World Health Organization recommendation on psychotherapeutic interventions for common maternal mental health problems among women to improve early childhood development in low and middle income countries:

Report of systematic review and meta-analysis of RCTs

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Background

Early childhood development (ECD) refers to the process of cognitive, physical, language, temperament, socio-emotional, and motor development of children that starts at the time of conception and continues to 8 years of age. The day-to-day interactions between children and their primary caregivers influence neurological, cognitive, emotional and social development throughout childhood (Knudsen, 2014; Shonkoff et al, 2009). The first 1000 days are especially important being the time when the brain develops rapidly. It is therefore a critical period for the child to receive nurturing care; it is also a period when the children are especially sensitive to interventions.

Recent literature has shown that maternal mental health problems are not only detrimental to a woman's physical health but also associated with higher rates of emotional, behavioural and physical problems among their young children (Rahman et al, 2008). This is particularly important in low- and middle-income (LAMI) countries where the negative effects of maternal mental health on the growth and development of infants and young children are more prominent and independent of the influence of confounding factors such as poverty and malnutrition (Stewart, 2007; Engle, 2009). In low-income settings, maternal depression has been linked directly to low birth weight and under-nutrition during the first year of life, as well as to higher rates of diarrhoeal diseases, incomplete immunization and poor cognitive development among young children (Patel et al, 2003; Rahman et al, 2004a; Rahman et al, 2004b; Rahman et al, 2007; Waqas et al, 2018). These adverse effects on child health have long lasting adverse academic and socioeconomic outcomes, contributing to a vicious cycle of poverty and inequality evident across generations (Peet et al,2015; Case & Paxson, 2008; Engle et al, 2007). It is estimated that aforementioned child developmental deficits account for 19.8% of annual adult income, with a global cost of 177 billion USD for physical growth deficits alone (Grantham-McGregor et al, 2007; Fink et al, 2016).

Although the pathways between perinatal psychiatric morbidities and child development have not been fully elucidated yet, recent research suggests a mediating relationship than a causal one. In this context, a number of psychological interventions conducted in the peripartum period aimed at improving maternal mental health also report a corresponding improvement in child behavioural and physical health. For instance, a significant improvement in infant weight, height, diarrhoeal illness, immunization coverage, infant mortality, and breast feeding practices have been reported among participants of maternal psychosocial interventions (Cooper et al, 2002; Rahman et al., 2008; Tripathy et al., 2010). Conversely, a number of interventions focused at early developmental outcomes among children report an improvement in maternal mental health as a secondary outcome (Rahman et al, 2009; Cooper et al, 2002; 2009). This further corroborates the complexity and mediating/moderating relationships between maternal and early developmental indicators among children. It, thus, warrants the identification of theoretical and taxonomic orientation of different interventions, that drive the bidirectional association between maternal and child outcomes.

The 2030 Sustainable Development Goals (SDG) recognize the early childhood development as a public health priority under SDG-4, ensuring good opportunities for early childhood development for all (United Nations, 2015). Therefore, developing consolidated WHO guidance highlighting the effects of psychological interventions aimed at improving maternal mental health and early development among children would provide a specific direction to health sector programmes. This systematic review and meta-analysis has thus, addresses following questions:

Scoping Question in PICO format

Question	What is the role of supporting maternal mental health as a key influence on ECD outcomes?	**Importance**
Population	Pregnant women or women who have recently given birth	
Intervention	Psychological intervention for depression and anxiety	
Comparison	Care as usual	
Outcome	• Child development (including motor, cognitive, language and socio-emotional) • Growth (Height, weight) • Breastfeeding • Care seeking for childhood illnesses • Rate of childhood illnesses • Child mortality • Depressive symptom severity • Anxiety symptom severity • Functioning • Adverse effects (including tolerability)	Critical Critical Important Important Important Important Important Important Important

Methods

Database Searches

Two reviewers independently conducted a systematic search of online academic databases of seven electronic bibliographic databases including MEDLINE, EMBASE, CINAHL, PsycINFO, the British Nursing Index, the Allied and Complementary Medicine database and the Cochrane Central Register, using a pretested search strategy (Table 1) as outlined in our previous systematic review (Rahman et al., 2013). Original articles reporting randomized and controlled trials published in English language from the year January 2012 to January 2018 and based in low and middle income countries (World Bank, 2015) were included. Furthermore, reference list of our previous systematic review and meta-analysis on psychosocial perinatal interventions published through December, 2011 were also included (Rahman et al., 2013). In case of any discrepancies in the electronic search process, differences were resolved through discussion among the reviewers and senior authors.

Inclusion criteria

a) Studies evaluating any non-pharmacological intervention assessing common perinatal mental health problems (anxiety and depression) conducted during the peripartum period.

b) Studies evaluating any non-pharmacological intervention with a primary focus on early childhood development *and* assessing common perinatal mental health problems (anxiety and depression) as a secondary outcome.

c) Studies conducted in World-Bank defined low and middle income countries (World Bank, 2015).

d) Studies reporting a health outcome among children aged 0-3 years old.

Exclusion criteria

a) Studies published in a language other than English due to unavailability of bilingual experts.

b) Non-intervention or qualitative studies.

c) Abstracts, conference papers, review papers and letter to editors were excluded.

e) Studies without information about ethical approval.

f) Studies conducted among specialized groups, such as women with prior mental health or physical problems or those who experienced stillbirth.

g) Studies reporting outcomes among children with medical comorbidities or congenital malformations.

h) Studies assessing effectiveness of complementary medications.

Intervention(s)/exposure(s)

All non-pharmacological interventions with a primary *or* secondary focus on improving the mental health of women, and a primary or secondary focus on improving the development and health of their children were included. All psychosocial interventions were included that either focused on maternal mental health as a primary outcome or child development interventions that reported maternal mental health as a secondary outcome.

Comparator(s)/control

When there were control groups such as participants undergoing pharmacological interventions or care as usual, comparisons were conducted.

Primary outcome(s)

a) Perinatal mental health and early child development related outcomes assessed at primary end-points were included. These outcomes include:

Outcomes:

- Depressive symptom severity
- Anxiety symptom severity
- Child development (including cognition, language, socio-emotional and motor)
- Growth (Height, weight)
- Breastfeeding
- Parenting practices
- Care seeking for childhood illnesses
- Rate of childhood illnesses
- Responsive caregiving activities including stimulation and play
- Provision of early learning opportunities (including play-based learning)
- Adverse effects (including tolerability)

b) Process outcomes included processes involved in implementation of intervention programs included in systematic reviews to allow subgroup analyses.

Taxonomy of interventions: Distillation and matching

Three reviewers evaluated the content of the interventions to identify commonly utilized strategies and elements. To ensure uniformity, this process was undertaken two phases. In the first phase, the senior authors and subject experts conceptualized an elaborate taxonomy of treatment components of psychosocial interventions for common mental disorders after conducting a through literature review (Abraham & Michie, 2008; Michie et al, 2013; Pentecost et al,

2015; Singla et al, 2017; Chorpita et al, 2005). This taxonomy included 58 most commonly utilized behaviour change techniques and treatment elements that are then clustered into four hierarchies: a) treatment specific elements b) non-specific elements and c) in-session techniques used by the delivery agents. The treatment-specific elements were based on several strategies packing behavioural, interpersonal, emotional, and cognitive elements. Non-specific elements mainly pertained to engagement skills while in-session techniques included psychoeducation, direct suggestions, motivational interviewing and biofeedback among others. Thereafter, all of these elements were operationalized and manualised into a scoring matrix to aid the review process.

In the second phase, a thematic analysis of the content of interventions and their manuals was conducted by the reviewers and senior authors. The thematic analysis was based on the conceptual framework of distillation and matching proposed by Chorbita et al., which conceptualizes psychosocial interventions as composites of individual strategies and elements rather than a single unit (Chorpita et al, 2005). Unlike the dominant approaches whereby psychosocial interventions are evaluated on basis of their theoretical orientations as grouping factors, distillation and matching process identifies the treatment elements and strategies accounting for the effects and rationale of the psychosocial interventions. Therefore, this process may aggregate pragmatically similar but disaggregate realistically/theoretically similar interventions.

Data extraction, selection and coding

Extraction of data on pretested proformas were conducted by a two reviewers working independently from each other. Prior to running the formal data extraction process, inter-rater reliability was established using the Cohen's Kappa. All data were extracted regarding implementation processes related to target population, primary outcomes, geographical setting, and format of intervention program, theoretical basis, type and training of delivery agent, and effect sizes of primary outcomes related to maternal mental health and child cognitive development measured at primary time points. Any differences in data extraction was resolved by discussion between the reviewers and the principle authors.

Strategy for data synthesis

For the purpose of analysis, the interventions were divided into two sets: a) those that impacted maternal mental health directly and, b) those with a primary focus on child development/health and indirectly impacting symptoms of maternal depression or anxiety as a secondary outcome. Quantitative and dichotomous primary outcomes were converted into standardized mean differences (SMD; mean of intervention group minus mean of control group, divided by the pooled standard deviation) and aggregated using random-effects model (Higgins et al, 2011; Chinn, 2000). These meta-analyses were represented as forest plots of SMDs, their 95% confidence interval and relative weights calculated as inverse of its variance and accounting for both original with-in studies variance and between studies variance Tau (Borenstein et al, 2007). Statistical significance was set at P value < 0.05 (two-tailed test) or as the absence of overlap between the 95% of the pooled effect size.

If both categorical and continuous data were reported, continuous data was preferred for quantitative synthesis. Assuming that the underlying continuous data in all groups follow a logistic distribution, the binary outcomes were converted into standardized differences in means using the following formula: $SMD= \sqrt{3}/\pi \ln OR$ (Higgins & Green, 2011).

When there were more than 4 studies, subgroup analyses with mixed effects were conducted among known groups such as geographical scope, theoretical nature and elements of interventions, and setting of intervention (Fu et al, 2011). Heterogeneity

among trials was calculated using the Q statistics and I^2 measure of inconsistency which describes the percentage of variability in the effect estimates accounting for heterogeneity beyond sampling error (Higgins et al, 2011); where p=0.10 and/or I^2 >50% indicate significant heterogeneity. We also conducted post-hoc sensitivity analyses (using leave-one-out analyses) to test the impact of exclusion of a single trial with a disproportionately large effect.

Risk of bias and quality assessment

If more than five studies reported an outcome, publication bias among included studies was identified by visualizing the funnel plot and the Egger's statistics (significant at $P < 0.10$) (Egger et al, 2003). In case of a significant publication bias, pooled effect sizes were adjusted by using the Duval and Tweedie's trim & fill method (Duval and Tweedie, 2000). The trim-and-fill method of Duvall and Tweedie enhances the symmetry of the funnel plot by adding studies that seem to be potentially missing across the mean.

A group of reviewers assessed the risk of bias among included randomized controlled trials using the modified Cochrane risk of bias tool against the following matrices: a) random sequence generation b) allocation concealment c) blinding of research personnel d) blinding of outcome assessors e) attrition bias f) other biases and g) selective reporting (Higgins et al, 2011). The modified risk of bias tool included two additional matrices; objectivity of outcome and status of termination of intervention as per the pre-defined time-point. Studies meeting three or more high-risk/unclear criteria were considered as having an overall low quality (Cujipers et al, 2014). When there were more than 10 studies for an outcome, meta-regression analysis was run to analyse the effect of quantitative and dichotomous moderators (e.g. age of participants, proportions of each sex, and quality of the studies, primary end points, and sample size) on pooled effectiveness of interventions.

Strength of evidence and recommendations

Once the evidence was identified and synthesized and its quality assessed, the direction and strength of the recommendations was determined by examining additional criteria:

- GRADE approach: The quality of the meta-analytical evidence and strength of recommendations for each outcome was evaluated using the GRADE approach as outlined by the Grading of Recommendations, Assessment, Development and Evaluations (GRADE) Working Group (GRADE, 2004).

  Using this approach, meta-analytical evidence for each outcome was rated across following matrices; a) study design, b) Quality c) consistency d) indirectness e) imprecision and f) magnitude of effect size. The final quality of the evidence based on GRADE scores was categorized as high, moderate, low and very low.
- Desirable and undesirable effects of these recommendations.
- The certainty or quality of the evidence of effects (i.e. risk of bias, inconsistency, indirectness, imprecision, and publication bias).
- Values, preferences and feasibility issues related to the recommended interventions in different settings; and
- The resource use implications of options available to program managers in different settings.

Results

Electronic searching of databases yielded 20,273 titles and abstracts eligible for screening. After screening of these titles and abstracts, a total of 22 unique full texts were found eligible to be included in the evidence synthesis. Moreover, 11 additional full texts were also included from a systematic review published by the senior authors in 2013, yielding a total of 33 full texts (Rahman

et al, 2013). A total of 17 studies described interventions with a primary maternal mental health focus while 16 studies pertained to interventions with a secondary focus on maternal mental health. The database search process are presented in detail as a PRISMA flowchart (Figure 1).

List of included RCTs/cRCTs

The RCTs/cRCTs included in this systematic review are cited in the bibliography section of this report.

Section 1

Interventions with a primary focus on maternal mental health outcome

There were a total of 17 studies and a long term follow up study (Rahman et al., 2008; Maselko et al, 2015) where the primary outcomes were maternal mental health problems. A majority of the studies (13, 76.47 %) reported a randomized controlled design, followed by cluster randomized controlled trial (3, 17.65%), and prospective interventional controlled design (1, 5.88%). A total of 7 (41.18%) in urban areas, 3 (17.65%) interventions were delivered in rural areas and 1 (5.88%) in deprived urban area (missing information; n=6). Out of these 17 interventions, 10 (58.82%) were conducted at a healthcare facility while 4 (23.52%) were community based (not reported, n= 3). A majority of these interventions targeted women at high risk of mental health problems identified by screening tools (10, 58.82%) while the rest targeted women with a diagnosed condition using detailed interviews or a cut off score using a psychometric scale (7, 41.18%). Study wise information regarding these variables is presented in Supplementary Table 1.

Most commonly employed psychometric scales for assessment of maternal outcomes were Edinburgh Postnatal Depression Scale (EPDS), Beck's Depression Inventory (BDI), Spielberg's State Trait Anxiety Inventory (SSTAI), Structured Clinical Interview for DSM (SCID), Centre for Epidemiological Studies Depression (CESD), Kesseler 10-item scale (K-10), Postpartum Depression Scale (PDS) and Symptoms Checlist-90 items (SCL-90). The most commonly employed scales for measurement of child outcomes includes the Bayley Scales of Infant and Toddler Development (BSID). It assesses child development in five areas: cognitive, language, motor, social-emotional, and adaptive behaviour. Please, see supplementary table 1 for detailed results.

A majority of the maternal mental health-focused programmes incorporated single modal interventions rather than multicomponent integrated and comprehensive intervention packages. Detailed characteristics of included studies and recipients are given in Table 1 and Table 2. The most commonly employed strategies included psychoeducation (5, 29.41%), cognitive behavioural therapy (5, 11.76%), interpersonal psychotherapy; various non-specific strategies such as participatory learning, social support, aerobic exercise (2, 5.0%), kangaroo care and music therapy (1, 5.88%), or a combination of strategies (2, 11.76%).

The strategies included many common elements such as engagement with the mother and family, interpersonal skills and promoting social support, coping skills, problem solving, stress management, mood monitoring, motivational enhancement , parenting skills, and incorporating advice about health, nutrition, exercise and substance use. The description of principals and rationale behind these interventions has been detailed in Table 2. Frequency and percentage of reviewer rated elements of interventions are detailed in supplementary table 2 and 3 and Figures 4-7.

Eight out of 17 interventions (47.06%) were delivered by non-specialists (4, 23.53%), 5 (29.41%) by specialists, 1 (5.88%) a combination of specialists and non-specialists (missing information n=3). The delivery agents included midwife (2, 11.76%), nurse (2, 11.76%), research therapists (1, 5.88%), local women (1, 5.88%), midwives and doctors (1, 5.88%), lady health workers (1, 5.88%), trained instructor (1, 5.88%), obstetrician (1, 5.88%), physician (1, 5.88%), psychologists (1, 5.88%), physicians and physiotherapists (1, 5.88%), while 3 (17.65%) studies did not report the delivery agent of interventions. Integration of these intervention into existing healthcare setups was reported in 5 (29.41%) trials, 3 (17.65%) non-integrated and rest were not specified.

Duration of overall intervention program ranged from 2 weeks to 20 months (x̃= 6 weeks) in these trials. And the number of sessions ranged from 1 to 20 (x̃= 7) and duration of individual sessions 40 minutes to 4 hours (x̃= 75 min). Number of booster sessions were not frequently reported in the trials (supplementary Table 4).

Effectiveness of these intervention was evaluated across several outcomes. Out of 17 included trials, severity of symptoms of maternal anxiety was reported in 5 (29.41%) trials and maternal depressive symptoms in 14 trials (82.35%). Only four studies (23.53%) had reported any child outcomes including exclusive breast feeding (n=2, 11.76%), childhood recent illnesses (n=2,11.76%), care-seeking practices (n=2, 11.76%), neonatal mortality (n=1, 5.88%), low birth weight (n=1, , 5.88%), weight for age-z scores (n=1, 5.88%), height for age-z scores (n=1, 5.88%), stunting (n=1, 5.88%), BMI for age (n=1, 5.88%), child anxiety symptoms (n=1, 5.88%), emotional difficulties (n=1, 5.88%), child cognitive development (n=1, 5.88%) and play frequency (n=1, 5.88%). Outcomes reported in $\geq$ two studies were meta-analysed to yield a pooled effect size (Forest plots 1 to 5).

