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REVIEW PAPER

# Healthcare-Based Interventions to Improve Parenting Outcomes in LMICs: A Systematic Review and Meta-Analysis

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## Abstract

**Objectives** Although a number of early childhood development (ECD) interventions in healthcare settings in low- and middle-income countries (LMICs) have been developed to improve parent-directed outcomes and support ECD, their impact have yet to be established. This review assesses the effectiveness of healthcare-based ECD interventions in LMICs on the following key evidence-informed parenting outcomes affecting ECD: (1) responsive caregiving (2) cognitive stimulation and (3) parental mental health. Impacts on parental knowledge regarding ECD and parenting stress were also assessed.

**Methods** PubMed, PsycINFO, Scopus, CINAHL and Embase were searched. We included randomized controlled trials reporting effects of healthcare-based ECD interventions in LMICs on parent-directed outcomes in the first five years of life. Data extraction included study characteristics, design, sample size, participant characteristics, settings, intervention descriptions, and outcomes. Meta-analyses were conducted using random effects models.

**Results** 8 articles were included. Summary standardized mean differences demonstrated significant benefits of healthcare-based interventions in LMICs for improving: (1) cognitive stimulation (n = 4; SMD = 0.32; 95% CI: 0.08 to 0.56) and (2) ECD knowledge (n = 4; SMD = 0.44; 95% CI: 0.27 to 0.60). No significant effects were seen on maternal depression and parenting stress; only one study assessed parent-child interactions in the context of responsiveness. Limitations included small number of studies for moderation analysis, high heterogeneity, variability in measures used for outcomes and timing of assessments.

**Conclusions for practice** Our results demonstrate statistically significant effects of healthcare-based interventions in LMICs on improving key evidence-based parenting outcomes and offers one promising strategy to support children reach their full developmental potential.

**Keywords** Child development · Parenting · Healthcare · Meta-analysis · Systematic review

## Introduction

Early childhood development (ECD), such as speech, cognition and social-emotional skills obtained prior to 5 years of age, are predictive of later educational, emotional, and economic achievement (Cunha & Heckman, 2009; Duncan et al., 2007; Patel et al., 2018; Walker et al., 2011). Consequently, delays in these early developmental skills can have profound impacts on a child's life course trajectory. Thus, in low- and middle-income countries (LMICs) where nearly 45% of children less than 5 years of age fail to reach their developmental potential, strategies to support ECD are a public health priority (Lu et al., 2016).

The Nurturing Care Framework (NCF), presented initially in the seminal Lancet Early Childhood Development

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series and adopted by the World Health Assembly in 2018, highlights the critical research-based components needed to support ECD: health, nutrition, safety, responsive caregiving and opportunities for learning (Britto et al., 2017). Incorporating these components, the World Health Organization (WHO) recently developed its first guidelines towards improving ECD with a specific focus on responsive caregiving, opportunities for early learning, and maternal mental health (*Improving Early Childhood Development; WHO Guideline.*, 2020). As a means to direct policy and advocacy efforts, the evidence-informed guidelines underscore the importance of early life experiences, and parent-directed outcomes in particular, in promoting ECD (Black et al., 2017; Kadir et al., 2018).

Several ECD interventions, that is those interventions which focus on improving key parent-directed outcomes, are now being developed; many with significant effects. Indeed, a meta-analysis conducted to assess the effectiveness of ECD interventions in LMICs found them to be effective in supporting positive parent-child interactions and improving cognitive stimulation activities (Jeong et al., 2016). The analyses, which assessed interventions using various platforms of delivery (e.g., home visits), highlight the promise of such interventions in improving key targets supporting ECD. Together with the fact that child development is now an integral component of the Sustainable Development Goals (World Health Organization, 2015), there is growing demand to implement ECD interventions at scale in resource-limited settings including LMICs (Dua et al., 2016).

Central to the NCF and the WHO guidelines is the involvement of the healthcare sector. The healthcare setting has several characteristics which make it uniquely positioned to serve as an integral setting for a scalable, population-level approach for supporting ECD. First, there is often an already established infrastructure in place for reaching caregivers and their children. Second, routine health visits for immunizations in early childhood provide an opportunity for frequent touchpoints during a period of critical brain development. Third, immunizations and well-child visits are recommended for all children providing a population-level, non-stigmatizing platform for delivery of evidence-informed interventions.

Increasingly, ECD interventions are now leveraging these advantages within the healthcare setting in LMICs to target parent-directed outcomes and support ECD.

Although a systematic review (Peacock-Chambers et al., 2017) and meta-analysis (Shah et al., 2016) have demonstrated the effectiveness of healthcare-based ECD interventions on supporting responsive interactions and cognitive stimulation in the United States, to our knowledge no such analyses have been conducted with a focus on LMICs. Addressing this gap in the literature is critical for healthcare providers (e.g., pediatricians), international public health agencies, and policy makers as they strive to make informed evidence-based decisions regarding implementation, incorporation, and dissemination of ECD interventions in LMICs. Given the increased attention to healthcare settings as a potential platform to integrate ECD interventions, a focus specifically on LMICs which account for potential differences in service resources and contexts from the United States is warranted. Therefore, the objective of this review and meta-analysis was to evaluate the effectiveness of healthcare-based ECD interventions in LMICs on improving the following parent-directed outcomes: (1) responsive caregiving (2) cognitive stimulation and (3) parental mental health. Impacts on parental knowledge regarding ECD and parental stress were also explored.

