was the largest ($g' = 1.54$) when the program lasted for less than one month. If teachers participate in in-service programs of short duration, they may improve their warm and sensitive responses. The finding supports previous results that a short-period intervention is effective for a set of specific skills (i.e., interaction quality), contrary to programs that have a comprehensive and broad focus (Englund, 2010; Grace et al., 2008; Hamre & Hatfield, 2012; Hindman & Wasik, 2012; N. Howe et al., 2012; Roehrig et al., 2011).

We suggest that programs shorter than 1 month, programs with more than 20 sessions, or programs with over 4 h per session would be effective for improving childcare teachers' sensitivity. The in-service programs included in the current study focused on a specific feature of teachers, such as sensitive responsiveness and content. Therefore, we conclude that the specific feature can be enhanced through short-period interventions (i.e., shorter than 1 month) or highly dense sessions.

However, only one study included an in-service program that lasted 4–6 h per session, and the study used a tool that many teachers were familiar with in their own country, not an internationally validated measure. Considering that a large effect of 4–6 h per session was observed because of the familiarity of the measure, we should interpret the effectiveness of the high number of hours cautiously.

### 4.3. Limitations and directions for future research

We examined the effect size of in-service programs for childcare teachers on the quality of interactions. Although children could benefit from teachers' participation in PD programs (Egert et al., 2018; Werner et al., 2016), we did not explore the direct effect on child development because of the limited reports of variables on child levels. Further research is required to investigate whether interventions for interaction quality could enhance infants' development. By verifying the transfer effects of training on children, the importance of in-service programs for teachers could be better supported.

The meta-analysis results are dependent on the number of samples and the quality of outcome measures. We set the criteria of outcome measures focusing on the qualitative features of interactions (e.g., sensitive climate among CLASS subfactors, sensitive interactions in CIS measure). The measures, such as CLASS, CIS, and ECERS, are used to observe teacher–child interactions from an objective point of view by trained researchers, yielding reliable and validated outcomes for the teacher–child interaction; however, several Albanian and Korean studies relied on newly developed tests without supplementary standards or validation processes. Some scores may have been overestimated because the authors designed measures that reported larger effect sizes than standardized measures (Gottfredson et al., 2015). Therefore, future studies should conduct more methodologically valid experiments to determine which in-service programs are effective for childcare teachers and infants.

Finally, as pointed out by previous meta-analyses (Egert et al., 2018, 2020; Werner et al., 2016), the relatively small number of analyzed studies made it difficult to find statistically significant outcomes between studies. As the results of the moderator analysis involve only correlational findings and not a causal relation, we should be more careful in interpreting the conclusion.

Furthermore, this study included eight Korean studies. Although the number of Korean studies is not insignificant, their lower percentage than the total number is comparable to that of a previous meta-analysis that included only literature in English. The Campbell collaboration recommends search attempts to identify studies published in any language (Moher et al., 2009); Cochrane also advocates that the search not be restricted by language (Lasserson et al., 2019). Although our findings were not considerably different from what we found in English-language literature, this study may be valuable from a methodological perspective. Moreover, enhancing and acquiring high-quality care for children is a global task, and all children should have opportunities to receive high-quality childcare (United Nations, 2015). Thus, discussions of ECEC quality worldwide should be initiated without language restrictions.

### 4.4. Contribution and implication of the present findings

We first attempted to synthesize the effects of in-service programs in improving the interaction quality of childcare teachers. Previous meta-analyses of in-service programs had an uneven distribution and included only studies written in English, meaning that they did not necessarily apply to Korea. By including research that targets Korean childcare teachers and synthesizes the effects of in-service programs, we could provide information on executing effective in-service programs in the Korean childcare system. We also conclude that in-service programs for Korean teachers are moderately effective in improving the quality of their interactions.

The delivery format of a hybrid type of *workshop and coaching* was found to be the most effective way to enhance the quality of interactions. As Korean childcare teachers reported that they could not interact with infants as sensitively and efficiently as they had envisioned (Lim et al., 2018), it is recommended that Korean childcare teachers use effective ways (i.e., workshops and coaching) to enhance their knowledge and skills regarding interactions. Given the lower interaction quality of ECEC teachers in Korea than in other countries (Byun et al., 2022; Sheridan et al., 2009), the implementation of effective in-service programs to improve childcare teachers' interaction quality should be emphasized in Korean childcare settings. Moreover, the ongoing refresher and promotion education programs do not meet the needs of childcare teachers because most in-service education programs are conducted in a uniform and undifferentiated course in the form of a collective lecture-type class. The one-to-one coaching program, My Teaching Partner (MTP), provides specific feedback when a teacher sends a video containing interactive scenes with children in the classroom and uploads it to a secure website (Downer et al., 2009). This program, which has been systematically operated by expert groups at Virginia University, improved teachers' interaction quality and led to the growth of children's language and literacy (Early et al., 2017; Mashburn et al., 2010). Rather than relying on the

uniform method of in-service programs in Korean childcare settings, more effective and diversified ways, such as the MTP program with workshops explaining the principles of interactions, should be pursued.

The current review provides information about the features of the intensity of in-service programs that are beneficial for ECEC teachers, policymakers, and program developers. Considering that this aggregated information came from systematic reviews in many countries, this study could provide more evidence-based insights into functional mechanisms related to PD effectiveness.

## 5. Conclusion

Warm and sensitive interaction with infants, defined as interaction quality in this study, is critical for supporting children's growth in childcare settings. Domestic and foreign in-service programs were found to contribute to effectively improving the childcare teachers' quality of interactions. Based on the findings of the present study, the provision of in-service programs using a mixed-delivery format of workshops and coaching targeting childcare teachers should be expanded. Moreover, the in-service programs should be delivered in shorter than a 1-month period, more frequently (i.e., more than 20 sessions), or with longer sessions (i.e., 4–6 h per session) to improve teachers' interaction quality effectively.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Data availability

Data will be made available on request.

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