These interventions led to a significant improvement in maternal anxiety symptoms (SMD= -0.51, 95% CI= -0.72 to -0.30, n=411, $P < 0.001$, I^2= 9.75%, Q-value= 4.43) and maternal depressive symptoms (SMD= -0.695, 95% CI= -0.92 to -0.47, n= 16,123, $P < 0.001$, I^2= 93.39%, Q-value= 196.62), exclusive breast feeding (SMD= 0.155, 95% CI= 0.07 to 0.25, n= 18,314 , P =0.001; OR=1.33, 95% CI=1.12 to 1.56, I^2= 22.40%, Q-value= 1.29) and recent illnesses (SMD= -0.607, 95% CI= -1.24 to -0.03, n= 17,631 , $P < 0.001$, I^2= 97.92%, Q-value= 48.08). While no significant improvement was reported in care seeking behaviours in event of child illnesses (SMD= 0.436, 95% CI= -0.76 to 1.54, n= 17,631, P =0.44, I^2= 98.39%, Q-value= 62.21).

Several outcomes were reported in single studies with effect sizes as follows: child anxiety symptoms (SMD= 0.141, 95% CI= -0.02 to 0.30, n= 584, P =0.089); neonatal mortality (SMD= -0.187, 95% CI= -0.26 to -0.11; ; OR=0.71, 95% CI= 0.62 to 0.81, n= 19,030, $P < 0.001$); low birth weight (SMD= 0.05, 95% CI= -0.42 to 0.52, n=349, P=0.840); weight for age (SMD= -0.015, 95% CI= -0.26 to 0.23, n= 727, P= 0.903); height for age (SMD=0.156, 95% CI= 0.010 to 0.302, n= 727, P=0.306); stunting (SMD= -0.172, 95% CI= -0.37 to -0.0.03, n= 705, P =0.093); BMI for age (SMD= -0.075, 95% CI= -0.24 to 0.09, n= 584, P =0.365); childhood emotional difficulties (SMD= 0.082, 95% CI= -0.08 to 0.24, n= 584, P =0.323); child cognitive development (SMD= 0.300, 95% CI= 0.14 to 0.46, n= 584, $P < 0.001$) and play frequency (SMD= 0.582, 95% CI= 0.41 to 0.75, n= 705, $P < 0.001$). Sensitivity analysis involving removal of each study one by one did not reveal any change in pooled effect size related to depressive and anxiety symptoms and exclusive breast feeding. Detailed results have been presented as Forest plots 1-5.

Visualization of funnel plot revealed no publication bias in reporting of maternal anxiety symptoms (Egger's regression intercept P-value > 0.1). However, it was significant in reporting of severity of depressive symptoms (Egger's P= 0.01). Several methodological inconsistencies were, however, identified in the included clinical trials. Out of 17 included trials, 4 (22.22%) were found to have a high quality; $\leq$ 3 study design characteristics exhibiting an unclear or high risk of bias. The highest proportion of high risk of bias was exhibited in reporting of blinding of participants and personnel, and outcome assessors and allocation concealment. While the highest proportion of the parameter "other biases" was rated as unclear. Detailed rating of risk of bias have been presented in Figures 2 and 3.

Further subgroup analysis were conducted to explore differences in effect sizes of these interventions according to their nature, theoretical basis, and setting and delivery agents. No significant subgroup differences were found on the basis of scope, components of intervention, quality theoretical orientation and delivery agent of intervention for the outcomes of anxiety and depression. However, interventions focusing on depressive symptomatology, delivered in houses (SMD= -1.06, 95% CI= -1.22 to -0.89) yielded higher effect sizes followed by community (SMD=-0.71, 95% CI= -1.18 to -0.23) and hospital based interventions (SMD= -0.65, 95% CI= -0.85 to -0.45) (Table 2). Due to a significant proportion of missing data, meta-regression analyses could not be conducted for duration, and number of sessions of interventions.

Section 2

Interventions with an indirect impact on maternal mental health

A total of 16 studies reported interventions with a secondary focus on maternal mental health problems. Majority of the studies evaluated these interventions using a randomized controlled design (9, 56.25 %), followed by cluster randomized controlled trial (7, 43.75%). Out of the 16 studies, 8 (50.0%) were conducted in urban settings and 5 (31.25%) in rural areas (missing information n= 3). A total of 9 (56.25%) studies were delivered in community settings whereas 6 (37.5%) in health care facilities and 1 (6.25%) in rural parishes. A majority of the interventions 12 (75%) were prevention based and only 4 (25%) interventions were treatment based (Supplementary table 1).

These interventions utilized a variety of psychometric instruments for assessing maternal mental health and early childhood outcomes. Centre for Epidemiological Studies Depression (CESD), Edinburgh Postantal Depression Scale (EPDS) and Self Reporting Questionnaire (SRQ) were the most utilized for assessment of depressive symptomatology, state-trait anxiety inventory for symptoms of anxiety and Bayley scales of infant development for assessment of Cognitive, receptive and expressive language, and fine and gross motor development among children. Morris et al (2012) assessed maternal mood using the Kitgum maternal mood scale, an indigenously developed psychometric scale for sadness and grief among mothers in northern Uganda (Supplementary table 1).

While the primary focus of the intervention was child development or health, several psychosocial or behavioural strategies and elements were incorporated in the programmes. The theoretical basis for these interventions included psychoeduation (7, 43.75%), psychosocial stimulation (2, 12.5%), multimodal interventions with Cognitive behavioural, interpersonal, psychoeducation, and stimulation interventions (2, 12.5%), CBT (1, 6.25%), social support (1, 6.25%), play based program (1, 6.25%), Participatory learning and action (1, 6.25%) and breastfeeding training (1, 6.25%) (Supplementary table 2).

These interventions utilized a variety of specific strategies including behavioural, interpersonal, cognitive, parenting techniques, cognitive coping skills, specific intervention delivery techniques and psycho-education. Most frequently reported elements were parent-child interaction, communication skills, nutrition, caregiver coping, social support and behavioural contracting. While most frequently employed non-specific elements were discussion of advantages and barriers to treatment (Supplementary table 3 and figures 6-7).

Out of total 16 interventions, only 2 (12.5%) were delivered by specialists while 14 (87.5%) were delivered by non-specialists. Delivery agents include community health workers 4 (25%), local women 3 (18.75%), lady health workers 1 (6.25%), nurses 2(12.5%), community volunteers 1 (6.25%), clinical psychologist 1 (6.25%), female community leader 1 (6.25%), researcher 1 (6.25%), whereas 1 (6.25%) study did not specify any delivery agent. Overall intervention duration and number of sessions ranged from 2 weeks to 18 months and 1 to 72 sessions respectively in included studies (Supplementary table 4).

Outcomes related to maternal depressive symptoms were reported in (11, 68.75%), anxiety (3, 18.75%), maternal involvement (6, 37.50%), cognitive development (5, 31.25%), exclusive breastfeeding (4, 25.0%), birth weight (3, 18.75%), care seeking (3, 18.75%), expressive (3, 18.75%) and receptive language development (4, 25.0%), height for age-z scores (HAZ) 6 (37.50%), weight for age-z scores (WAZ) 3 (18.75%), risk of infectious illnesses among children (2, 12.50%), gross motor (2, 12.5%) and fine motor development (1, 6.25%). Please, see forest plots 6-18 for detailed results. Two studies (Attanasio et al, 2014; Shariat & Abedinia, 2017) did not report effect size data pertaining to symptoms of anxiety and depression, however, these were included in meta-analyses of outcomes pertaining to early childhood developmental outcomes.

A variety of outcomes were reported in interventions with a secondary focus on maternal mental health. A significant improvement was reported in symptoms of maternal anxiety (SMD= -0.490, 95% CI= -0.691 to -0.290, n= 395, P <0.001, I^2= 0%, Q-value= 1.87) and depression (SMD= -0.182, 95% CI= -0.269 to -0.095, n= 12,605, P <0.001, I^2= 53.37%, Q-value= 23.59,11 studies), cognitive development (SMD= 0.568, 95% CI= 0.238 to 0.899, n= 3253, P =0.001, I^2= 95.26%, Q-value= 147.61), height for age (z-scores) (SMD= 0.081, 95% CI= -0.001 to 0.163, n= 4284, P =0.053, I^2= 33.96%, Q-value= 12.11), infant engagement (SMD=

0.386, 95% CI= 0.200 to 0.571, n= 555, P <0.001, I^2= 0%, Q-value= 0.89), expressive language (SMD= 0.372, 95% CI= 0.045 to 0.699, n= 2772, P= 0.026, I^2= 94.42%, Q-value= 89.61), receptive language (SMD= 0.304, 95% CI= 0.085 to 0.522, n= 3063, P =0.006, I^2= 88.76%, Q-value= 53.37), birth weight (SMD= 0.150, 95% CI= 0.020 to 0.281, n=1772, P =0.024, I^2= 0%, Q-value= 1.28), neonatal mortality (SMD= -0.226, 95% CI= -0.328 to -0.125; OR= 0.66, 95% CI= 0.55 to 0.80 n= 18715), weight for age (z-scores) (SMD= 0.135, 95% CI= -0.009 to 0.278, n= 3120, P =0.065, I^2= 66.23%, Q-value= 11.84), maternal involvement (SMD= 0.765, 95% CI= 0.129 to 1.402, n= 1405, P =0.018, I^2= 96.81%, Q-value= 157.0) and exclusive breast-feeding (SMD= 0.597, 95% CI= -0.045 to 1.239, n= 20,005; OR= 2.95, 95% CI= 0.92 to 9.46, P =0.068, I^2= 87.65%, Q-value= 24.99). Sensitivity analysis improved the significance of outcomes pertaining to exclusive breast feeding after removal of Fottrell et al (2013) and height for age. Please, see forest plots 6-18 for detailed results.

However, no significant improvement was reported in care seeking (SMD= -0.129, 95% CI= -0.329 to 0.070, n= 20,015, P =0.240, I^2= 31.50%, Q-value= 2.92), child recent illness (SMD= -0.118, 95% CI= -0.400 to 0.164, n= 738, P =0.413, I^2= 59.14%, Q-value= 4.89), fine motor (SMD= 0.054, 95% CI= -0.0.036 to 0.144, n= 1899, P =0.241, I2= 0%, Q-value= 0.24) and gross motor (SMD= 0.068, 95% CI= -0.013 to 0.149, n= 2325, P =0.101, I^2= 0%, Q-value= 1.57). Exclusion of statistics pertaining to young children (Aboud et al, 2013), yielded a significant reduction in recent illnesses among children. Subgroup analyses revealed that multimodal interventions yielded higher effect sizes for depressive symptoms than their counterparts. For cognitive development among children, higher effect sizes were reported for low quality studies and single component interventions. No publication bias was revealed for depressive symptoms, height for age and maternal involvement. However, visualization of funnel plot revealed significant publication bias in reporting of cognitive development among children (P-value= 0.01). Detailed results of subgroup analyses are presented in table 3.

Using the Cochrane risk of bias tool, a high proportion of studies were judged to have an unclear risk of bias across several matrices. The most frequent matrices rated as having high risk of bias included allocation concealment, blinding of participants and personnel and outcome assessors and other biases. While risk of bias was noted in selective reporting and attrition bias. A total of 5 of these studies were rated as having a high quality, with <3 matrices rated as having a high risk of bias. Detailed rating of risk of bias have been presented in Figure 2 and 3.

Sensitivity analyses & special cases of interventions

When the aforementioned sets were compared, it was found that interventions with a primary focus on maternal mental health yielded a higher effect size when compared with its counterparts. Studies with a primary focus on maternal mental health yielded a higher pooled effect size for depression (-0.70 vs -0.18, $\chi 2$= 16.68, P < 0.001). However, this difference in effect size was insignificant for the outcome of maternal anxiety (-0.50 vs -0.49, $\chi 2$= 0.02, P =0.89).

A careful dichotomy of interventions was conducted by the reviewers, based on authors' hypotheses, active psychotherapeutic elements and primary focus of interventions. However, one of the interventions having a primary focus on child health, had also incorporated specific elements of psychological therapies targeted toward maternal mental health (Singla et al., 2015). It was a multimodal intervention, primarily designed as a parenting and psycho-stimulation interventions comprising of six sessions on child care and included activities like role play, games, parent–child interactions, and group-based problem solving). Parents also received one or two home visits by the volunteer to review the five parenting messages, discuss their enactment, resolve barriers to enacting them, and make other relevant observations (eg, the provision of home-made toys and pictures, whether parents talked to one another and their child in a respectful tone). This intervention also combined 4 session of mother care for both the parents including several components spanning across non-specific elements of engagement and specific elements drawn from cognitive behavioural and interpersonal psychotherapies. Removal of this study from the pooled meta-analysis did not reveal any significant changes in the effect size. Another study presented as a special case (Tripathy et al, 2010), described a participatory intervention

but also included several behavioural therapeutic elements such as identifying affect, identifying and eliciting social support, problem solving, stress management, decision making, goal setting and interpersonal focus in addition to several non-specific elements of engagement. This program had explored maternal depressive symptoms as a primary outcome. Sensitivity analysis involving removal of this study from the pooled meta-analysis did not reveal any significant changes in the effect size of interventions with a primary focus on maternal mental health.

Strength of evidence

The GRADE approach was used to rate the strength of evidence of primary outcomes included in present quantitative synthesis. According to it, most of the outcomes had limitations in domains pertaining to the risk of bias, inconsistency and imprecision. While, indirectness did not exhibit serious threats to validity of the present evidence. Evidence for publication bias, consistency could not be assessed for outcomes reported in single studies.

Certainty of evidence for twelve outcomes was rated as high: maternal anxiety symptoms, child anxiety, neonatal mortality, exclusive breast feeding, weight for age, height for age, stunting, height for age, BMI for age, emotional difficulties, child cognition, and play frequency; moderate for low birth weight; low for risk of childhood illnesses; and very low for maternal depressive symptoms for care-seeking attitudes. Detailed results have been reported in tables 4 and table 5.

However, the certainty of evidence for outcomes reported in interventions with a secondary focus on maternal mental health, was generally better than those reported in their counterparts. Certainty of evidence was high for weight for age, height for age, gross and fine motor development, care-seeking attitudes and rate of childhood illnesses; moderate for symptoms of maternal anxiety and depression, cognitive development, expressive and receptive language, maternal involvement and neonatal mortality; low for exclusive breastfeeding.

Conclusions & recommendations

The overarching objective of this review was to explore the effectiveness of interventions with a primary or secondary focus on maternal mental health in improving both maternal mental health and child development outcomes in LMIC. This review also grades the strength of this evidence using the GRADE approach as outlined by the Grading of Recommendations, Assessment, Development and Evaluations (GRADE) Working Group (GRADE, 2004).

Based on the present findings:

Strategies addressing maternal anxiety and depression should be integrated into early child development programmes to improve both maternal mental health and child development outcomes.

Strength of recommendation: Strong

Certainty of evidence: Moderate

Additional considerations

Based on the findings of this review, the strength of recommendations for maternal outcomes (anxiety and depression) was found to be of consistent and good quality. The present meta-analysis reports an improvement in the severity of depressive and anxiety symptoms in the perinatal period, yielding effect sizes of moderate strength. However, poor trends were noted in the outcomes related to early childhood development, with only four studies reporting child outcomes or long term follow ups. Although the evidence was found to be of high to moderate certainty for most of these outcomes, we recommend further research.

It was generally observed that the interventions generally reported in this review were based on varying theoretical backgrounds, principals and content. Irrespective of the nature of interventions and targeted maternal or ECD indicators, the overall lessons of the review should be considered generalizable for their application among pregnant women.

- Strategies addressing maternal mental health should be integrated into ECD programs to improve maternal engagement with the children.
  Certainty of evidence: High
- Strategies and elements addressing maternal mental health should be integrated into ECD programs to improve exclusive breastfeeding practices among mothers in low and middle income countries.
  Certainty of evidence: High
- Strategies addressing maternal mental health should be integrated into MCH programs to reduce the burden of these conditions. The most commonly employed strategies with a theoretical orientation include cognitive behavioural and interpersonal. Non-specific strategies such as psychoeducation were more commonly employed. All of these strategies were effective for maternal mental health.
  Certainty of evidence: Good
- Strategies addressing maternal mental health should be integrated into MCH programs to improve child survival.
  Certainty of evidence: Good
- Strategies addressing maternal mental health should be integrated into MCH programs to improve child growth
  Certainty of evidence: Uncertain
- Strategies addressing maternal mental health should be integrated into MCH programs to improve child language development.
  Certainty of evidence: Uncertain
- Strategies addressing maternal mental health should be integrated into MCH programs to improve child motor development.
  Certainty of evidence: Uncertain
- There is some evidence that specialist and non-specialist interventions are equally effective in improving maternal mental health.
  Certainty of evidence: Good
- Non-specialist interventions are more cost effective than specialist delivered interventions.
  Certainty of evidence: Good
- Duration of overall intervention program ranged from 2 weeks to 20 months ($\tilde{x}$= 6 weeks), with number of sessions ranging from 1 to 20 ($\tilde{x}$= 7) and duration of individual sessions 40 minutes to 4 hours ($\tilde{x}$= 75 min). Number of booster sessions were not frequently reported in the trials. However, the relationship of these variables with pooled effectiveness of trials could not be determined due to a high proportion of missing data in the trials.
  Certainty of evidence: Uncertain
- Multiple component, comprehensive, and holistic interventions should have a better efficacy over single component interventions. The future interventions should incorporate multiple components including cognitive behavioural therapy, cognitive stimulation, exercise, health and maternal and child diet related education.
  Certainty of evidence: low

Future direction:

- Information related to the 'how' of the program—i.e., how the program was implemented successfully with regards to the training, supervision and compensation of delivery agents, key program characteristics, and relevant barriers or facilitators—were not commonly reported. These interventions should be manualized in order to improve the overall quality and reproducibility of program implementation.
- There was only one intervention programs aimed towards improving maternal and child health in refugee and conflict settings.
- A number of these programs were adapted from guidelines and sample interventions from organizations such as the UNICEF. It is very important to adapt these interventions to the local sociocultural setting.
- Only a few interventions had included micronutrient supplementation, generally reporting insignificant improvements in maternal mental health. However, macronutrient supplementation programs integrated with psychosocial interventions generally yielded better outcomes. Macronutrient supplementation may yield better outcomes in resource constrained areas.
- Most of the interventions were based in local clinics and hospitals. There were only a few community or workplace based intervention programs. Embedding these interventions in local community centers, religious schools such as madrassahs and Sunday mass schools should be explored in future research.
- Most of the psychoeducational interventions were based on didactic formats. Cognitive stimulation of the child by learning through play and interactive support groups were also reported as components of these interventions.
- There were no intervention programs designed for teen pregnancies which are prevalent in many traditional cultures.
- All of the programs targeted expectant or new entrants into motherhood. However, expectant fathers should be made stakeholders in these interventions. This is important to target relevant risk factors of maternal and child health (e.g., intimate partner violence and involvement of father in parental care).
- No interventions were conducted in federally administered tribal regions of Pakistan, Bangladesh and Afghanistan supporting a high percentage of residents identify as internally displaced people or refugees.