## Methods

### Search Strategy

A systematic review search discovery of healthcare-based intervention studies published from January 1, 2000, through July 23, 2020, which focused on improving parent-directed outcomes to support ECD in LMICs was designed and implemented using the following databases by the fifth author, a clinical librarian: SCOPUS, PubMed, EMBASE, CINAHL, and PsycInfo. Comprehensive combinations of controlled vocabulary terms and keywords comprised the searches, which intersected two broadly articulated concept areas: (1) parenting relationships and parenting proxies (e.g., "parent-child relations", "family relations", "home life") and (2) LMICs (e.g., "developing country", "low-income country," exact geographical regions and countries). Depending on the database, result sets were filtered (preserving high sensitivity) to include clinical or randomized trials, infants and pre-school children age groups, articles published after January 1, 2000, and English-language articles (See online resource for search string). The results were reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines (Liberati et al., 2009).

### Selection Criteria

We included English-language, peer-reviewed publications meeting the following criteria: (1) focused on parent-directed interventions that aimed to promote ECD; (2) reported intervention outcomes related to responsive parenting behavior, cognitive stimulation, parental mental health outcomes, parental stress, and/or parenting knowledge regarding ECD;

(3) implemented the parent-directed intervention primarily in a healthcare setting (e.g., health clinic); (4) included parents of children equal to or less than 60 months of age; (5) took place in a LMIC; and (6) used a randomized controlled trial (RCT) or quasi-RCT study design.

We excluded articles that were: (1) parent-directed interventions studies which specifically aimed to treat a behavioral issue or disorder (e.g., attention-deficit/hyperactivity disorder); (2) focused only on children with development disabilities or disorders (e.g., autism spectrum disorders); (3) evaluated interventions designed primarily to target nutrition practices (e.g., breastfeeding); and (4) took place predominantly outside of the healthcare setting (e.g., home visiting programs).