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Tables & Figures

Table 1: Search Strategy for Peer-reviewed articles

Focus	Search terms
Population & condition being studied	exp Depression/ maternal depression.mp. exp Depressive Disorder/ or perinatal depression.mp.

	postnatal depression.mp. or exp Depression, Postpartum/ postpartum depression.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms] exp Mental Disorders/ or exp Anxiety Disorders/ or common mental disorders.mp. mental health.mp. or exp Mental Health/ depress*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms] exp Psychotic Disorders/ or postpartum psychosis.mp. exp Anxiety/ or anxiety.mp. or exp Anxiety Disorders/
Study design	randomised controlled trial.mp. controlled clinical trial.mp. or exp Controlled Clinical Trial/ clinical trials.mp. or exp Clinical Trial/ evaluation studies.mp. or exp Evaluation Studies/ Cross over studies.mp. or exp Cross-Over Studies/
Setting	(Afghan* or Albania* or Algeria* or American Samoa* or Angola* or Argentin* or Armeni* or Azerbaijan* or Bangladesh* or Belarus*or Belize* or Benin* or Bhutan* or Bolivia* or Bosnia* or Botswana* or Brazil* or Bulgaria* or Burkina* or Burundi* or Cabo Verde* or Cape Verde* or Cambodia* or Cameroon* or Central African* or Chad* or Chin* or Colombia* or Comor* or Congo* or Costa Rica* or Cote Ivoire or Ivorian* or Cuba* or Djibouti* or Dominica* or Dominican Republic or Ecuador* or Egypt* or El Salvador* or Equatorial Guinea* or Eritrea* or Ethiopia* or Fiji* or Gabon* or Gambia* or Georgia* or Ghana* or Grenad* or Guatemala* or Guinea* or Guinea* Bissau or Guyan* or Haiti* or Hondura* or India* or Indonesia* or Iran* or Iraq* or Jamaica* or Jordan* or Kazakhstan* or Kenya* or Kiribati* or Korea* or Kosov* or Kyrgyz* Republic or Lao* or Leban* or Lesotho* or Mosotho* or Basotho* or Liberia* or Libya* or Macedonia* or Madagas* or Malawi* or Malaysia* or Maldiv* or Mali* or Marshall* or Mauritania* or Mauriti* or Mexic* or Micronesia* or Moldova* or Mongolia* or Montenegr* or Morocc* or Mozambi* or Myanmar* or Namibia* or Nepal* or Nicaragua* or Niger* or Nigeria* or Pakistan* or Palau* or Panama* or Papua New Guinea* or Paraguay* or Peru* or Philippine* or Filipino* or Romania* or Russia* or Rwand* or Samoa* or Sao Tome or Saotomean* or Senegal* or Serbia or Sierra Leone* or Solomon Island* or Somali* or South Africa* or South Sudan* or Sri Lanka* or St Lucia* or St Vincent* or Sudan* or Suriname* or Swazi* or Syrian* or Tajik* or Tanzania* or Thai* or Timor Leste or Togo* or Tonga* or Tunisia* or Turk* or Turkmen* or Tuvalu* or Uganda* or Ukrain* or Uzbek* or Vanuatu* or Venezuela* or Vietnam* or West Bank or Gaza or Palesti* or Yemen* or Zambia* or Zimbabwe*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]

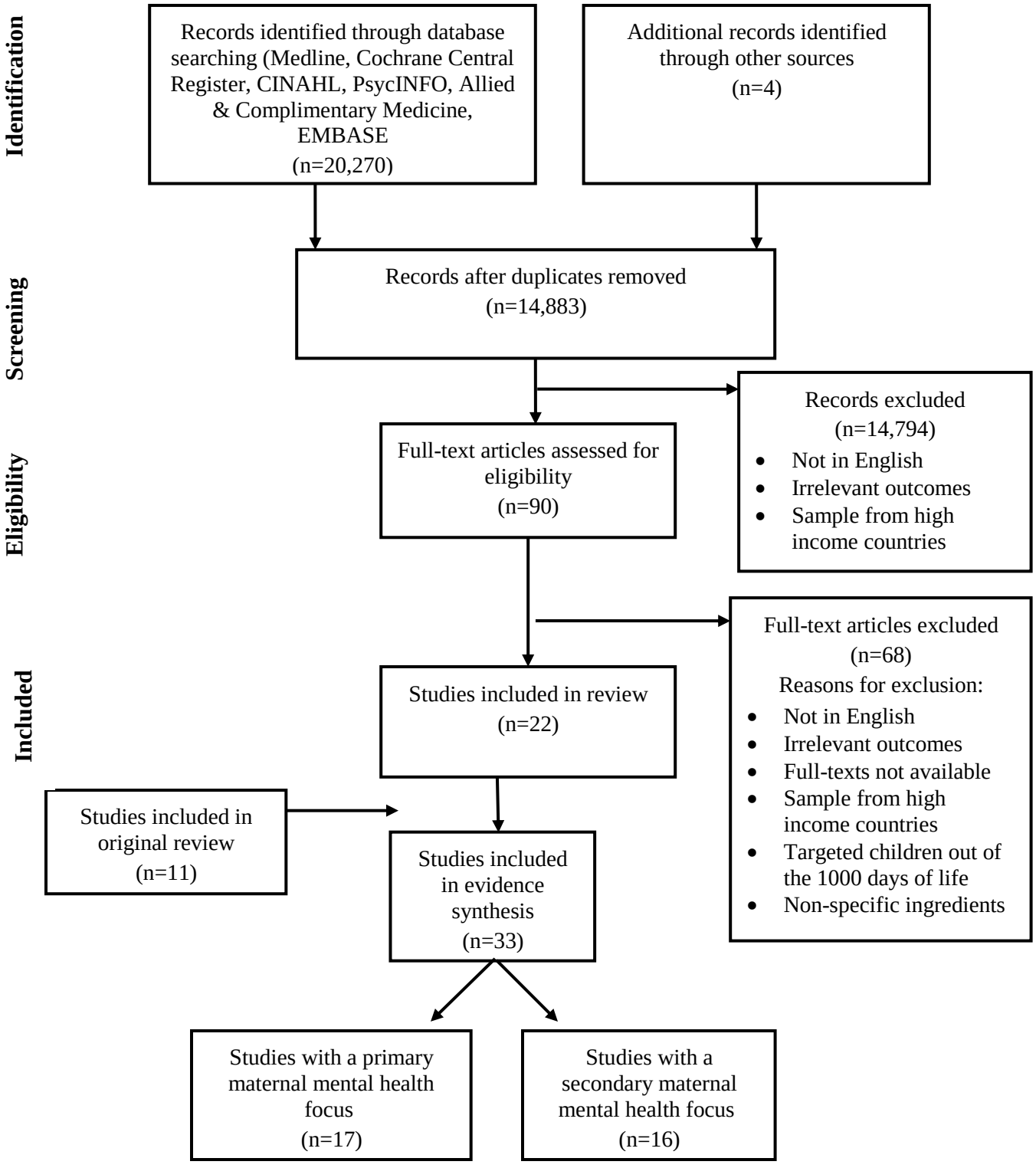

Figure 1 Flow diagram of identification and selection of articles for inclusion in review.

Table 2: Subgroup analyses for maternal and child outcomes reported in interventions with a primary focus on maternal mental health[1]

Outcome	Subgroup	Category	Number of trials	SMD (95% CI)	Q-value	P-value
Depressive symptoms	Quality	High	3	-0.90 (-1.3 to -0.50)	1.17	0.28
		Low	11	-0.64 (-0.90 to -0.37)		
	Scope of intervention	Prevention	9	-0.66 (-0.97 to -0.34)	1.6	0.69
		Treatment	5	-0.75 (-1.05 to -0.44)		
	Multicomponent therapy	Yes	3	-0.53 (-0.97 to -0.09)	0.68	0.41
		No	11	-0.74 (-0.95 to -0.52)		
	Theoretical basis	Cognitive behavioural therapy	4	-0.71 (-1.09 to -0.34)	6.06	0.12
		Exercise	2	-1.26 (-2.12 to -0.41)		
		Interpersonal	2	-0.35 (-0.60 to -0.1)		
		Psycho-education	6	-0.64 (-0.72 to -0.36)		
	Setting	Community	3	-0.71 (-1.18 to -0.23)	10.03	0.01*
		Home	1	-1.06 (-1.22 to -0.89)		
		Hospital	10	-0.65 (-0.85 to -0.45)		
	Delivery agent	Non-specialist	4	-0.57 (-0.91 to -0.22)	0.67	0.41
		Specialist	10	-0.74 (-0.88 to -0.48)		
Anxiety symptoms	Quality	Low	1	-0.77 (-1.19 to -0.35)	1.96	0.16
		High	4	-0.43 (-0.66 to -0.21)		
	Scope of intervention	Prevention	4	-0.46 (-0.68 to -0.24)	1.26	0.26
		Treatment	1	-0.79 (-1.31 to -0.27)		
	Multicomponent therapy	Yes	1	-0.79 (-1.31 to -0.27)	1.26	0.26
		No	4	-0.46 (-0.68 to -0.24)		
	Theoretical basis	Cognitive behavioural therapy	2	-0.47 (-0.98 to -0.02)	1.58	0.45
		Psychosocial	2	-0.42 (-0.79 to -0.06)		
		Psycho-education	1	-0.77 (-1.19 to -0.35)		
	Setting	Community	0	-	-	-
		Home	0	-	-	-
		Hospital	5	-	-	-
	Delivery agent	Non-specialist	5	-	-	-
		Specialist	0	-	-	-

*denotes $P < 0.05$

Table 3: Subgroup analyses for maternal and child outcomes reported in interventions with a secondary focus on maternal mental health[1]

Outcome	Subgroup	Category	Number of trials	SMD (95% CI)	Q-value	P-value
Depressive symptoms	Quality	High	3	-0.125 (-0.266 to -0.089)	-5.96	0.342
		Low	8	-0.213 (-0.328 to -0.098)	-1.97	
	Scope of intervention	Prevention	-	-	-	-
		Treatment	-	-	-	-
	Multicomponent therapy	Yes	1	-0.621 (-0.88 to (-0.36)	8.99	< 0.001*
		No	11	-0.105 (-0.14 to -0.07)	0	
	Theoretical basis	Cognitive behavioural therapy	2	-0.152 (-0.36 to 0.06)	2.39	0.91
		Psycho-education	6	-0.209 (-0.35 to -0.07)	16.94	
		Psychosocial stimulation	3	-0.173 (-0.31 to -0.03)	3.48	
	Setting	Community	6	-0.211 (-0.38 to -0.04)	16.26	0.79
		Home	4	-0.165 (-0.29 to -0.04)	4.61	
		Hospital	2	-0.127 (-0.29 to 0.03)	0.62	
	Delivery agent	Non-specialist	-	-	-	-
		Specialist	-	-	-	-
Exclusive breast feeding	Theoretical basis	Cognitive behavioural therapy	1	0.740 (0.42 to 1.06)	0	0.66
		Psychosocial	1	1.388 (-0.23 to 3.01)	0	
		Psycho-education	2	0.450 (-0.78 to 1.68)	2.67	
	Setting	Community	1	0.740 (0.42 to 1.06)	0	0.66
		Home	2	0.450 (-0.78 to 1.68)	2.67	
		Hospital	1	1.388 (-0.23 to 3.01)	0	
	Delivery agent	Non-specialist	2	0.365 (-0.33 to 1.06)	18.96	0.137
		Specialist	2	1.38 (0.05 to 1.24)	0	
Cognitive development	Quality	High	4	0.225 (0.17 to 0.35)	6.26	< 0.001*
		Low	1	1.571 (1.04 to 2.10)	6.89	
	Multicomponent therapy	Yes	1	0.17 (0.01 to 0.02)	0	0.03*
		No	5	0.63 (0.24 to 1.02)	140.51	
	Theoretical basis	Cognitive behavioural therapy	1	0.346 (0.11 to 0.58)	0	0.04*
		Psycho-education	3	0.953 (0.24 to 1.67)	88.88	
		Psychosocial stimulation	1	0.16 (0.07 to 0.26)	2.28	
	Setting	Community	3	0.648 (0.21 to 1.08)	146.84	0.17
		Hospital	2	0.321 (0.16 to 0.48)	0.44	
	Delivery agent	Non-specialist	4	0.593 (0.23 to 0.96)	147.53	0.42
		Specialist	1	0.40 (0.11 to 0.58)	0	
Height for age	Quality	High	3	0.043 (-0.03 to 0.12)	1.52	0.24
		Low	3	0.180 (-0.03 to 0.39)	7.77	

	Multicomponent therapy	Yes	1	0.007 (-0.15 to 0.19)	0	0.34
		No	6	0.095 (0.002 to 0.187)	11.11	
	Theoretical basis	Cognitive behavioural therapy	2	0.136 (-0.03 to 0.30)	1.54	0.72
		Psycho-education	3	0.111 (-0.12 to 0.34)	8.34	
		Psychosocial stimulation	1	0.062 (-0.03 to 0.15)	0.79	
	Setting	Community	4	0.081 (0.01 to 0.15)	3.88	0.02*
		Home	1	0.765 (0.26 to 1.27)	0	
		Hospital	1	-0.028 (-0.22 to 0.16)	0	
Maternal involvement	Quality	High	2	1.176 (-0.87 to 3.22)	124.67	0.58
		Low	4	0.540 (0.21 to 0.87)	14.33	
	Multicomponent therapy	Yes	1	0.829 (0.56 to 1.09)	155.20	0.86
		No	5	0.753 (-0.03 to 1.54)	0	
	Theoretical basis	Cognitive behavioural therapy	1	0.135 (-0.10 to 0.37)	0	0.78
		Psycho-education	2	0.60 (0.14 to 1.07)	4.75	
		Psychosocial stimulation	3	1.10 (-0.27 to 2.46)	121.90	
	Setting	Community	3	1.059 (-0.13 to 2.25)	125.39	0.21
		Home	1	0.236 (0.03 to 0.45)	0	
		Hospital	2	0.559 (0.10 to 1.02)	2.51	
	Delivery agent	Non-specialist	4	0.851 (-0.02 to 1.73)	153.00	0.56
		Specialist	2	0.559 (0.10 o 1.02)	2.51	

*denotes $P < 0.05$

Table 4: GRADE evidence for interventions with a primary focus on maternal mental health

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	**Study design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**perinatal psychological interventions**	**care as usual**	**Relative (95% CI)**	**Absolute (95% CI)**		
Anxiety symptoms												
4	randomised trials	not serious	not serious	not serious	not serious	none	204	207	-	SMD **0.51 SD lower** (0.511 lower to 0.302 lower)	⨁⨁⨁⨁ HIGH	IMPORTANT
Depressive symptoms												
14	randomised trials	not serious	serious [a]	not serious	not serious	publication bias strongly suspected [b]	8245	7878	-	SMD **0.695 SD lower** (0.924 lower to 0.465 lower)	⨁⨁◯◯ LOW	IMPORTANT
Exclusive breastfeeding												
2	randomised trials	not serious	not serious	not serious	not serious	none	9836	8478	-	SMD **0.155 SD higher** (0.065 higher to 0.246 higher)	⨁⨁⨁⨁ HIGH	IMPORTANT
Recent illnesses												
2	randomised trials	not serious	serious [a]	not serious	serious [c]	none	9167	8464	-	SMD **0.607 SD lower** (1.239 lower to 0.025 lower)	⨁⨁◯◯ LOW	IMPORTANT
Care-seeking												

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	**Study design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**perinatal psychological interventions**	**care as usual**	**Relative (95% CI)**	**Absolute (95% CI)**		
2	randomised trials	not serious	serious [a]	not serious	very serious [c]	none	9167	8464	-	SMD **0.436 SD higher** (0.67 lower to 1.541 higher)	⨁◯◯◯ VERY LOW	IMPORTANT
Child anxiety												
1	randomised trials	not serious	not serious	not serious	not serious	none	289	295	-	SMD **0.141 SD higher** (0.021 lower to 0.304 higher)	⨁⨁⨁⨁ HIGH	CRITICAL
Neonatal mortality												
1	randomised trials	not serious	not serious	not serious	not serious	none	9770	9260	-	SMD **0.187 SD lower** (0.26 lower to 0.114 lower)	⨁⨁⨁⨁ HIGH	IMPORTANT
Low birth weight												
1	randomised trials	not serious	not serious	not serious	serious [d]	none	167	167	-	SMD **0.096 SD lower** (0.465 lower to 0.273 higher)	⨁⨁⨁◯ MODERATE	CRITICAL
Weight for age (z-scores)												
1	randomised trials	not serious	not serious	not serious	not serious	none	368	359	-	SMD **0.015 SD lower** (0.264 lower to 0.233 higher)	⨁⨁⨁⨁ HIGH	CRITICAL

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	**Study design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**perinatal psychological interventions**	**care as usual**	**Relative (95% CI)**	**Absolute (95% CI)**		
Height for age (z-scores)												
1	randomised trials	not serious	not serious	not serious	not serious	none	368	359	-	SMD **0.156 SD higher** (0.01 higher to 0.302 higher)	⨁⨁⨁⨁ HIGH	CRITICAL
Stunting												
1	randomised trials	not serious	not serious	not serious	not serious	none	360	345	-	SMD **0.172 SD lower** (0.347 lower to 0.029 higher)	⨁⨁⨁⨁ HIGH	CRITICAL
BMI for age												
1	randomised trials	not serious	not serious	not serious	not serious	none	289	295	-	SMD **0.075 SD lower** (0.237 lower to 0.087 higher)	⨁⨁⨁⨁ HIGH	CRITICAL
Childhood emotional difficulties												
1	randomised trials	not serious	not serious	not serious	not serious	none	289	295	-	SMD **0.082 SD higher** (0.08 lower to 0.244 higher)	⨁⨁⨁⨁ HIGH	CRITICAL
Child cognition												

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	**Study design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**perinatal psychological interventions**	**care as usual**	**Relative (95% CI)**	**Absolute (95% CI)**		
1	randomised trials	not serious	not serious	not serious	not serious	none	289	295	-	SMD **0.3 SD higher** (0.136 higher to 0.463 higher)	⨁⨁⨁⨁ HIGH	CRITICAL
Play frequency												
1	randomised trials	not serious	not serious	not serious	not serious	none	360	345	-	SMD **0.582 SD higher** (0.412 higher to 0.752 higher)	⨁⨁⨁⨁ HIGH	IMPORTANT

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

Explanations

a. Substantial heterogeneity was detected (I squared= 93.93%). It was partly explained by subgroup analysis.

b. Assymetric funnel plot; Egger's regression statistics < 0.1

c. Confidence interval for the pooled estimate are not consistent with benefit and harm.

d. Downgraded for imprecision by one level because the results are based on a single study, with a relatively small sample size and few events.

Table 5: GRADE evidence for interventions with a secondary focus on maternal mental health

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	**Study design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**[intervention]**	**[comparison]**	**Relative (95% CI)**	**Absolute (95% CI)**		
Maternal anxiety symptoms												
3	randomised trials	serious [a]	not serious	not serious	not serious	none	197	198	-	SMD **0.49 SD lower** (0.691 lower to 0.29 lower)	⨁⨁⨁◯ MODERATE	IMPORTANT
Maternal depressive symptoms												
11	randomised trials	serious [a]	not serious	not serious	not serious	none	6448	6887	-	SMD **0.182 SD lower** (0.279 lower to 0.095 lower)	⨁⨁⨁◯ MODERATE	IMPORTANT
Cognitive development												
5	randomised trials	not serious	serious [b]	not serious	not serious	none	1638	1615	-	SMD **0.568 SD higher** (0.238 higher to 0.899 higher)	⨁⨁⨁◯ MODERATE	CRITICAL
Height for age (z-scores)												
6	randomised trials	not serious	not serious	not serious	not serious	none	2182	2102	-	SMD **0.081 SD higher** (0.001 lower to 0.163 higher)	⨁⨁⨁⨁ HIGH	CRITICAL
												WAZ

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	**Study design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**[intervention]**	**[comparison]**	**Relative (95% CI)**	**Absolute (95% CI)**		
3	randomised trials	not serious	not serious	not serious	not serious	none	1585	1535	-	SMD **0.135 SD higher** (0.009 lower to 0.278 higher)	⨁⨁⨁⨁ HIGH	CRITICAL
Expressive language												
3	randomised trials	not serious	serious [b]	not serious	not serious	none	1382	1390	-	SMD **0.372 SD higher** (0.045 higher to 0.699 higher)	⨁⨁⨁◯ MODERATE	CRITICAL
Receptive language												
4	randomised trials	not serious	serious [b]	not serious	not serious	none	1542	1521	-	SMD **0.304 SD higher** (0.085 higher to 0.522 higher)	⨁⨁⨁◯ MODERATE	CRITICAL
Gross motor												
2	randomised trials	not serious	not serious	not serious	not serious	none	1161	1164	-	SMD **0.068 SD higher** (0.013 lower to 0.149 higher)	⨁⨁⨁⨁ HIGH	CRITICAL
Fine motor												
1	randomised trials	not serious	not serious	not serious	not serious	none	945	954	-	SMD **0.054 SD higher** (0.036 lower to 0.144 higher)	⨁⨁⨁⨁ HIGH	CRITICAL

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	**Study design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**[intervention]**	**[comparison]**	**Relative (95% CI)**	**Absolute (95% CI)**		
Exclusive breastfeeding												
4	randomised trials	not serious	serious [b]	not serious	serious [c]	none	9494	10571	-	**0** (0 to 0)	⨁⨁◯◯ LOW	IMPORTANT
Care seeking for childhood illnesses												
3	randomised trials	not serious [a]	not serious	not serious	not serious	none	9496	10519	-	SMD **0.129 SD lower** (0.329 lower to 0.07 higher)	⨁⨁⨁⨁ HIGH	IMPORTANT
Risk of childhood illnesses												
2	randomised trials	not serious	not serious	not serious	not serious	none	381	357	-	SMD **0.118 SD lower** (0.4 lower to 0.164 lower)	⨁⨁⨁⨁ HIGH	IMPORTANT
Maternal involvement												
6	randomised trials	not serious	serious [b]	not serious	not serious	none	729	676	-	SMD **0.765 SD higher** (0.129 higher to 1.402 higher)	⨁⨁⨁◯ MODERATE	IMPORTANT
Neonatal mortality												
1	randomised trials	serious [a]	not serious	not serious	not serious	none	8819	9896	-	SMD **0.226 SD lower** (0.328 lower to 0.125 lower)	⨁⨁⨁◯ MODERATE	IMPORTANT

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

Explanations

a. A majority of studies reporting this outcome, had an overall high or unclear risk of bias across several matrices. However, subgroup analysis revealed no threat to validity of pooled results, among high and low quality studies.

b. Substantial heterogeneity was observed in reporting of this outcome, explainable by subgroup analyses, and variability in content of intervention and psychometric instruments.

c. Wide confidence intervals; 95% confidence interval includes no effect and the upper or lower confidence limit crosses the minimal important difference.

Table 6: Evidence to Decision Table

	JUDGEMENT	EXPLANATION	ADDITIONAL CONSIDERATIONS
PROBLEM	**Is the problem a priority?** ○ No ○ Probably no ○ Probably yes ✓ Yes ○ Varies ○ Don't know	We consider this problem to be a priority because: • Peripartum common mental health problems such as depression and anxiety are very prevalent across the globe. Gaynes et al., in a systematic review of 109 articles published in English between 1980 and 2004, found that up to 13% of pregnant women suffer from major or minor depression (Gaynes et al, 2005). Another recent meta-analysis revealed the average prevalence of antenatal common mental health problems to be 15.9% (95% CI: 15.0–16.8%) and postpartum common mental health problems to be 19.8% (95% CI: 19.2–20.6) (Fisher et al, 2011). Owing to gender sensitivities in the cultural setting of South Asia, an especially high prevalence of psychiatric illnesses in pregnant females has been reported (Waqas et al, 2015). • Several studies have drawn attention to the adverse effects of peripartum anxiety and depression in the developing child. These effects include preterm birth, low birth weight, reduced cognitive ability and increased fearfulness, increased incidence of respiratory and skin illnesses in early life and elevated awakening cortisol levels (Dunkel Schetter et al, 2012; Sanchez et al, 2013).	
DESIRABLE EFFECTS	**How substantial are the desirable anticipated effects?** ○ Trivial ○ Small ✓ Moderate ○ Large	These psychosocial interventions exhibit several desirable outcomes, albeit with varying quality and effect sizes. The present meta-analysis revealed statistically significant effect of these interventions in improving following outcomes: • Perinatal anxiety, depression, breastfeeding and care seeking attitudes. • Child development indicators such as cognition, mortality, risk of infectious illnesses and play frequency.	

	○ Varies ○ Don't know	No data regarding adverse effects of psychosocial interventions during the perinatal period, was identified in the present systematic review.	
UNDESIRABLE EFFECTS	**How substantial are the undesirable anticipated effects?** ○ Large ○ Moderate ○ Small ✓ Trivial ○ Varies ○ Don't know		
CERTAINTY OF EVIDENCE	**What is the overall certainty of the evidence of effects?** ○ Very low ○ Low ✓ Moderate ○ High ○ No included studies	We consider the quality of evidence to be moderate overall because • Certainty of evidence for twelve outcomes was rated as high: maternal anxiety symptoms, child anxiety, neonatal mortality, exclusive breast feeding, weight for age, height for age, stunting, height for age, BMI for age, emotional difficulties, child cognition, and play frequency; moderate for low birth weight; low for risk of childhood illnesses; and very low for maternal depressive symptoms for care-seeking attitudes. Detailed results have been reported in Tables 1 and Table 2. • However, the quality of evidence in outcomes reported in integrated interventions was generally better than those reported in their counterparts. Strength of evidence was high for weight for age, height for age, gross and fine motor development, care-seeking attitudes and rate of childhood illnesses; while it was moderate for symptoms of maternal anxiety and depression, cognitive development, expressive and receptive language, maternal involvement and neonatal mortality. While it was low for exclusive breastfeeding.	

VALUES AND PREFERENCES	**Is there important uncertainty about or variability in how much people value the main outcomes?** ○ Important uncertainty or variability ○ Possibly important uncertainty or variability ✓ Probably no important uncertainty or variability ○ No important uncertainty or variability	We consider there to be probably no important uncertainty or variability because: • *Attitudes of pregnant women with perinatal mental health problems and their family members about psychosocial interventions and facilitators and/or barriers:* Recent studies on perinatal psychosocial interventions have reported good uptake and acceptability among pregnant women. For instance, Khan et al reported an improvement in understanding of mental health symptomatology, help seeking attitudes and high retention rates (95%) among pregnant women in a conflict area of Pakistan. This intervention also exhibited good acceptability among family members including husbands and mother in laws who found themselves to be more competent of recognized distressing among pregnant women and cited better understanding about its impact on the health of future offspring. Similar positive remarks were reported by Gao et al conducting interpersonal psychotherapy among Chinese pregnant women. He reported a good acceptability of this intervention among 61.4% of the respondents. Participants reported the program helped them "recognise that a good relationship with my mother-in-law was a treasure" and gave them "knowledge and skills to cope with the postpartum period". Gu et al, trialled midwife's antenatal clinical services in Fudan, China, reporting a good partnership and positive attitudes of pregnant women towards their midwife carers. In a similar context, Morris et al reported an excellent acceptability of LTP play program among internally displaced people in Kitgum district, Northern Uganda. Moreover, 9/106 participants in their intervention went onto initiate their own intervention groups spontaneously to help the locals. Cooper et al (2002) reported a good acceptance of the adapted Health Visitor Intervention Program in Cape Town, South Africa. A majority of the recipients (>90%) of intervention felt supported by, trusted and openly talked to the provider and felt better able to respond to their babies solve problems. However, a recent feasibility evaluation of Thinking Healthy Program (Atif et al, 2017) revealed several barriers in implementation of peer delivered programs: a) confidentiality among peers b) tension, sadness and depression being stigmatized as "madness" c) lack of monetary support d) local traditions preventing mothers to attend group meetings without men accompanying.	

		.	
BALANCE OF EFFECTS	**Does the balance between desirable and undesirable effects favor the intervention or the comparison?** ○ Favors the comparison ○ Probably favors the comparison ○ Does not favor either the intervention or the comparison ○ Probably favors the intervention ○ Favors the intervention ○ Varies ✓Don't know	Overall, there is uncertainty about the balance between desirable and undesirable effects of these psychosocial interventions. Because none of the studies included in the present systematic review reported any undesirable effects of outcomes of the reviewed psychosocial interventions.	
RESOURCES REQUIRED	**How large are the resource requirements (costs)?** ○ Large costs ○ Moderate costs ○ Negligible costs and savings ○ Moderate savings ○ Large savings ✓Varies ○ Don't know	There is uncertainty around the resource requirements for psychosocial interventions delivered during the intra-partum period. This is mainly due to a general lack of cost-effectiveness analyses for a majority of the studies included in the present systematic review. However, the resource requirements for the pharmacological interventions is likely to be lower generally than for the non-pharmacological interventions. But we opine that psychosocial interventions for perinatal common mental health problems could have important effects on costs and outcomes. The most obvious effects might be that specialist/non-specialist healthcare workers would be required to undertake more visits but that the prevalence of CMDs and its associated costs such as medication use would be reduced. Broader effects such as the impact on the baby, other children and the partner need also to be considered. Patel et al, reported the favourable results of the impact of 6–8 sessions of Healthy activity Program (HAP) on mental health and secondary outcomes at the primary 3-month post-enrolment endpoint (Patel et al, 2017). The key findings were that HAP produced significantly lower symptom severity (adjusted mean difference [AMD] in Beck Depression	

		Inventory–II [BDI-II] score = −7.57; 95% CI −10.27, −4.86) and higher remission rate (adjusted prevalence ratio [aPR] = 1.61; 95% CI 1.34, 1.93). HAP also showed superior results on the secondary outcomes of disability, days out of work, and intimate partner physical violence in women. The incremental cost of HAP per quality adjusted life year (QALY) gained was Intl$9,333 (95% CI Intl$3,862, Intl$28,169), with an 87% chance of being cost-effective from a health system perspective in the study setting. According to Weobong et al, the cost-effectiveness of HAP program was sustained at 12 months follow ups. HAP was found to be cost-effective as compared to the usual care (incremental cost per QALY gained was −$1,721; 95% likelihood of cost effectiveness and 58% for cost savings). In the recent Lancet series on early child development, the cost of integrating Thinking Healthy component of mhGAP into existing MNCH services has been estimated. The additional investment for scaling up support for perinatal depression in MNCH services is estimated to cost USD 0.1-0.2 per person per year indicating that maternal mental health interventions can be added to MNCH services at little additional cost (Richter et al, 2017). The cost-effectiveness of psychosocial interventions is also corroborated by another systematic review summarizing 13 studies on economic evaluation of psychosocial interventions in high income countries (Morrell et al, 2016).	
CERTAINTY OF EVIDENCE OF REQUIRED RESOURCES	**What is the certainty of the evidence of resource requirements (costs)?** ○ Very low ○ Low ○ Moderate ○ High ✓No included studies	See above.	

COST EFFECTIVENESS	**Does the cost-effectiveness of the intervention favor the intervention or the comparison?** ○ Favors the comparison ○ Probably favors the comparison ○ Does not favor either the intervention or the comparison ✓Probably favors the intervention ○ Favors the intervention ○ Varies ○ No included studies	The cost-effectiveness is likely to vary for the different interventions. However, not much evidence seems to be available on this from the low and middle income countries. And most of the evidence is limited to the context of high income countries.	
EQUITY	**What would be the impact on health equity?** ○ Reduced ○ Probably reduced ○ Probably no impact ✓Probably increased ○ Increased ○ Varies ○ Don't know	We consider the impact on health equity to probably increase because: • Perinatal depression is now being recognized as a major public health concern. It is very prevalent among mothers belonging to low and middle income countries and leads to poor emotional, physical and behavioural effects among the mothers. • Moreover, it also accounts for several adverse outcomes among children. These effects include low birth weight, stunting and muscle wasting, preterm birth, respiratory disorders, intrauterine growth restriction, emotional problems and diarrheal illness in infants, poor academic performance, and increased risk of depression in infants born to depressed mothers. • Furthermore, a general lack in specialist and non-specialist mental health workforce further warrants for establishing cost-effective and culture sensitive intervention programs in the LAMIC (WHO, 2014).	

ACCEPTABILITY	**Is the intervention acceptable to key stakeholders?** ○ No ○ Probably no ✓ Probably yes ○ Yes ○ Varies ○ Don't know	We consider these interventions to be probably acceptable to the affected population in the low and income countries. High retention rates were common in many of the included studies. And the attitudes of the mothers and community were generally positive indicating a good acceptability of these interventions. Moreover, the attitudes of the work force were positive in studies of qualitative nature as priorly identified. • *Attitudes of healthcare professionals:* Previous literature generally reports a positive attitude of healthcare professionals towards psychosocial interventions. Healthcare worked employed by Cooper et al (2009) in Cape Town South Africa reported strong support from the local community. Similar attitudes were reported in Pakistan where lady healthcare workers delivering Learning through Play program in Rawalpindi, agreed (87.5%) that the intervention was relevant to their work, easily integratable (84%), understandable (100%), and easily communicable to mothers (84%) (Rahman et al, 2009). Peer to peer delivered Thinking healthy program revealed that peers were able to inspire more social support, satisfaction, and good opportunities for learning new skills and facts and improve chances of a permanent job as lady health workers. However, lack of monetary support (Atif et al, 2016) was cited as a barrier	
FEASIBILITY	**Is the intervention feasible to implement?** ○ No ○ Probably no ✓ Probably yes ○ Yes ○ Varies ○ Don't know	We consider feasibility of the interventions to be probably feasible because: • The present meta-analysis indicated good effectiveness of these interventions across several outcomes, albeit the quality of the evidence ranges from low to moderate. • Intervention features, such as number of sessions, duration or frequency, could possibly be adapted for each particular setting, however, we do not have enough evidence to support this. • Costs of the interventions can be reduced by employing trained and supported non-specialists and peers. However, it has lower effect size than specialist delivered interventions.	

		• Furthermore, integrated interventions can further lower the associated costs, by utilizing pre-established healthcare systems.	