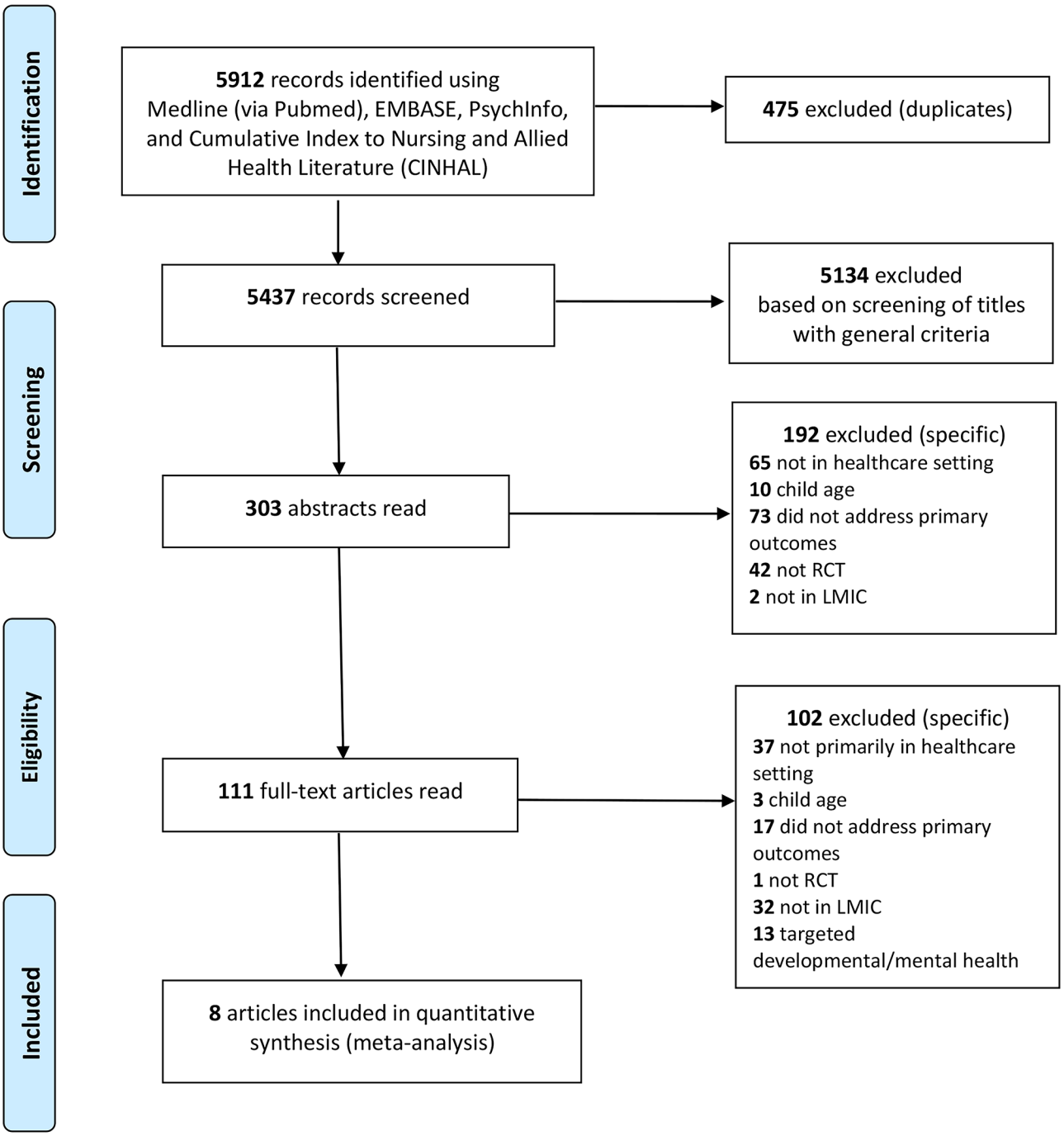


**Fig. 1** Study identification, exclusion, and inclusion

**Table 1** Individual Study Characteristics

| First Author, Year | Country | Intervention | | | Participants Sample Size (*n*) | | Outcomes Relevant to Review | | Evaluation Period | Findings |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Description | Mode of Delivery | Number and Length of Sessions for Study | Parental Characteristics | Child's Age | Parent Outcome | Parent Assessment | | |
| Hamadani, 2019 | Bangladesh | Pairs of mothers participated in developmentally appropriate mother-child play sessions | Frontline government health workers | 25 play sessions every two wks for one year; 4–60 min | Mothers ($n = 1737$) | 5–24 mo | 1. Parental knowledge 2. Cognitive stimulation 3. Maternal depression | 1. Questionnaire used in prior study 2. UNICEF FCI questionnaire 3. Shortened CES-D | Baseline and after receiving intervention for 12 mo | Intervention group showed greater improvements in child rearing knowledge, home stimulation, and had significantly lower maternal depression scores |
| Khan, 2018 | Pakistan | Educational topics on child stimulation, nutrition, and maternal mental health delivered through flipbooks in a 1:1 format | Doctors and clinic assistants | Quarterly sessions; visits to clinic at 3, 6, 9 mo; 10-minute sessions | Mothers ($n = 2327$) | Less than 40 days | 1. Maternal depression | 1. PHQ9 | At 12 mo of age | Percentage of mothers with depression were lower in intervention group |
| Chang, 2015 | Jamaica, Antigua, and St. Lucia | Video messages about child development; discussions about video content; demonstration | Community health workers | 5 group visits at 3,6,9,12,18-mo health visits; median of 16 min | Mothers ($n = 501$) | 6–8 wks | 1. Maternal depression 2. Parenting knowledge 3. Stimulation | 1.CES-D 2. Parenting knowledge questionnaire 3. HOME (aggregate score) | Baseline, post-intervention (minimum of 2 wks after 18-mo clinic visit) | Intervention group had significant increases in praise, decreased negative talk, and greater gains in parenting knowledge |
| Nahar, 2014 | Bangladesh | Counseling and play sessions with mothers and children | Community health workers | 1-hour session every other week for 6 months | Mothers ($n = 506$) | 6–24 mo | 1. Maternal depression | 1. Modified CES-D | Baseline, 3 and 6 mo after intervention | No significant group differences |

**Table 1** (continued)

| First Author, Year | Country | Intervention | | | Participants Sample Size (*n*) | | Outcomes Relevant to Review | | Evaluation Period | Findings |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Description | Mode of Delivery | Number and Length of Sessions for Study | Parental Characteristics | Child's Age | Parent Outcome | Parent Assessment | | |
| Nahar, 2012 | Bangladesh | Psychosocial stimulation; play activities; parent education on child development and child rearing practices | Community health workers | 1-hour session every other week for 6 months | Parents whose children recovered from an acute infection at the hospital ($n = 507$) | 6–24 mo | 1. Cognitive stimulation 2. Responsiveness | 1. HOME aggregate 2. Modified questionnaire used in a prior study in Bangladesh | 1. Baseline and 6 months | Intervention group increased in maternal involvement, use of play materials, and had improvement in child-rearing practices |

**Table 1** (continued)

| First Author, Year | Country | Intervention | | | Participants Sample Size (*n*) | | Outcomes Relevant to Review | | Evaluation Period | Findings |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Description | Mode of Delivery | Number and Length of Sessions for Study | Parental Characteristics | Child's Age | Parent Outcome | Parent Assessment | | |
| Aboud, 2013 | Bangladesh | Group sessions on parenting practices related to health, nutrition, communication and play; home visits | Community health workers | 14 group sessions: bi-weekly for 4 months, monthly for 6 months | Mothers ($n = 463$) | 4–14 mo | 1. Cognitive stimulation<br>2. Maternal depression<br>3. Parenting knowledge | 1. HOME aggregate score<br>2. CES-D<br>3. 6-item questionnaire | Baseline, 1 mo after the end of intervention | Intervention group improved in home parenting practices, stimulation, and had increased maternal knowledge in child development |
| Zhang, 2018 | China | Education program; FCC intervention that encouraged parents to engage with child while they were in the NICU for at least 4 h a day | Nurses and Doctors | FCC intervention for at least 4 h a day until discharge | Parents with infants born at less than 37 wks of gestation ($n = 120$) | Newborn (born at less than 37 wks) | 1. Parental stress<br>2. Parental anxiety | 1 & 2. WK Zung Self-Assessment Instrument | Baseline, after educational sessions (discharge, 1 week and 1 mo after discharge) | Intervention group reported less anxiety and depression |
| Husain, 2017 | Pakistan | Group sessions using psychosocial techniques and a pictorial calendar displaying stages of childhood development to facilitate discussion | Graduate psychologists with supervision by clinical psychologists | 12 wks; 10 group sessions, 60–90 min per session | Women who met diagnosis of depression using Revised Clinical Interview Schedule ($n = 247$) | 0–30 mo | 1. Maternal depression<br>2. Severity of depression<br>3. Stress in parent-child relationship<br>4. Self-esteem and personal worthlessness<br>5. Perceived social support<br>6. Maternal knowledge and attitudes about 0–36 mo of development | 1. EDPS<br>2. HAM-D<br>3. PSI<br>4. RSES (Urdu version)<br>5. MSPSS<br>6. IDQ | Baseline, 3 mo, 6 mo | Intervention group had reduced stress, maternal depression, and severity of depression; improvements in self-esteem; no difference in perceived social support; increased knowledge and improved attitudes about child development (after 6 mo) |