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Figure 2. Risk of bias graph: review authors' judgements about each risk of bias item presented as percentages across all included studies

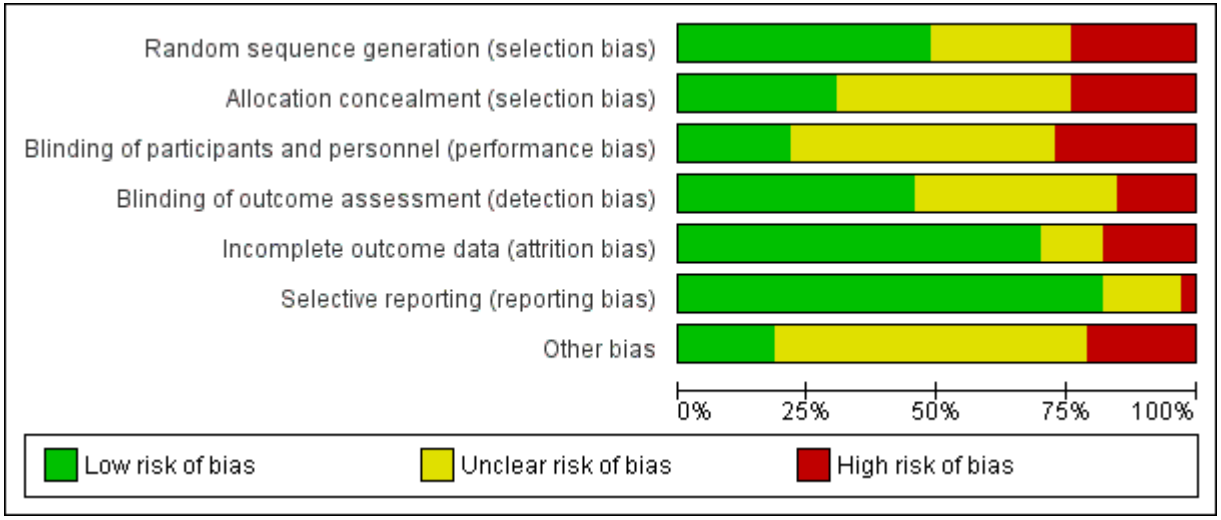
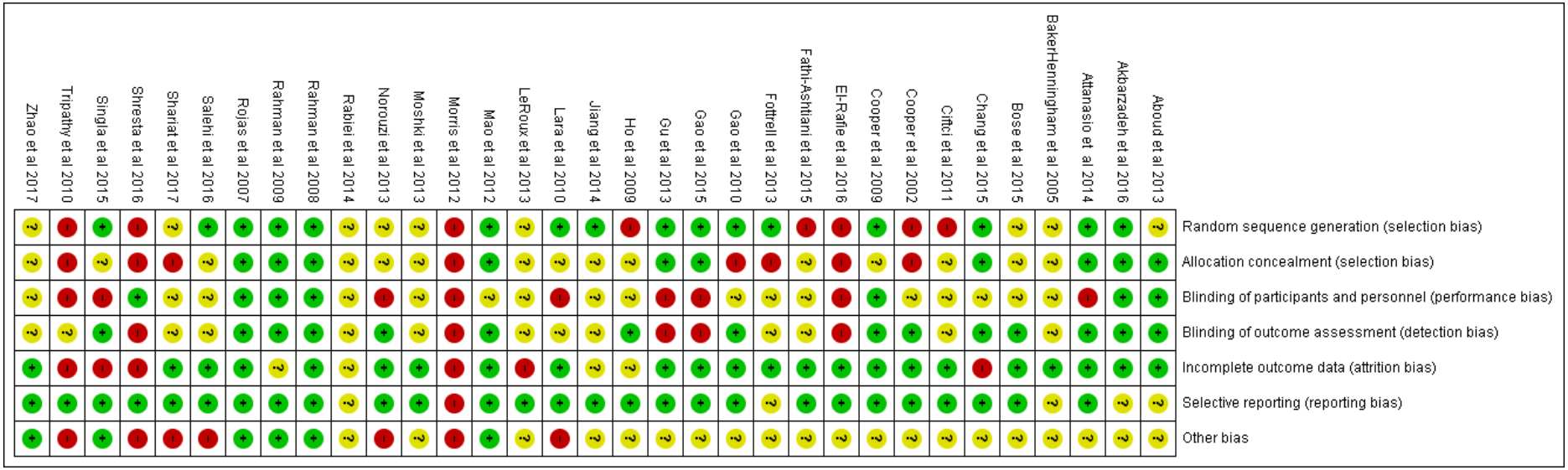


Figure 3: Summary of risk of bias across studies

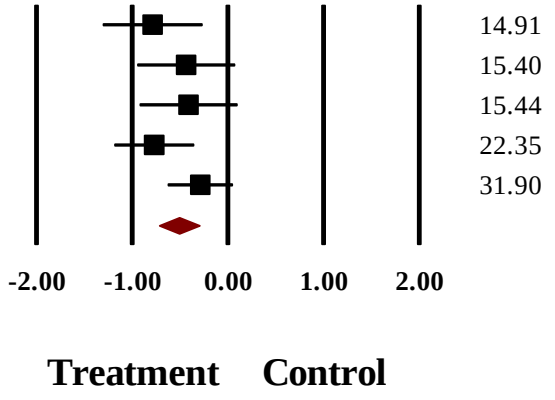


Forest plots for interventions with a primary focus on maternal mental health

Forest plot 1: Effectiveness of psychotherapeutic interventions on anxiety symptoms

Anxiety symptoms

Study name	Std diff in means	Standard error	Lower limit	Upper limit	p-Value	Total	Relative weight
Salehi/2016	-0.786	0.266	-1.307	-0.265	0.003	61	14.91
Norozi/2013/KC+Music	-0.436	0.261	-0.948	0.076	0.095	60	15.40
Norozi/2013/Kangaroo care	-0.411	0.261	-0.922	0.101	0.115	60	15.44
Gu/2013	-0.769	0.213	-1.186	-0.352	0.000	95	22.35
Fathi-Asthiani/2015a	-0.288	0.173	-0.627	0.052	0.097	135	31.90
	-0.511	0.107	-0.721	-0.302	0.000	411	



Forest plot 2: Effectiveness of psychotherapeutic interventions on depressive symptoms

Depressive symptoms

Study name	Std diff in means	Standard error	Lower limit	Upper limit	p-Value	Total	Relative weight
Zhao/2017b	-0.633	0.134	-0.895	-0.371	0.000	334	7.48
Tripathy/2010c	-0.177	0.033	-0.241	-0.112	0.000	12431	8.24
Rojas/2007	-0.843	0.165	-1.166	-0.520	0.000	209	7.12
Rahman/2008d	-0.625	0.072	-0.765	-0.485	0.000	818	8.04
Rabiei/2014	-0.719	0.179	-1.070	-0.368	0.000	133	6.95
Moshki/2013	-0.770	0.137	-1.038	-0.502	0.000	230	7.45
Mao/2012	-1.276	0.148	-1.566	-0.987	0.000	221	7.33
Lara/2010	-0.399	0.143	-0.679	-0.118	0.005	357	7.38
Jiang/2014	-1.056	0.083	-1.218	-0.894	0.000	729	7.96
Gao/2015a	-0.335	0.150	-0.629	-0.041	0.026	180	7.30
Gao/2010	-0.390	0.243	-0.866	0.086	0.108	194	6.12
Fathi-Asthiani/2015b	-0.220	0.173	-0.558	0.119	0.204	135	7.02
El-Rafi/2016	-0.861	0.209	-1.271	-0.451	0.000	100	6.56
Bose/2015	-1.735	0.325	-2.372	-1.097	0.000	52	5.06
	-0.695	0.117	-0.924	-0.465	0.000	16123	

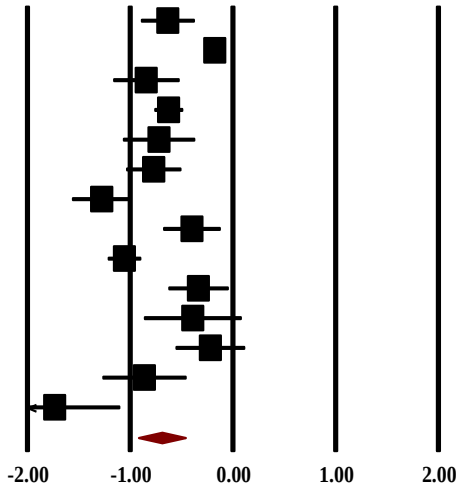


Figure 3: Effectiveness of interventions in improving exclusive breast feeding practices

Study name	Std diff in means	Standard error	Lower limit	Upper limit	p-Value	Treated	Control	Relative weight
Rahman/2008b	0.275	0.120	0.040	0.510	0.022	368	359	13.01
Tripathy/2010b	0.137	0.019	0.101	0.174	0.000	9468	8119	86.99
	0.155	0.046	0.065	0.246	0.001	9836	8478	

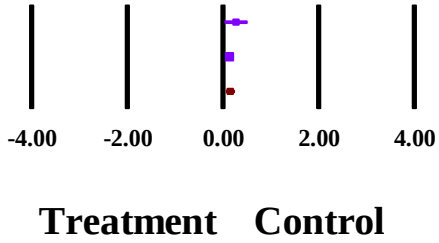


Figure 4: Effectiveness of interventions in improving care seeking practices

Care-seeking

Study name	Std diff in means	Standard error	Lower limit	Upper limit	p-Value	Total	Relative weight
Tripathy/2010/e	-0.120	0.026	-0.172	-0.068	0.000	1990 / 16926	50.75
Rahman/2008a	1.008	0.141	0.733	1.284	0.000	588 / 705	49.25
	0.436	0.564	-0.670	1.541	0.440	2578 / 17631	

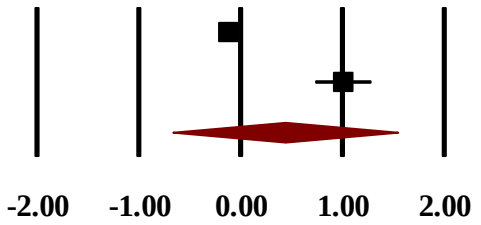
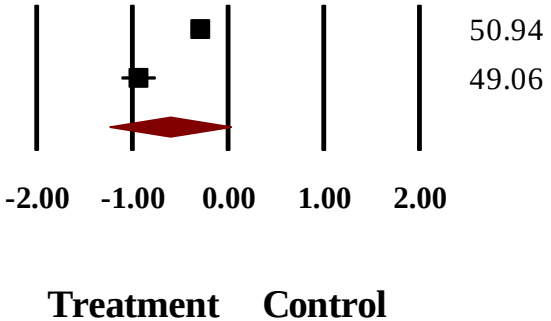


Figure 5: Effectiveness of interventions in improving rates of infectious illnesses among children

Childhood illnesses

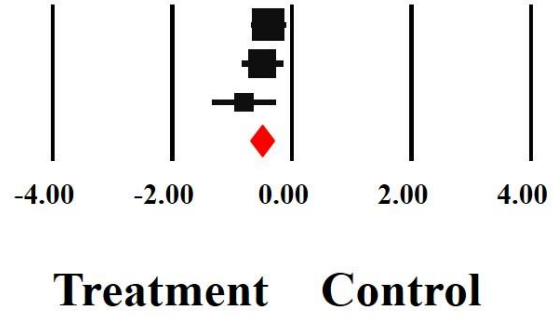
Study name	Std diff in means	Standard error	Lower limit	Upper limit	p-Value	Events/Total Total	Relative weight
Tripathy/2010a	-0.290	0.020	-0.330	-0.251	0.000	4127 / 16926	50.94
Rahman/2008c	-0.935	0.091	-1.113	-0.757	0.000	365 / 705	49.06
	-0.607	0.322	-1.239	0.025	0.060	4492 / 17631	



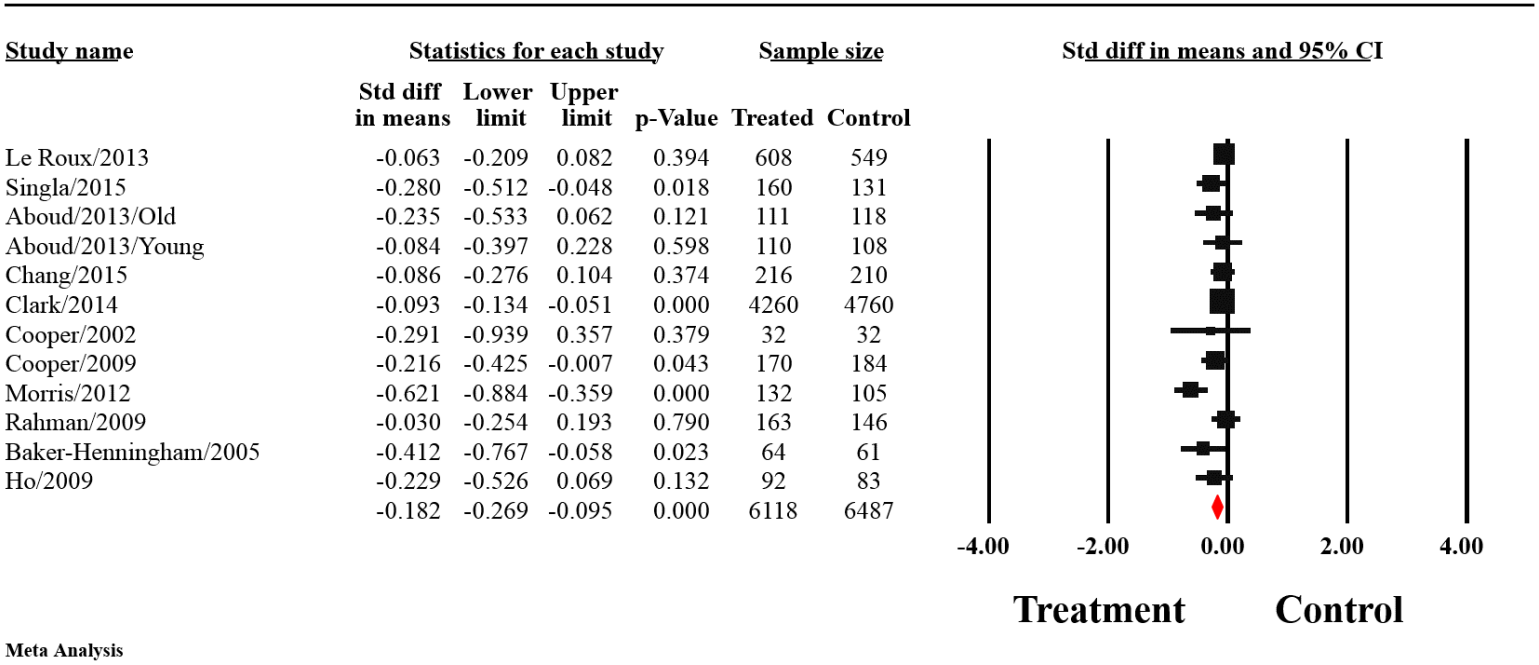
Effectiveness of interventions with a secondary focus on maternal mental health

Forest plot 6: Effectiveness of integrated interventions in improving symptoms of anxiety

Study name	Statistics for each study				Sample size		Std diff in means and 95% CI
	Std diff in means	Lower limit	Upper limit	p-Value	Treated	Control	
Akbarzadeh/2016	-0.389	-0.676	-0.102	0.008	96	94	
Shresta/2016	-0.496	-0.829	-0.163	0.003	69	74	
Ciftci/2011	-0.802	-1.320	-0.284	0.002	32	30	
	-0.490	-0.691	-0.290	0.000	197	198	

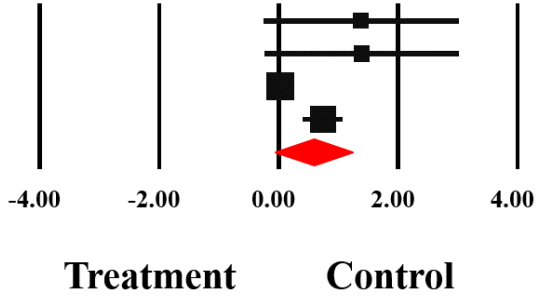


Forest plot 7: Effectiveness of interventions on depressive symptoms

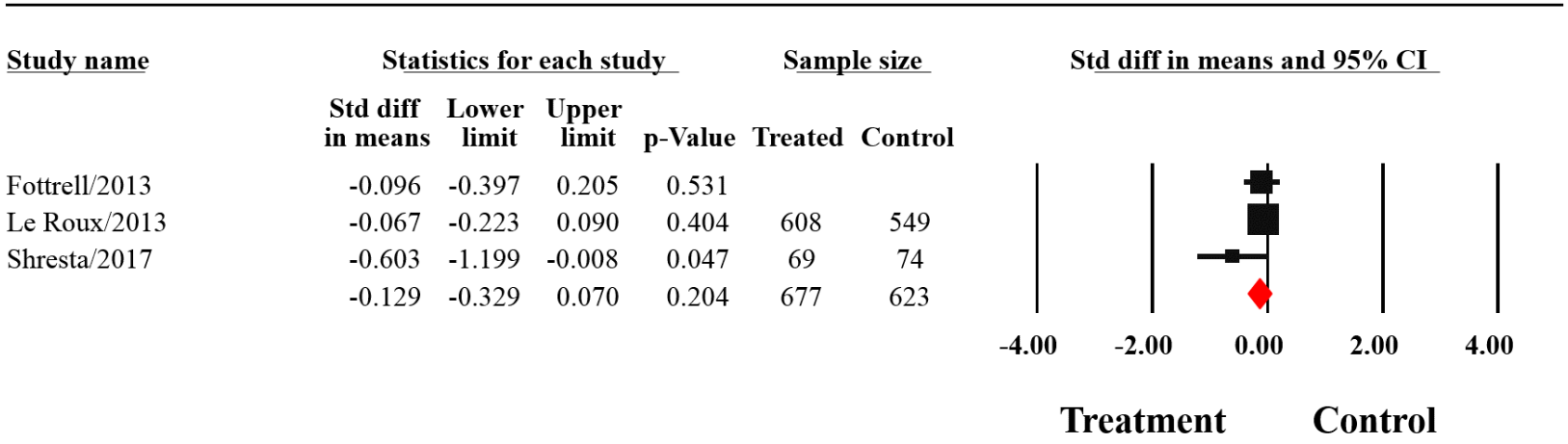


Forest plot 8: Effectiveness of interventions on exclusive breastfeeding practices

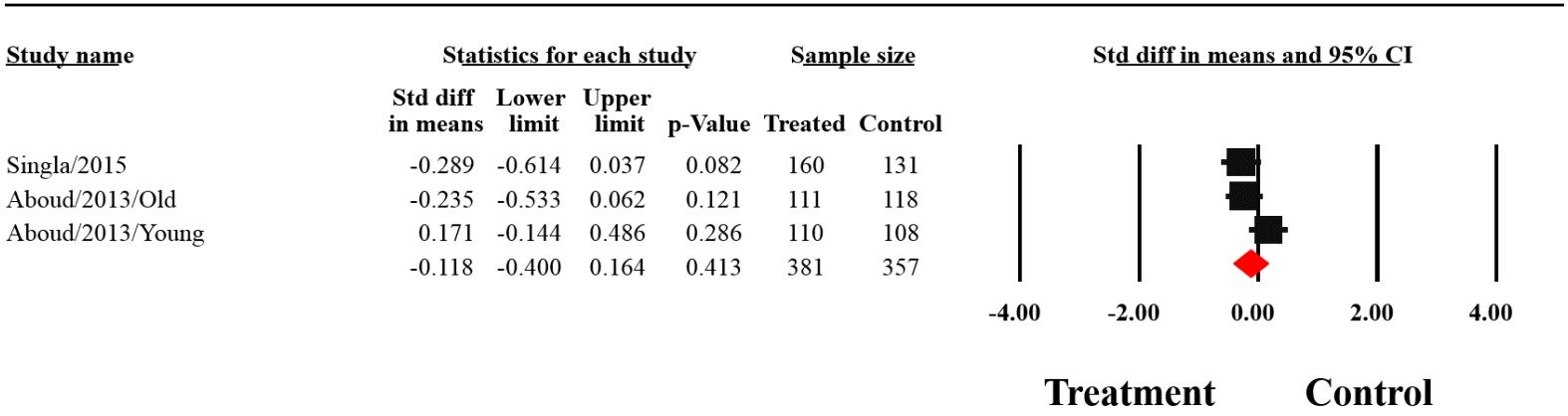
Study name	Statistics for each study				Sample size		Std diff in means and 95% CI
	Std diff in means	Lower limit	Upper limit	p-Value	Treated	Control	
Ciftci/2011	1.379	-0.242	3.000	0.095	32	30	
Shariat/2017	1.388	-0.230	3.006	0.093	35	36	
Fottrell/2013	0.027	-0.005	0.058	0.095			
Le Roux/2013	0.740	0.420	1.059	0.000	608	549	
	0.597	-0.045	1.239	0.068	675	615	



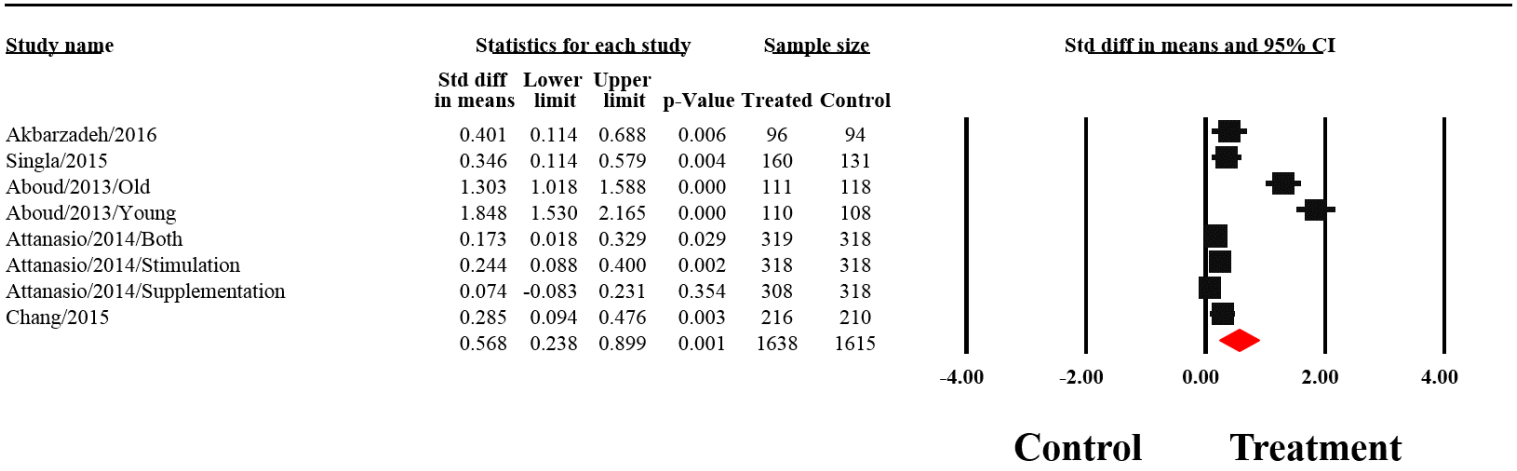
Forest plot 9: Effectiveness of interventions on care-seeking practices



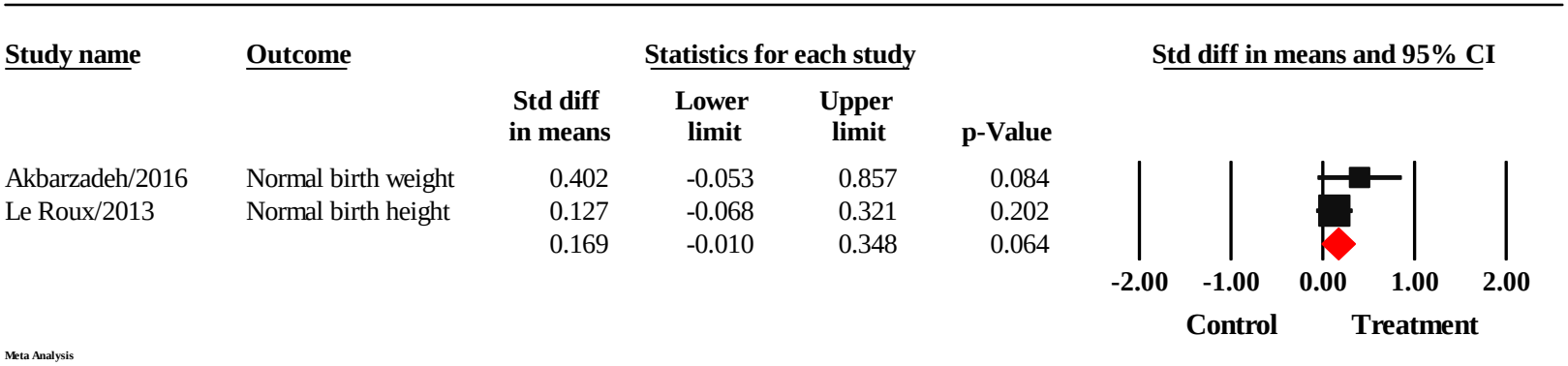
Forest plot 10: Effectiveness of interventions on risk of infectious illnesses among children



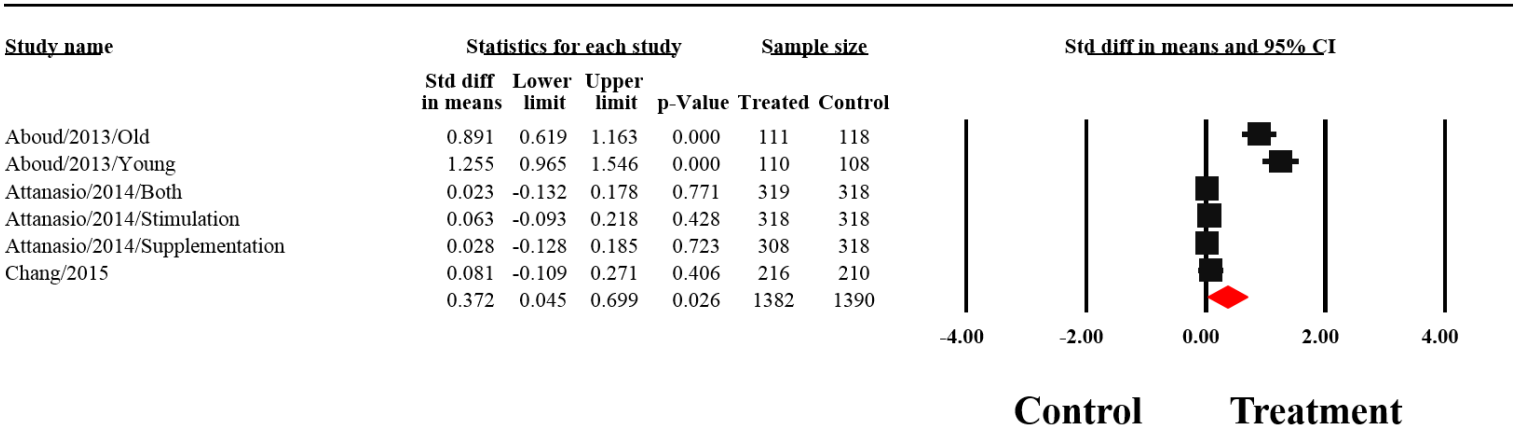
Forest plot 11: Effectiveness of interventions on child cognitive development



Forest plot 12: Effectiveness of integrated interventions on birth-weight

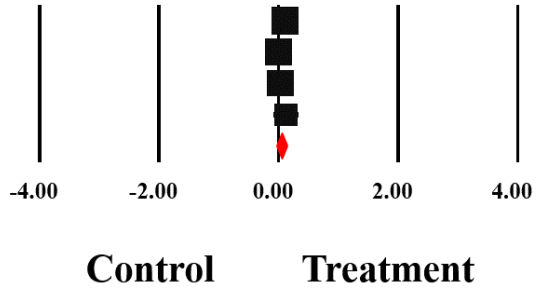


Forest plot 13: Effectiveness of interventions on development of expressive language among children



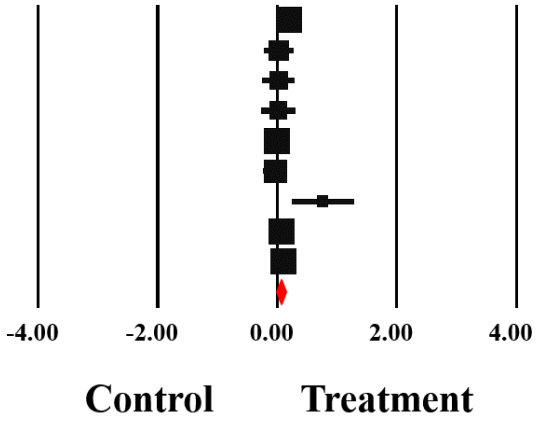
Forest plot 14: Effectiveness of interventions on gross motor development among children

Study name	Std diff in means	Lower limit	Upper limit	p-Value	Treated	Control
Attanasio/2014/Both	0.116	-0.040	0.271	0.145	319	318
Attanasio/2014/Stimulation	0.004	-0.152	0.159	0.964	318	318
Attanasio/2014/Supplementation	0.042	-0.115	0.198	0.604	308	318
Chang/2015	0.132	-0.058	0.322	0.174	216	210
	0.068	-0.013	0.149	0.101	1161	1164



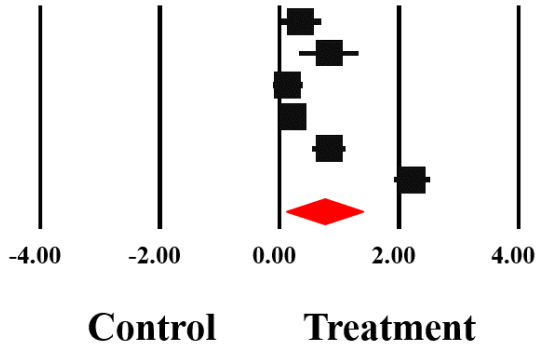
Forest plot 15: Effectiveness of interventions on development of HAZ among children

Study name	Std diff in means	Lower limit	Upper limit	p-Value	Treated	Control
Le Roux/2013	0.203	0.047	0.358	0.011	608	549
Singla/2015	0.026	-0.205	0.257	0.824	160	131
Aboud/2013/Old	0.027	-0.232	0.286	0.837	111	118
Aboud/2013/Young	0.023	-0.242	0.289	0.865	110	108
Attanasio/2014/Both	0.007	-0.148	0.162	0.930	319	318
Chang/2015	-0.028	-0.218	0.162	0.773	216	210
Cooper/2002	0.765	0.257	1.273	0.003	32	32
Attanasio/2014/Stim	0.074	-0.081	0.230	0.348	318	318
Attanasio/2014/Supp	0.105	-0.052	0.262	0.189	308	318
	0.081	-0.001	0.163	0.053	2182	2102



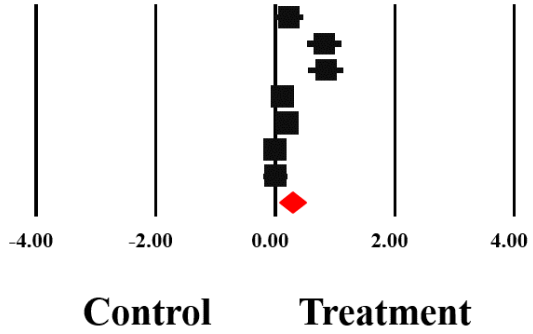
Forest plot 16: Effectiveness of interventions on improvement in maternal involvement among expectant mothers

Study name	Std diff in means	Lower limit	Upper limit	p-Value	Treated	Control
Shresta/2016	0.356	0.025	0.687	0.035	69	74
Shariat/2017	0.831	0.346	1.316	0.001	35	36
Singla/2015	0.135	-0.096	0.366	0.252	160	131
Cooper/2009	0.236	0.026	0.445	0.027	170	184
Morris/2012	0.829	0.562	1.095	0.000	132	105
Rahman/2009	2.220	1.937	2.504	0.000	163	146
	0.765	0.129	1.402	0.018	729	676



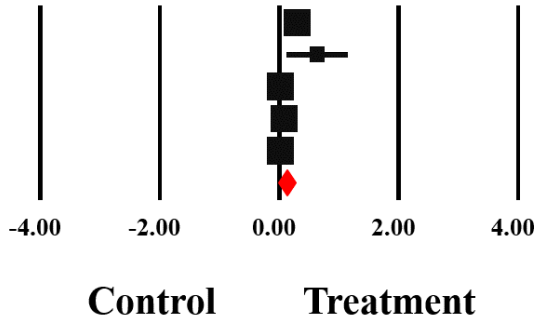
Forest plot 17: Effectiveness of interventions on development of receptive language among children

Study name	Std diff in means	Lower limit	Upper limit	p-Value	Treated	Control
Singla/2015	0.236	0.004	0.467	0.046	160	131
Aboud/2013/Old	0.827	0.557	1.097	0.000	111	118
Aboud/2013/Young	0.855	0.578	1.133	0.000	110	108
Attanasio/2014/Both	0.120	-0.035	0.276	0.129	319	318
Attanasio/2014/Stimulation	0.211	0.055	0.367	0.008	318	318
Attanasio/2014/Supplementation	0.000	-0.157	0.157	1.000	308	318
Chang/2015	0.009	-0.181	0.199	0.929	216	210
	0.304	0.085	0.522	0.006	1542	1521



Forest plot 18: Effectiveness of interventions on WAZ among children

Study name	Std diff in means	Lower limit	Upper limit	p-Value	Treated	Control
Le Roux/2013	0.295	0.128	0.461	0.001	608	549
Cooper/2002	0.634	0.132	1.137	0.013	32	32
Attanasio/2014/Stimulation	0.016	-0.139	0.172	0.838	318	318
Attanasio/2014/Supplementation	0.081	-0.076	0.238	0.311	308	318
Attanasio/2014/both	0.016	-0.140	0.171	0.842	319	318
	0.135	-0.009	0.278	0.065	1585	1535



Appendix Tables and Figures

Supplementary table 1: Demographic characteristics of participants included in intervention

Author, year	Age of mothers	Age of children	Study Design	Geographical scope	Settings	Tools used for outcome assessment
Studies with a primary focus on maternal mental health problems						
Bose GN, 2015	17–40 years	NA	RCT	Rural sub-district	NA	Not specified
El-Rafie, Khafagy & Gamal, 2016	20 to 35 years	NA	Prospective, interventional, controlled design	NA	Clinics	CES-D
Fathi-Ashtiani et al., 2015	25.8 years	NA	RCT	NA		EPDS, BDI, BAI
Gao et al., 2010	28.47 years	NA	RCT	NA	Hospital	EPDS
Gao et al., 2015	28.47 years	NA	RCT	NA	Hospital	EPDS
Gu et al., 2013	Mean age = 29.01, SD (2.55)	NA	RCT	NA	Clinics	STAI
Jiang et al., 2014	27.93 years	NA	cRCT	NA	Home visits	EPDS
Lara, Navarro & Navarrete, 2010	Mean age= 26.43	NA	RCT	Urban	Hospital, women's clinic and community health care center	SCID-I interviews, BDI-II, SCL-90
Mao et al., 2012	Mean age = 28.5 years	NA	RCT	Urban	Hospital	PHQ-9, EPDS, SCID
Moshki, Baloochi Beydokhti & Cheravi, 2014	Mean age= 28 years	NA	RCT	Urban	Health centers	EPDS