**Table 1** (continued)

| First Author, Year | Country | Intervention | | | Participants Sample Size (*n*) | | Outcomes Relevant to Review | | Evaluation Period | Findings |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Description | Mode of Delivery | Number and Length of Sessions for Study | Parental Characteristics | Child's Age | Parent Outcome | Parent Assessment | | |

Note: mo = Months, wks = Weeks, *n* = Number of Participants, FCC = Family Centered Care, O = Outcome, A = Assessment, CES-D = Center for Epidemiological Studies Depression Scale, UNICEF = United Nations Children's Fund, FCI = Family Cares Indicator, BSID-II = Bayley Scales of Infant Development, MDI = Mental Development Index, PDI = Psychomotor Development Index, Bayley-III = Bayley Scales of Infant and Toddler Development and Behavior, PHQ9 = Patient Health Questionaire-9, PSI = Parenting Stress Index, GMDS = Griffith Mental Development Scale, HOME = Home Observation for Measurement of the Environment Inventory, EDPS = Edinburgh Postnatal Depression Scale, HAM-D = Hamilton Depression Rating Scale, RSES = Rosenberg Self-Esteem Scale, MSPSS = Multidimensional Scale of Perceived Social Support, IDQ = Infant Development Questionnaire

### Data Extraction and Evaluation of Study Quality

Titles were initially screened for relevancy. Eligible abstracts were subsequently reviewed using the above-described inclusion and exclusion criteria. Full text articles were then independently reviewed using a structured screening form to assess eligibility. The structured form was used to extract data independently from each eligible study and included information on study characteristics (e.g., participant descriptions, randomization method), intervention elements (e.g., location, components), and outcome measurement. Methodological quality assessment of included studies was completed using the Cochrane Risk of Bias Tool to assess for selection, reporting, performance, detection, and attrition biases. Each of the above steps (e.g., screening, eligibility) was independently conducted by at least two reviewers who were authors on this paper. Any disagreements among reviewers during the review process and study quality were resolved through discussion and consensus.

### Outcomes

Primary outcomes for this review were the following: (1) responsive caregiving, (2) participation in cognitively stimulating activities (e.g., reading, play) and (3) parental mental health. Secondary outcomes included parental knowledge regarding ECD and parental stress.

### Statistical Analysis

Meta-analysis was conducted on standardized mean difference (SMD; Hedges g) between intervention and control groups with studies weighted by the inverse variance method. All meta-analyses were conducted with random effects for both measure and study (to adjust variances for clustering of measures within studies) fitted with restricted maximum likelihood methods. Heterogeneity among studies was assessed by computing the $Q$ statistic, its p-value, and $I^2$ statistic. Significant heterogeneity was found in previous meta-analyses assessing ECD interventions; therefore, expecting similar findings, we explored potential categorical moderators noted to impact outcomes in these studies (Jeong et al., 2016; Peacock-Chambers et al., 2017; Shah et al., 2016). Moderator analyses were conducted using mixed effect models, calculating the effect sizes as the standardized mean differences (SMDs) and 95% CI, and assessing for statistical differences of the effect sizes using the Qb statistic. Analyses were conducted for moderators if the same predictor and outcome were assessed by at least four studies. Analyses were conducted by using the metafor package for R 3.6 (www.R-project.org) and Comprehensive Meta-Analysis (Version 3.0).

## Results

The search produced 5912 articles from all databases. After screening, 8 studies were included (Fig. 1). Two studies represented different outcomes from the same trial (Nahar et al., 2012, 2015).

Table 1 provides an overview of the studies included in this review, including sample and participant characteristics, intervention description, and outcomes assessed. Four studies were randomized by individuals (Husain et al., 2017; Nahar et al., 2012, 2015; Zhang et al., 2018), while the remaining were randomized by clinic. Sample sizes ranged from 120 to 2327 parents at enrollment. Control groups in most of the studies received usual care or standard care.

### Setting and Participant Characteristics

The studies took place in six different countries. One of the studies took place in Jamaica, St. Lucia, and Antigua (Chang et al., 2015). Antigua is categorized as a high-income country based upon methodology to calculate gross national incomes by the World Bank (see http://data.worldbank.

org/ about/country-classifications/country-and-lending-groups); however, data were aggregated with Jamaica and St. Lucia, which are both LMICs and therefore included in this analysis.

Parents in the included studies were mostly women. In all studies in which it was reported, mean maternal education was 10 years or less. The majority of participants ranged in age from 22 to 28 years of age. No study included parents of children greater than two years of age; children ranged in age from newborn infants to 30 months of age.

## Intervention Description

The eight included studies represented seven healthcare-based ECD interventions. Although some studies used adaptations of the same intervention, variations including mode, frequency and intensity of delivery (Hamadani et al., 2019; Nahar et al., 2012, 2015). Some interventions were initially developed in countries other than their own (Hamadani et al., 2019; Husain et al., 2017; Nahar et al., 2012; Zhang et al., 2018); one of these interventions was adapted from a high-income country (Husain et al., 2017).

Most interventions were delivered in community-based clinics. Interventions ranged in terms of who delivered the program. The majority of interventions were delivered by community health workers while others used health professionals such as doctors and psychologists. A few of the interventions were delivered via a 1:1 format between intervention administrators and the parent (Khan et al., 2018; Nahar et al., 2012, 2015). However, some interventions which employed a group-based format also integrated individual components such as 1:1 counseling sessions (Aboud et al., 2013; Chang et al., 2015; Hamadani et al., 2019).

Interventions were delivered over a range of time periods from one to 24 months with three to 25 sessions of various lengths (10 min to four hours). Many of the interventions utilized modeling of parent-child shared play activities to promote parenting outcomes; others used visual content, such as flipbooks and video content.

## Outcomes Assessed

The included studies measured parenting outcomes according to the defined categories for this review (Table 1): cognitive stimulation activities (n = 4), responsive caregiving (n = 1), parental mental health (n = 7), knowledge regarding early childhood development (n = 4), and parenting stress (n = 2). Outcomes were measured at intervals ranging from immediately after the intervention was completed to one-year post-intervention with the majority ranging between two weeks to six months. Measurements used varied across articles.

Cognitive stimulation in the home was assessed in three studies using the Home Observation Measurement of the Environment (HOME) inventory (Aboud et al., 2013; Chang et al., 2015; Nahar et al., 2012) and was measured by self-report by Hamadani et al., (2019) using Family Care Indicators developed by UNICEF. Reliability of the measures used to assess cognitive stimulation was noted in three studies (Chang et al., 2015; Hamadani et al., 2019; Nahar et al., 2012).

Responsive interactions were measured in one study using a self-report questionnaire used in previous studies in Bangladesh (Nahar et al., 2012). This self-report questionnaire assessed behaviors such as demonstrating love and affection and interactions during everyday routine behaviors (e.g., dressing, bathing). The reliability of the parent-child interaction measure was noted.

In terms of mental health outcomes, six studies assessed symptoms related to depression; one study for anxiety (Table 1). Symptoms of maternal depression were measured using the Center for Epidemiologic Studies Depression Scale, the Edinburgh Postnatal Depression Scale, and the Patient Health Questionnaire 9. Authors noted details regarding reliability of measures for mental health outcomes in four of the studies (Aboud et al., 2013; Chang et al., 2015; Husain et al., 2017; Nahar et al., 2015).

Parental knowledge regarding ECD was assessed as it related to child rearing practices that promote ECD or maternal knowledge regarding attainment of developmental milestones/stages of development. All measures were self-report and were used in prior published studies or developed or adapted specifically for the study. The majority noted reliability of measures used for assessing knowledge (Aboud et al., 2013; Chang et al., 2015; Hamadani et al., 2019).

Lastly, parenting stress was reported in two articles (Husain et al., 2017; Zhang et al., 2018) used the W.K. Zung self-assessment, which was completed collectively by both parents. Husain et al., (2017) utilized the Urdu version of the Parenting Stress Index; reliability of the measure was assessed.

## Meta-Analysis Results

Summary standardized mean differences demonstrated significant benefits of healthcare based ECD interventions in LMICs for improving the following outcomes (Fig. 2 & Fig. 3): (1) parental provision of cognitive stimulation (n = 4; SMD = 0.32; 95% CI: 0.08 to 0.56) and (2) knowledge regarding ECD (n = 4; SMD = 0.44; 95% CI: 0.27 to 0.60). No significant effects were seen on symptoms of maternal depression (n = 6; SMD=-0.35; 95% CI: -0.78 to 0.08) and parenting stress (n = 2; SMD – 1.64; 95% CI: -3.50 to 0.23); only one study assessed parent-child interactions