Norouzi et al., 2013	20-40 years old	NA	RCT	Urban	Akbar Abadi teaching centre	STAI
Rabiei et al., 2014	Mean age= 24.32 years	NA	RCT	Urban	Health centers	BDI-II-Persian
Rahman et al., 2008	Mean age= 26.5 (5.2) years	NA	cRCT	Rural	Community settings	Structural clinic interview for DSM-IV diagnosis
Rojas et al., 2007	Mean age = 26.7 years	Mean age of infants was 5.8 (5.1) months	RCT	Deprived urban areas	Community clinics	EPDS
Salehi et al., 2016	Mean age= 26.04 years	NA	RCT	Urban	Primary health care centres	STAI
Tripathy et al., 2010	15-49 years old	NA	cRCT	Rural	Community	K-10
Zhao et al., 2017	Mean age = 30.43 years	NA	RCT	Urban	Hospital clinic	EPDS, PDSS
Studies with a secondary focus on maternal mental health problems						
Aboud et al., 2013	NA	Birth to 3 months of age	cRCT	Rural	Community	BSITD III, HOME Inventory, CES-D, Mothers' knowledge of the ages for child development
Akbarzadeh et al., 2016	18 to 40 years	Birth to 3 months of age	RCT	NA	Hospital	STAI, Mother's demographic characteristics, pregnancy characteristics, results of previous pregnancies, and others, , and the infant mental health evaluation.
Attanasio et al., 2014	Mean age = 28 years	12-24 months	cRCT	NA	Community	BSITD-III; height, weight, and hemoglobin levels and maternal depression.
Baker-Henningham et al., 2005	Mean age = 26 years	9 to 30 months	cRCT	Urban	Home visits	CESD
Chang et al., 2015	NA	Mean age = 19.7 months	cRCT	Urban	Hospital	Peabody Picture Vocabulary, Depression Scale, Parenting knowledge scale, Griffith Mental Development scales, Communicative Development Inventory, Home Observation for Measurement of the Environment

Cifti & Arikan, 2012	NA	2.5 months to 6 months	RCT	Urban	Home visits	STAI
Clarke et al., 2014	Mean age= 24.7 years	NA	RCT	Rural	Home visits	SRQ
Cooper et al., 2002	19 to 41 years	NA	RCT	Urban	Home visits	SCID
Cooper et al., 2009	Mean age Intervention arm = 25.5 (5.23) Control arm = 26.2 (5.84)	NA	RCT	Peri-urban	Home visits	SCID, video-taped mother-child interactions were rated
Ho et al., 2009	29.2 years	NA	RCT	NA	Hospital	EPDS
Le-Roux et al., 2013	Mean age = 26.5 years	NA	cRCT	Urban	Community	EPDS
Morris et al., 2012	Mean age 26.1 years	Mean age= 14.1 months	RCT	Rural	Established feeding centers	Acholi Home Observation for Measurement of the Environment (HOME), Kitgum maternal mood scale, knowledge attitudes and practice (KAP) test
Rahman et al., 2009	Mean age= 27.3 years	NA	cRCT	Rural	Community settings	Infant Development Questionnaire (IDQ), SRQ
Shariat & Adedinia, 2017	Mean age= 28.7 years	NA	RCT	Urban	Maternity clinic	GHQ, Avant's mother-infant attachment behaviour questionnaire, Muller Maternal Attachment Inventory (MMAI), short form of the Coopersmith Self-Esteem Inventory
Shrestha et al., 2016	Mean age= 23.13 years	NA	RCT	Urban	Hospital	STAI. Newborn care Knowledge Questionnaire (NKQ), Karitane Parenting Confidence Scale (KPCS)
Singla, Kumbakumba & Aboud, 2015	Mean age= 28.04 years	Mean age= 22.44 months	cRCT	Rural	Rural parishes	CESD

Footnotes: Randomized controlled trial (RCT); Bayley Scales of Infant and Toddler Development (BSITD); Edinburgh Postnatal Depression Scale (EPDS); Beck's Depression Inventory (BDI); Beck Anxiety Inventory (BAI);Spielberg's State Trait Anxiety Inventory (SSTAI); Structured Clinical Interview for DSM (SCID); Centre for Epidemiological Studies Depression (CESD); Kesseler 10-item scale (K-10); Postpartum Depression Scale (PDS); Symptoms Checlist-90 items (SCL-90); Self reporting questionnaire (SRQ)

Supplementary table 2: Description of interventions included in the review

Author, year	Strategy	Intervention description
Interventions with a primary focus on maternal mental health		
Bose GN, 2015	Exercise (aerobic training)	Each exercise session consisted of 10- minutes of walking, stretching and flexibility and three sets of moderate intensity cycling in 6 minutes.
El-Rafie, Khafagy & Gamal, 2016	Aerobic exercises	The experimental group regularly attended supervised exercise sessions for 12 weeks (three 60-minute exercise classes per week), commencing at 16–27 weeks of gestation. Each session includes warm-up (10 minutes); aerobic exercise (30 minutes) such as step aerobics (low-step level), stationary bicycling, or treadmill walking; stretching (10 minutes) such as Kegel exercises, pelvic curl, tailor press, back bridge, and crunches; and relaxation (10 minute) such as bending to relieve backache, arm reaches, and shoulder circles. Aerobic activities were prescribed at moderate-to-vigorous intensity. The music-accompanied sessions were supervised by a physician and physiotherapist and were conducted in small groups in a well-ventilated room.
Fathi-Ashtiani et al., 2015	Cognitive-based Therapy	The intervention included eight 40-60 minute CBT sessions delivered to the participants individually through recorded film and interactive workbook. A trained psychologist facilitated the session. These sessions were integrated into the women's standard prenatal visits. The content of the intervention included self-monitoring, self-focused attention, relaxation, understanding of the problem, setting up an alternative view, revising automatic thoughts, behavioural approach tasks, positive communication, realistic expectation about pregnancy, delivery and parenting
Gao et al., 2010	Inter-personal psycho-therapy (IPT)	The intervention program was based on the principles of interpersonal psychotherapy, previous qualitative studies on PPD amongst Chinese women and on quantitative studies on the predictors of PPD. Content of the intervention included role transition to motherhood, changes associated with role transition, ways to cope with role changing, obstacles to communication, communication skills, baby gender-related issues, signs, symptoms & etiology of postpartum depression, social support, interpersonal conflicts and skills to resolve these conflicts, marital relationship after birth, how to establish/maintain good relationships with others, issues related to Chinese postpartum practice "Zuo Yue Zi". It included two 2 hours group session and telephone follow-up within two weeks of delivery to reinforce what have been learnt in the sessions and to address any mood changes or interpersonal issues.
Gao et al., 2015	Inter-personal psycho-therapy (IPT)	The intervention involved the midwives giving the mothers information about her physical recovery and encouraged the new mother to take care of her infant after discharge from the hospital; about the nature and course of PPD. The new mother was encouraged to express the emotions attached to each of her new roles in motherhood and to explore any ambivalent feelings (use of affect). Maternal role attainment and how to cope with the difficulties the new mother would encounter in the postnatal period were clarified (clarification). Then the importance and sources of social support were signalized (signalling what is significant). The new mother's current and past interpersonal relationships and communication patterns were reviewed (reviewing relationship and communication patterns). Strategies to improve the relationships with husband and the mother-in-law were discussed and communication skills were provided (providing social support). Issues related with Chinese postpartum practice ''doing the month'' were also discussed (providing social support). After the session, the new mother was given the written material for the program. It included a 1-h education session before discharge and one telephone follow-up within the 2 weeks after discharge from the hospital.
Gu et al., 2013	Antenatal education	The midwife usually focussed on antenatal check-ups, consultation, making birth plans, parent education, and collaborated with obstetricians and other health professionals as necessary. The midwife would be on call for the woman's labour and birth except in designated circumstances. Each women had a chance of having continuous one-to-one care from the onset of labour to 2 h postpartum.
Jiang et al., 2014	Psycho-education & counselling	The intervention involved mailing postpartum depression prevention and treatment knowledge manual to participants, face-to-face counselling and psychological counselling interventions via telephone to individual risk factors. Mails & face-to-face counselling(1) Health education: mailing to families of intervention group postpartum depression prevention and treatment manuals and CD in which pathogenesis, risk factors and prevention knowledge of postpartum depression were prepared in accordance with domestic and foreign research data and question and answering (Q&A) focused on aspects of the solution to social support, marital relationship, child-rearing responsibilities for maternal families; (2) Out-patient counselling: Setting appointments for intervention group mothers so that they could come to Shenzhen Maternal and Child Health Hospital once a week for face-to-face counselling which lasted no less than 40 min each time; (3) Telephone counselling: an inquiry hotline was set up and designated a special person responsible for keeping the telephone counselling on psychological intervention against risk factors, weekly telephone to those who were in the intervention group but inconvenient to come to the hospital; (4) Referral: those poor puerperal who still had severe clinical symptoms of postpartum depression after health education, counselling, psychological counselling and other interventions were transferred to psychiatric specialized hospital for further treatment

Author, year	Strategy	Intervention description
Lara, Navarro & Navarrete, 2010	Psycho-education	This intervention includes information on normal pregnancy and the postpartum period, from psychoanalytic and risk factor perspectives. It also considers strategies aimed at reducing depressive levels through increasing positive thinking and pleasant activities, improving self-esteem, increasing self-care, learning skills to increase social support, working through feelings of past grief and loss and identifying and exploring unrealistic expectations about pregnancy and motherhood
Mao et al., 2012	CBT	Themes of the group sessions included “Understanding self-management and Chinese delivery culture,” “Effective problem solving and positive communication,” “Relaxation exercise and cognitive restructuring,” and “Improving self-confidence.” There were some homework after every session for participants to practice learned skills. Husbands were as secondary participation e.g. play-role, support and supervision, in the group training sessions. Homework after every session was given for participants to practice learned skills. One individual counselling session was arranged to tackle further personal problems.
Moshki, Baloochi Beydokhti & Cheravi, 2014	Antenatal education	"A participatory educational program was carried out for the experiment group, which included anatomic and physiological changes, nutrition, common complications during pregnancy, mental health and communication skills, familiarization with pregnancy stages, delivery and pain reduction methods, postpartum health, emotions and attitudes of women with special emphasis on components of HLC including internal HLC, powerful others HLC, chance HLC. Also, the subjects discussed in the workshops were presented in brief, with emphasis on HLC components for the spouses in one session. In the last session, training materials derived from available reliable sources about postpartum education and physical and mental health care were issued to the experiment group members."
Norouzi et al., 2013	Comple-mentary medicine	"Mothers were placed in the supine position and covered in a front-opening gown. Room temperature where the intervention was conducted, was maintained at 26 ◦C. Immediately before transfer, a primary educated nurse who was trained by a researcher, placed a cloth diaper over the infant. When the infant was settled on the mother’s chest, the nurse removed the cloth diaper, while the mother covered the gown around the infant. During the 30 min placing of the newborn on the mother’s chest, a trained partner attended in the room." A group of subjects were also exposed to music during the kangaroo care. The subjects in the intervention group, were exposed to music via an MP3-player with audio settings using an occlusive headphone. The type of music played through the headphones was soft instrumental and included relaxation music by Johann Sebastian Bach, which was selected in consultation with a neuroscience specialist. The MP3-player was started immediately after induction of KC and continued for 30 min.
Rabiei et al., 2014	CBT	"Fordyce has developed a program to increase the happiness of community consisting of 14 elements. This program has eight cognitive element and six elements of behavioural. She believes that with educating these components, individuals are able to increase their happiness. It was conducted with Lecture, discussion and question-response methods. Half the time of each session was devoted to presentations of the meeting and after a rest period, the second half of the training session was devoted for group discussion on the subject and question and answer exercises. At the end of each session, assignment was offered to all women in out of position of educational topics for exercise. Outlines of the intervention proram includes: First session: Definition of depression and symptoms of postpartum depression, definition of happiness, the necessity and importance through review of studies on happiness. Second session: Techniques to increase physical activity — being productive and doing something useful and meaningful techniques. Third Session: Techniques of principles for better planning and organization - techniques for off the concerns — techniques to reduce the demands and wishes. Fourth Session: Creativity increased techniques-moment living in the present techniques. Fifth Session: social enhancement techniques — being real techniques. Sixth Session: Techniques for increase intimacy as the primary source of happiness, prioritizing happiness, techniques and in valuing of great happiness. Seventh Session: Techniques of expression and optimistic enhancement. Eighth Session: An overview of all techniques, conducted a post-test (immediately) and determination time of post-test (2 months later). At the end of program, a summary of all happiness techniques overviewed with help of mothers and were asked questions about the current level of happiness and optimism of those. If they had questions about them, were answered by instructor. Then they were completed the BDI-II-Persian. Women for their participation in the program were acknowledged and time of follow-up session was set up for 2 months later"

Author, year	Strategy	Intervention description
Rahman et al., 2008	CBT	"The intervention, called the Thinking Healthy Program, used cognitive behaviour therapy techniques of active listening, collaboration with the family, guided discovery (ie, style of questioning to both gently probe for family's health beliefs and to stimulate alternative ideas), and homework (ie, trying things out between sessions, putting what has been learned into practice), and applied these to health workers' routine practice of maternal and child health education."
Rojas et al., 2007	Psychoeducation, structured pharmacotherapy, systematic monitoring of clinical progress and treatment compliance, further training to doctors, specialist supervision on regular basis	The multicomponent intervention included psychoeducational groups, structured pharmacotherapy if needed, systematic monitoring of clinical progress and treatment compliance, further training to doctors, and specialist supervision on a regular basis. Psychoeducational groups were similar to those in our previous trial, with information about symptoms and treatments, problem-solving and simple behavioural activation, and cognitive techniques. All topics were presented with examples relevant to the postnatal period. Psychoeducational group: eight weekly structured psycho-educational groups to convey information about symptoms and treatments and to teach problem solving and behavioural activation strategies and cognitive techniques using examples illustrative of the postnatal period. Treatment adherence support: medical appointments at weeks two and four and thereafter monthly for 6 months to monitor clinical progress and treatment compliance. Pharmacotherapy if needed: structured cost-free pharmacotherapy protocol of fluoxetine (20–40 mg per day) or sertraline (50–100 mg per day) for women who did not respond to fluoxetine or were lactating.
Salehi et al., 2016	CBT, psycho-education	Group CBT compared with interactive lectures. GCBT was delivered in 3 groups of 12 to 13 participants. Four lectures (2 sessions/wk) were conducted with the IL group (n=38), each lasting 120 to 150 min.
Tripathy et al., 2010	Participatory learning and action cycle, psychoeducation, social support	Groups took part in a participatory learning and action cycle (figure 4). Community members who were not regular group members were also encouraged to participate in discussions. Information about clean delivery practices and care-seeking behaviour was shared through stories and games, rather than presented as key messages. By discussion of case studies imparted through contextually appropriate stories, group members identified and prioritized maternal and newborn health problems in the community, collectively selected relevant strategies to address these problems, implemented the strategies, and assessed the results. Although some strategies were common, each group was free to implement its own combination of strategies. The intervention team adapted facilitation materials from the study in Makwanpur, Nepal, to guide the meetings. Groups used methods such as picture-card games, role play, and story-telling to help discussions about the causes and effects of typical problems in mothers and infants, and devised strategies for prevention, homecare support, and consultations
Zhao et al., 2017	Psycho-education	"Five of the sessions focused on maternal mental health while the last session was focused on the husbands of the participants. There were approximately 15 to 18 group facilitators present for each session of the intervention. Each group consisted of 10–12 participants and was guided by the researchers. The groups were interactive and each session focused on a specific topic, (1) session 1 focused on increasing awareness of antenatal anxiety and depression, (2) session 2 focused on improving high-risk pregnancy knowledge, (3) session 3 focused on understanding postpartum depression and identification, (4) session 4 focused on coping skills for family conflicts, (5) session 5 focused on encouraging psychological adjustment during delivery, and (6) session 6 focused on helping husbands learn how to identify their wives' postpartum depressive symptoms and support them to manage it. We asked high-risk pregnant women to participate in sessions 1–5 on their own while their husbands only participated in session 6 in order to avoid interference and embarrassment when discussing sensitive issues like family conflicts."
Interventions with a secondary focus on maternal mental health		
Chang et al., 2015	Psycho-education	The intervention included short films, which were divided into nine modules. Each module were about 3 minutes in duration, covered the following topics: love, responding and comforting, talking to children, praise, using bath time to play and learn, looking at books, simple toys to make, drawing and games, and puzzles. The films showed mothers doing the behaviours the authors wished to encourage.
Aboud et al., 2013	Psycho-education	Parenting practices related to health, nutrition, communication and play: specifically showing love and avoiding harsh discipline, responsive self-feeding and providing a diverse diet with animal-source foods, hand-washing before feeding and after defecation, talking and singing with the child, and providing interesting play materials and playmates. There were two components to the intervention: one in which the community groups of mothers met for 14 sessions, fortnightly for 4 months and monthly for 6 months, covering the topics and practicing the messages with their children; the other included meetings with government paid family welfare assistants who were instructed to deliver messages during a 10-min counselling session to mothers of young children at home and at their community clinics. On average the mothers received two home visits (range 1-5) and heard the messages at clinics.