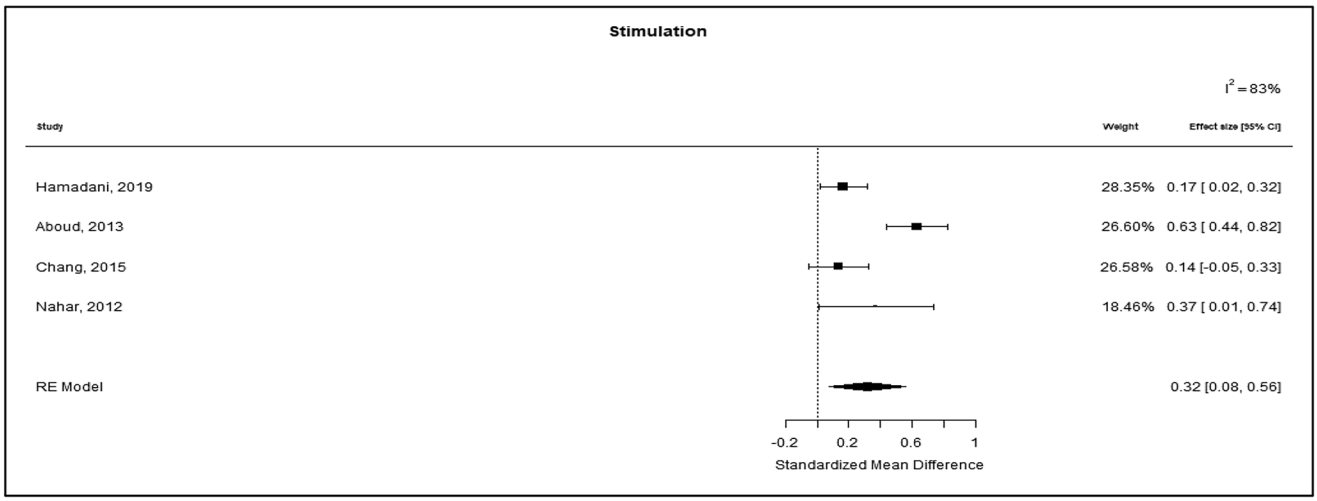


**Fig. 2** Forest plot displaying the effect size and 95% CIs of health care-based parenting intervention and provision of cognitive stimulation. Positive effects indicate that cognitive stimulation was increased in intervention participants relative to control participants.

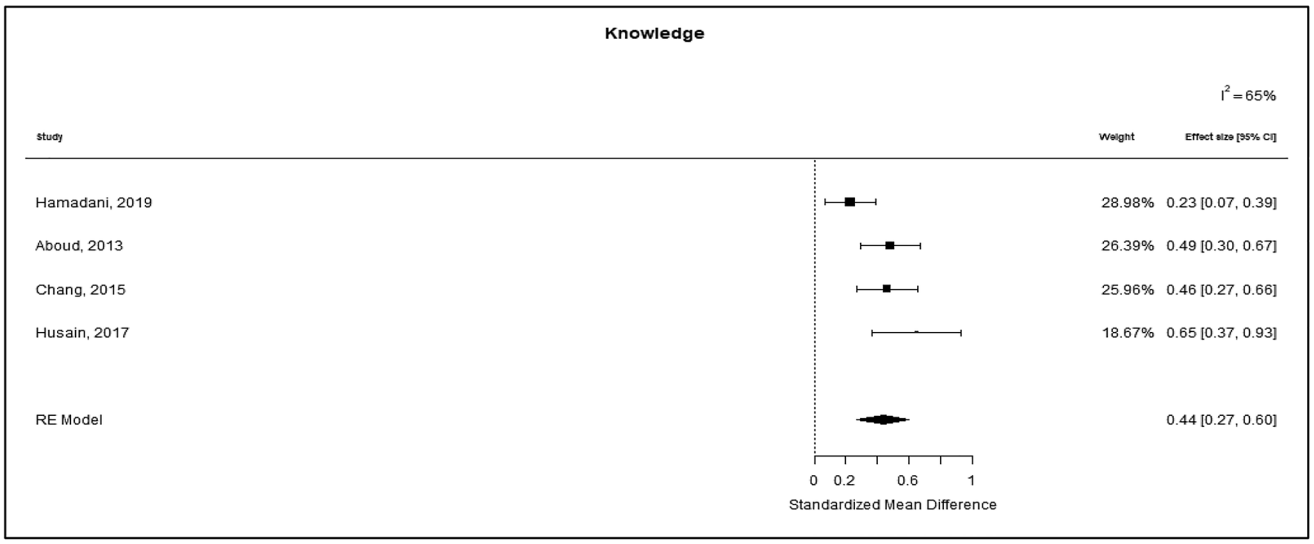


**Fig. 3** Forest plot displaying the effect size and 95% CIs of health care-based parenting intervention caregiver knowledge regarding early child development. Positive effects indicate that knowledge was increased in intervention participants relative to control participants.

in the context of responsiveness and meta-analysis was not conducted.

## Moderator Analyses

Statistically significant heterogeneity was noted among studies for outcomes related to cognitive stimulation ($Q = 16.5$, $p < 0.01$, $I^2 = 81.8\%$), knowledge regarding ECD ($Q = 8.6$, $p < 0.05$, $I^2 = 64.9\%$), maternal depression ($Q = 129.8$, $p < 0.001$, $I^2 = 96.1\%$), and parenting stress ($Q = 40.9$, $p < 0.001$, $I^2 = 97.6\%$). As shown in Table 2, meta-regression analyses revealed effect sizes for maternal depression varied according to who delivered the intervention, with larger effect sizes seen in studies evaluating interventions delivered by a professional (SMD =-0.96, 95% CI: -1.37 to -0.56) compared to delivered by nonprofessionals (SMD =-0.05, 95% CI: -0.16 to -0.07). The effect size for maternal knowledge varied according to whether the intervention targeted children who were malnourished: larger effect sizes were noted in the studies evaluating interventions which did not target children who were malnourished (SMD = 0.51, 95% CI: 0.39 to 0.63) compared to the study that did (SMD = 0.23, 95% CI: 0.07 to 0.39). Analyses demonstrated effect sizes for stimulation did not differ significantly by any of the moderators examined.

**Table 2** Results of Moderator Analysis on Caregiver Knowledge, Provision of Stimulation, and Depression Outcomes

| Moderator Variable | Knowledge | | | Between Groups | | Stimulation | | | Between Groups | | Depression | | | Between Groups |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Number of studies** | **ES (95%CI)** | ***p*value** | **QB** | ***p*** | **Number of studies** | **ES (95%CI)** | ***p*value** | **QB** | ***p*** | **Number of studies** | **ES (95%CI)** | ***p*value** | ***p*** |
| **Age** | | | | 0.05 | 0.82 | | | | 1.59 | 0.45 | | | | 0.52 |
| *Mean age less than 12 months of age* | 2 | 0.48 (0.34 to 0.61) | < 0.001 | | | 2 | 0.38 (-0.09 to 0.84) | 0.12 | | | 3 | -0.37 (-1.16 to 0.43) | 0.43 | |
| *Mean age greater than 12 months of age* | 2 | 0.62 (0.01 to 0.84) | 0.04 | | | 1 | 0.17 (0.02 to 0.32) | 0.03 | | | 2 | -0.44 (-1.00 to 0.13) | 0.13 | |
| **Delivery format** | | | | a | a | | | | 0.09 | 0.76 | | | | 0.44 |
| *Group or combination of group/individual* | 4 | a | a | | | 3 | 0.30 (0.01 to 0.59) | 0.04 | | | 4 | -0.19 (-0.47 to 0.09) | 0.17 | |
| *Individual* | 0 | a | a | | | 1 | 0.37 (0.01 to 0.74) | 0.04 | | | 2 | -0.63 (-1.69 to 0.43) | 0.25 | |
| **Country** | | | | 0.03 | 0.86 | | | | 1.66 | 0.2 | | | | 0.05 |
| *Lower-middle* | 3 | 0.44(0.20 to 0.68) | < 0.001 | | | 3 | 0.38 (0.06 to 0.70) | 0.02 | | | 5 | -0.44 (-0.92 to 0.05) | 0.08 | |
| *Upper-middle* | 1 | 0.47(0.27 to 0.66) | < 0.001 | | | 1 | 0.14 (-0.05 to 0.33) | 0.16 | | | 1 | 0.09 (-0.11 to 0.28) | 0.38 | |
| **Delivered by a professional** | | | | 0.41 | 0.52 | | | | a | a | | | | < 0.001 |
| *No* | 3 | 0.39 (0.22 to 0.56) | < 0.001 | | | 4 | a | a | | | 4 | -0.05 (-0.16 to -0.07) | 0.4 | |
| *Yes* | 1 | 0.65 (0.37 to 0.93) | < 0.001 | | | 0 | a | a | | | 2 | -0.96 (-1.37 to -0.56) | < 0.001 | |
| **Number of delivery sessions (12 or more)** | | | | 1.27 | 0.26 | | | | 1.66 | 0.2 | | | | 0.23 |
| *No* | 2 | 0.53 (0.36 to 0.70) | < 0.001 | | | 1 | 0.14 (-0.05 to 0.33) | 0.16 | | | 3 | -0.60 (-1.41 to 0.21) | 0.15 | |
| *Yes* | 2 | 0.35 (0.10 to 0.60) | 0.01 | | | 3 | 0.38 (0.06 to 0.70) | 0.02 | | | 3 | -0.10 (-0.22 to 0.01) | 0.08 | |
| **Targeted underweight children** | | | | 7.30 | 0.01 | | | | 0.48 | 0.49 | | | | 0.34 |
| *No* | 3 | 0.51 (0.39 to 0.63) | < 0.001 | | | 2 | 0.38 (-0.09 to 0.84) | 0.12 | | | 4 | -0.46 (-1.09 to 0.17) | 0.15 | |
| *Yes* | 1 | 0.23 (0.07 to 0.39) | < 0.001 | | | 2 | 0.20 (0.05 to 0.36) | 0.01 | | | 2 | -0.15 (-0.29 to -0.00) | 0.05 | |

a = Insufficient studies to conduct analysis

### Risk of Bias

Risk of bias assessments are presented in Table 3 (Online resource). Performance bias was present in all included studies; however, given the nature of interventions, blinding of participants was not expected to be possible. Most of the included studies were assessed as low risk regarding selection, detection, and attrition biases; the majority were preregistered and assessed as low risk for reporting bias.

## Discussion

Policy makers, clinicians, and public health organizations are imparted with the responsibility of distinguishing which strategies offer promise for wide-scale dissemination of ECD interventions to best reach the large number of children failing to meet their developmental potential in LMICs. Integrating ECD interventions within the healthcare setting offers one promising strategy but raises the question of whether embedding parent-directed programs in healthcare settings in LMICs is feasible and, if so, whether it is effective in improving research-based parenting outcomes that support ECD. In pursuit to answer these questions, we conducted a meta-analysis which aimed to examine the extent to which healthcare-based programs in LMICs are effective in improving key parent-directed outcomes.

We found a total of eight studies describing seven randomized controlled trials of ECD interventions integrated within healthcare settings in LMIC targeting parent-directed outcomes. Data from the randomized trials demonstrated significant effects of healthcare-based ECD interventions on parental provision of cognitive stimulation and parental knowledge regarding ECD. These results suggest the healthcare setting could be an alternate or an added component to existing programs, such as home-visiting programs, assisting with larger dissemination and/or synergy in delivery.

No significant effects of healthcare-based parenting interventions on symptoms of depression were found. However, when reviewing these results, the following points must be considered. The included studies in this review focused on healthcare-based interventions specifically in the context of improving ECD and therefore did not capture those studies whose primary aim was to improve depression without this focus. Indeed only one of the studies included in this meta-analysis specifically recruited women who had symptoms of depression or who met a diagnosis of depression (Husain et al., 2017). Further, although six studies assessed maternal mental health outcomes only two of the studies included these outcomes as primary (Husain et al., 2017; Nahar et al., 2015). Lastly, although there may have been improvements on symptoms of depression, the studies may have had insufficient power to identify a statistically significant pooled effect. Poor maternal mental health is associated with worse child developmental outcomes, including increases in problematic behavior and diminished cognitive achievement (Rahman et al., 2013; Wachs et al., 2009). Consequently, our results suggest it may be beneficial to include a greater focus on mental health when considering the development and evaluation of future healthcare-based interventions targeting ECD.

### Limitations

Our study has limitations which should be noted. First, our analyses were based upon a small number of studies which can impact the power to detect pooled intervention effects. Likewise, the meta-regression analyses conducted were performed on a limited number of studies and precluded our ability to conduct moderation analyses for all outcomes. Results should be viewed as exploratory and evaluated further in future studies. Lastly, in addition to variability in time of assessment and ages of parents' children, there was variability in the tools and methods (i.e., self-report versus observational assessment) for measuring outcomes which may have influenced comparability between studies.

### Implications for Future Research and Policy

Despite these limitations, our results have important considerations for future research and policy. A limited number of studies assessed parent-child interactions in the context of responsive and sensitive interactions. Although an extensive body of research has noted these interactions are essential in supporting ECD, a feasible way to assess these characteristics in diverse international settings remains a challenge. Observational assessments, which are the gold standard, often require additional resources including personnel and training. Many of the studies used the observational assessment, HOME inventory, to assess for these interactions; some adapted it for self-report use which offers one promising solution. However, scores were often reported as an aggregate. Reporting different subscale scores (e.g., responsivity, learning materials) may allow for better comparison between interventions and assist in understanding underlying mechanisms for program outcomes.

The economic gains from investing in early childhood programs are well-established (Gertler et al., 2014; Heckman, 2006). Integrating ECD interventions within the healthcare setting may also offer significant economic gains through effects on future educational, income, and health outcomes. Additional research seeking to quantify these effects would be useful in providing governments with economic incentives to develop, adapt, and invest in

healthcare-based strategies to address ECD (Vaivada et al., 2017).

All but one study targeted mothers as caregivers. Including other caregivers, for example grandparents, may be particularly important in countries where multigenerational living situations may be more common (Reher & Requena, 2018). Additionally, there was a lack of emphasis on targeting fathers despite evidence demonstrating the importance of paternal involvement on cognitive stimulation, maternal well-being and child development outcomes (Cabrera et al., 2007; Jeong et al., 2018; Maselko et al., 2019; Tamis-LeMonda et al., 2004; Yargawa & Leonardi-Bee, 2015). In addition to promoting ECD, targeting other caregivers would also allow programs to study potential positive impacts on maternal outcomes including mental health.

Although our results suggest promise of healthcare-based ECD interventions in LMICs, strategies on *how* to implement these programs for widespread dissemination are needed to ensure successful uptake within existing healthcare infrastructures. Specifically, future work should apply implementation science methodology to identify facilitators and barriers which enable programs to be implemented effectively within healthcare settings (Yousafzai et al., 2018). For example, while exploratory and with limitations, our results demonstrated the effect of healthcare-based ECD interventions on maternal depression were affected by who delivered the intervention. Assessing implementation outcomes including fidelity and acceptability to key components of treatments may facilitate delivery by nonprofessionals and support future accessibility and sustainability efforts in resource-scarce settings. Likewise, understanding which barriers were encountered and how they were addressed are also critical pieces of information required for future implementation and scalability efforts.

## Conclusions

To our knowledge, this systematic review and meta-analysis is the first to assess the effect of healthcare-based interventions in LMICs on key evidence-informed parenting outcomes affecting ECD. Our results demonstrate healthcare-based ECD interventions have positive effects on parental provision of cognitive stimulation and knowledge regarding ECD; however, no effects were seen on maternal depression and parenting stress. The utilization of standardized measures for evaluating parenting outcomes will be an important aspect to inform future evaluations of ECD interventions. As one promising strategy to assist children in reaching their developmental potential, future studies should also consider assessing implementation to support scalability and accessibility efforts of healthcare-based ECD interventions in LMICs.

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**Authors' contributions** Dr. Shah conceptualized and designed the study, conducted the moderator analysis, conducted and double-checked data extraction, drafted the initial manuscript, and reviewed and revised the manuscript. Andrea Camarena, Christen Park, and Aleah Martin conducted data extraction, double checked data extraction, developed tables/figures, and *reviewed and revised the manuscript.* Professor Clark developed the search strategy, performed the literature search, drafted the search strategy section, and reviewed and revised the manuscript. Dr. Atkins contributed to study design and provided critical revision of the manuscript. Dr. Schwartz contributed to study design, conducted the meta-analyses, edited the meta-analyses section, interpreted the data, reviewed and provided critical revision of the manuscript. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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**Code Availability** Not applicable.

## Declarations

**Conflict of Interest** The authors have no conflicts of interest relevant to this article to disclose.

**Ethics Approval** Institutional Review Board (IRB) approval was not sought as this study is an analysis of already published studies which have already obtained ethical approval. This article does not contain any studies with human participants performed by any of the authors.

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