Author, year	Strategy	Intervention description
Akbarzadeh et al., 2016	not specified	Topics included physiology of pregnancy and childbirth, awareness of the feelings and perceptions of the embryo, the concept of attachment, attachment behaviour (the relationship with the foetus), attachment behaviour (control of anxiety and negative thoughts) and patterns of proper sleep, exercise and nutrition during pregnancy. They were trained on attachment skills in four 60-90-minute sessions held once a week
Attanasio et al., 2014	Psycho-social	The psychosocial stimulation program was based on the Jamaican home visiting model. The curriculum and materials were adapted to the Colombian sociocultural context. The curriculum was delivered by home visitors who conducted weekly home visits. In these visits, low cost or homemade toys, picture books, and form boards were used to demonstrate play activities. These materials were left in the homes for the week after the visit and were changed weekly. The aims of the visits were to improve the quality of maternal-child interactions and to assist mothers to participate in developmentally appropriate learning activities, many centred on daily routines. The micronutrient supplementation consisted of Sprinkles (Hexagon Nutrition, Mumbai, India)—encapsulated micronutrients in powder form—developed to treat childhood anemia. Each single dose sachet contains 12.5 mg iron, 5 mg zinc, vitamin A 300 μg retinol equivalents, 160 μg folic acid, and 30 mg vitamin C.
Baker-Henningham et al., 2005	Psycho-social	The intervention focused on improving child development by improving mothers' knowledge and practices of child rearing and their parenting self-esteem. The intervention included 30-minute weekly home visits conducted by community health staff. They used home-made toys, books and materials available in the house to facilitate age-appropriate play activities between the caregivers and the child. Child nutrition, parenting problems, child discipline strategies, promotion of child play and learning activities were also discussed.
Cifti & Arikan, 2012	Breast-feeding training	Training regarding the advantages of breast milk and breastfeeding, its benefits for the mother and the infant and techniques for expressing and storing breast milk. One-to-one training, which was at least one-hour long with the mothers. They also received a training booklet containing the information in the training.
Clarke et al., 2014	Participatory learning and action	Strategies differed across groups and included home visits, using social dramas and picture card games to raise awareness of common health problems, prevention and treatment strategies, and collecting voluntary donations to community funds to facilitate care seeking.
Cooper et al., 2002	Psycho-education	Used items from the Neonatal Behavioural Assessment Schedule to sensitise the mother to her infant's individual capacities and sensitivities. Advice regarding various aspects of infant management, including sleeping, crying, feeding, was also given
Cooper et al., 2009	Psycho-education	Adaptation of a preventive intervention program by health visitors devised for implementation in Britain, which follows the principles of The Social Baby. Used items from the Neonatal Behavioural Assessment Schedule to sensitize the mother to her infant's individual capacities and sensitivities.
Ho et al., 2009	Psycho-education	The education program included a printed three-page booklet containing the incidence, symptoms, causes, and management information about the PPD developed by Heh and Fu.
Le Roux et al., 2013	CBT	The PIP condition received antenatal and postnatal home visits by Community Health Workers (CHW) in addition to the clinic-based care. CHWs systematically visited every home in their assigned neighbourhood, identified pregnant mothers, carried a scale to weigh infants, plotted weight on growth charts to identify underweight children, and transcribed outcomes from the government-issued Road-to-Health card. The antenatal messages concerned: 1) good maternal nutrition and preparing for breastfeeding; 2) regular antenatal clinic attendance and danger signs; 3) HIV testing, PMTCT tasks and partner prevention strategies; and 4) stopping alcohol use. The postnatal messages were: 1) breastfeeding and growth monitoring; 2) medical adherence (immunisations, prevention for HIV-exposed children); 3) infant bonding; and 4) securing the child grant. The home visits were monitored in two ways: 1) CHW handwritten notes; and 2) CHWs carried mobile phones that noted visit time, length, content covered, and perceived impact.
Morris et al., 2012	Social support, psycho-education	"The intervention consisted of group sessions and home visits. The mother and baby group was the key component of the intervention. Education on child development was combined with teaching and practicing simple age–appropriate play activities and toy making to enhance development in all areas, stimulate the child, and foster good caregiver-child relationships. It was conducted in a flexible and interactive manner, using what was happening in the group, combined with mother's experiences at home, as class material. For example, some of the liveliest discussions were over how to set limits and teach good behaviour as mothers

Author, year	Strategy	Intervention description
		shared experiences of the costs and benefits of physical punishment, which had increased under the stresses of Internally Displaced Person (IDP) life. A final session was dedicated to how mothers could sustain what they had learned in the group or on their own with the aim of generating mother-to-mother transmission of knowledge. Home visits were made by the psychosocial facilitator and nutrition support worker together. Standard nutritional education and monitoring were combined with discussion designed to reinforce the psychosocial knowledge disseminated in the mother-to-mother groups and to address specific behavioural or relational challenges, and to promote particular aspects of child development according to individual need and the home context. If a mother was defaulting from the group, this was also discussed. The training materials used in the intervention were adapted from the Learning through Play program (Hincks- Dellcrest Centre, 2002). These are multicultural, primarily picture-based materials that can be used to educate mothers with no or little reading skills on the importance of play, how to play, and the five key areas of child development: physical, intellectual, language and communication, relationships, and sense of self. The content was adapted to the Acholi IDP context using the findings from a preliminary ethnographic survey with 20 key informants consisting of IDP mothers and traditional birth attendants from the area as well as the opinions of the Acholi facilitators. The drawings were recreated by a local artist to reflect details of the Acholi IDP culture and context."
Rahman et al., 2009	Play-based program	"Starting in the last trimester of pregnancy, this parent-based program provided center-based parent groups, as well as fortnightly individual home visits. In addition, efforts were made to mobilize self-help groups of mothers to support each other and engage in fun child-focused activities, using the program as a focal point. The 'Learning Through Play' program is intended to stimulate early child development. The central feature of the program is a pictorial calendar devised for parents, depicting eight successive stages of child development from birth to 3 years, with illustrations of parent–child play and other activities that promote parental involvement, learning and attachment. In each stage, five key areas of child development are depicted: sense of self, physical, relationships, understanding and communication. Information about each area is written in simple, low-literacy language, with accompanying pictures that act as visual cues. The calendar is accompanied by a comprehensive training manual for workers, which provides additional information on child development and techniques on how to conduct groups or individual sessions for parents, using the calendar as a focus. A key feature of the 'Learning Through Play' program is its emphasis on the quality of the mother–infant interaction, and helping the mother read infant cues and develop sensitive responsiveness towards the infant through play, which can be pleasurable for both the mother and the infant." Half-day workshop on the second birth month stage of development with a group of 6-8 mothers. a 'Learning Through Play' calendar was given to take. Fortnightly home visits to discuss their child's development, using the calendar as the basis for discussion
Shariat & Adedinia, 2017	Psycho-education	The clinical psychologist provided the mothers with in-depth and thorough information on attachment behaviours during pregnancy in each session. These attachment behaviours included father and mother having a conversation with the fetus, father touching mother's abdomen, caressing and touching mother's abdomen to feel fetal movements, addressing the fetus, mother singing a song or lullaby to the fetus, finding fetal position, paying attention to fetal movements and other interactive behaviours with the fetus, counting fetal movements, imagining the facial features of the fetus positively, mother imagine breastfeeding her infant, physical contact between mother and infant through seeing, touching, and smelling, and father supporting and paying attention to mother. Further information was presented about the benefits of breastfeeding and the positive outcomes of talking to infants. The mothers were allotted thirty minutes to ask questions and receive answers at the end of each session. They were also given an instructional package and a CD-ROM associated with mother-infant attachment behaviours aside from the group sessions.
Shrestha et al., 2016	Education	"The program was designed to be interactive, motivating, and supportive, rather than prescriptive, in style so that mothers were encouraged to learn how to care appropriately for their babies. The nurses used various techniques, such as clarification, discussions, and posters, to deliver the content over the session lasting approximately 10-15 minutes during a one-to-one bedside interaction in a comfortable environment. The researcher also developed a brochure to reinforce the educational sessions. It contained appealing photographs, was easy to understand, interesting, familiar, realistic, clearly presented, and had proper use of attractive colors. Mothers also received around 5-7 min postnatal follow-up telephone support from the research, provided mainly during the day at the participant's convenience within two weeks after discharge. In the telephone follow-up the researcher reinforced the knowledge learned at the education sessions, and also explored the signs and symptoms of cord infection. "
Singla, Kumbakumba &	Cognitive behavioural interpersonal & stimulation interventions	"Through a series of active and interactive activities derived from evidence-based cognitive, behavioural, interpersonal, and stimulation interventions (eg, roleplay, games, parent–child interactions, and group-based problem solving), parents were encouraged to learn and enact new practices with their child, spouse, or peers, depending on the specific practice. Parents were assigned homework to practice between sessions. During the session, the volunteer used a series of colored posters depicting the messages, and families received their own Activity Booklet, which included smaller versions of these posters. The parenting

Author, year	Strategy	Intervention description
Aboud, 2015		program included introductory and concluding sessions covering all messages, six sessions on child care, and four sessions for each parent on mother care. Parents also received one or two home visits by the volunteer to review the five parenting messages, discuss their enactment, resolve barriers to enacting them, and make other relevant observations (eg, the provision of home-made toys and pictures, whether parents talked to one another and their child in a respectful tone). Unlike previous home-visit stimulation programs,28 our visits were not used to demonstrate and practise"

Supplementary table 3: Scope and taxonomy of interventions

Author, year	Type	Major elements	Elements
Interventions with a primary focus on maternal mental health			
Bose GN, 2015	Treatment	Behavioural coping skills, exercise	Stress management, aerobics
El-Rafie, Khafagy & Gamal, 2016	Treatment	Behavioural coping skills	Relaxation, stress management
Fathi-Ashtiani et al., 2015	At risk	Interpersonal skills, behavioural coping skills, cognitive coping,	Identifying affect, communication skills, problem solving, relaxation, exposure stress management, self-monitoring
Goa et al., 2010	At risk	Engagement, interpersonal skills, parenting skills, behavioural coping skills, psychoeducation	Identifying and eliciting social support, communication skills, assessing relationships, problem solving, stress management, caregiver coping, parent child interaction, birth procedure, nutrition, breast feeding
Gao et al., 2015	Treatment	Engagement, interpersonal skills, parenting skills, behavioural coping skills, psychoeducation	Identifying affect, identifying and eliciting social support, communication skills, assessing relationships, problem solving, parent child interaction, breast feeding,
Gu et al., 2013	At risk	Behavioural coping skills, psychoeducation, parenting skills,	Exposure, stress management, parent child interaction, birth procedure, nutrition, breast feeding, sexual behaviour
Jiang et al., 2014	Treatment	Psychoeducation	Psychological counselling
Lara, Navarro & Navarrete, 2010	At risk	Interpersonal skills, behavioural coping skills, cognitive coping	Communication skills, assertiveness training, stress management, self-monitoring, identifying thoughts, cognitive restructuring, distraction, self-praise, mood monitoring, mindfulness
Mao et al., 2012	At risk	Behavioural coping skills, interpersonal skills, cognitive coping, psychoeducation	problem solving, relaxation, identifying thoughts, behaviours, communication skills, self-monitoring, birth procedures, cognitive restructuring, self-talk, self-praise, mood monitoring, self-awareness
Moshki, Baloochi Beydokhti & Cheravi, 2014	At risk	Engagement, interpersonal skills, behavioural coping skills	Identifying and eliciting social support, communication skills, assertiveness training, emotional regulation, stress management

Nourozi et al., 2013	At risk	Engagement, parenting skills	Involvement of family, parent-child interaction
Rabiei et al., 2014	Treatment	Engagement, interpersonal skills, behavioural coping skills, cognitive coping, exercise	Identifying and eliciting social support, communication skills, assertiveness training, assessing relationships, problem solving, relaxation, emotional regulation, stress management, self-awareness, mindfulness, aerobics and non-aerobic exercise
Rahman et al., 2008	Treatment	Engagement, interpersonal skills, behavioural coping skills	Identifying and eliciting social support, communication skills, assertiveness training problem solving, stress management, decision making,
Rojas et al., 2007	Treatment	Interpersonal skills, behavioural coping skills, cognitive coping	Identifying affect, assertiveness training, problem solving, relaxation, emotional regulation, stress management, cognitive restructuring, mindfulness,
Salehi et al., 2016	Treatment	Engagement, interpersonal skills, behavioural coping skills, cognitive coping,	Active listening, empathy, collaboration, inciting social support, eliciting commitment, discussing disadvantages of treatment, discussing barriers to treatment, identifying affect, identifying and eliciting social support, communication skills, assertiveness training, problem solving, emotional regulation, stress management, decision making, identifying behaviours and thoughts, cognitive restructuring, mood monitoring, self-awareness, motivational enhancement, praise, behavioural contracting, assigning homework, interpersonal focus, motivational interviewing, reviewing homework, goal setting, empathy,
Tripathy et al., 2010	At risk	Engagement, interpersonal skills, behavioural coping skills, techniques used by delivery agent	Active listening, empathy, collaboration, inciting social support, eliciting commitment, discussing advantages of treatment, discussing barriers to treatment, identifying affect, identifying and eliciting social support, problem solving, stress management, decision making, self-monitoring, motivational enhancement, role play, interpersonal focus, goal setting,
Zhao et al., 2017	At risk	Interpersonal skills, behavioural coping skills, psychoeducation, cognitive coping,	Communication skills, assessing relationships, problem solving, emotional regulation, birth procedure, cognitive restructuring, identifying thoughts, behaviours, mood monitoring
Interventions with a secondary focus on maternal mental health			
Aboud et al., 2013	At risk	Engagement, behavioural coping skills, interpersonal skills, parenting skills	Identifying and eliciting social support, problem solving, communication skills, care giver coping, parent child relationship
Akbarzadeh et al., 2016	At risk	Behavioural coping skills, cognitive coping, parenting skills	Relaxation, emotional regulation, stress management, self-monitoring, mindfulness, caregiver coping, cognitive restructuring,
Attanasio et al., 2014	At risk	Engagement, cognitive coping, interpersonal skills, parenting skills, psychoeducation, techniques	Empathy, discussing advantages of treatment, discussing barriers of treatment, communication skills, parent-child interaction, nutrition, cognitive restructuring, behavioural contracting, behavioural experiments, direct suggestions, reviewing homework, goal settings, micronutrients,

		implemented by delivery agent, nutrients behaviour	
Baker-Henningham et al., 2014	Treatment	Engagement, interpersonal skills, behavioural coping skills, parenting skills	Identifying and eliciting social support, communication skills, assertiveness training, stress management, caregiver coping
Chang et al., 2015	At risk	Parenting skills, techniques used by delivery agent	Parent-child interaction coaching, praise,
Cifti & Arikan, 2012	At risk	Psychoeducation	Birth procedure, breast feeding,
Clark et al., 2014/Fottrell et al., 2013	At risk	Engagement, interpersonal skills, behavioural coping, parenting skills, psychoeducation, cognitive coping, techniques used by delivery agent	Involvement of significant other, active listening, empathy, collaboration, eliciting commitment, discussing advantages of treatment, communication skills, exposure, self-monitoring, caregiver coping, parent-child interaction, breastfeeding, cognitive restructuring, self-awareness, motivational enhancements, praise, role plays, behavioural contracting, assigning homework, interpersonal focus, behavioural experiments, reviewing homework, empathy,
Cooper et al., 2002	At risk	Engagement, interpersonal skills, Parenting skills, techniques implemented by delivery agent	Empathy, inciting social support, discussing advantages of treatment, discussing barriers of treatment, identifying and eliciting social support, communication skills, caregiver coping, parent-child interaction, behavioural contracting
Cooper et al., 2009	Treatment	Parenting skills	Parent child interaction,
Ho et al., 2009	Treatment	Cognitive coping, psychoeducation	Mood monitoring, self-awareness, Psychoeducation of what is postpartum depression, what are causes, who to contact
Le-Roux et al., 2013	At risk	Psychoeducation	Nutrition, breast feeding, sexual behaviour,
Morris et al, 2012	At risk	Interpersonal skills, parenting skills, Psychoeducation, cognitive coping	Communication skills, assessing relationships, parent-child interaction coaching, nutrition, self-awareness
Rahman et al., 2009	At risk	Engagement, interpersonal skills, parenting skills, techniques implemented by delivery agent	Identifying and eliciting social support, communication skills, caregiver coping, parent child interaction, behavioural contracting
Shariat & Adedinia, 2017	Preventive	Interpersonal skills, behavioural coping skills, parenting skills. Cognitive coping	Communication skills, exposure, self -monitoring, caregiver coping, parent child interaction, cognitive restructuring, self-awareness
Shrestha et al, 2016	At risk	Psychoeducation,	Breastfeeding
Singla, Kumbakumba & Aboud, 2015	At risk	Engagement, interpersonal skills	Identifying and eliciting social support, communication skills, cognitive, behavioural, interpersonal, and stimulation interventions (eg, roleplay, games, parent–child interactions, and group-based problem solving), parents were encouraged to learn and enact new practices with their child, spouse, or peers.

Supplementary table 4: Delivery agent and duration of interventions

Author, year	Delivery agent	Integration	Duration of one session (minutes)	Program duration (weeks)	Number of sessions
Interventions with a primary focus on maternal mental health					
Bose GN, 2015	NR	NR	NR	4 weeks exercise program	16
El-Rafie, Khafagy & Gamal, 2016	The music-accompanied sessions were supervised by a physician and physiotherapist	NR	60 min	12 weeks	3
Fathi-Ashtiani et al., 2015	trained psychologists	Integrated into women's standard prenatal visits	60 min	NR	8
Gao et al., 2010	Psychologist and midwife educator	Standalone	90 min	NR	2
Gao et al., 2015	Midwife educator	Integrated into hospital settings	60 min	2 weeks	2
Gu et al., 2013	Midwife	Integrated into routine care	NR	NR	NR
Jiang et al., 2014	NR	Standalone	40 min face to face counseling	NR	NR
Lara, Navarro & Navarrete, 2010	Four facilitators with extensive clinical experience (ranging from 5-25 years)	NR	120 min	8 wees	8
Mao et al., 2012	Obstetrician (second author)	NR	90 min	Four weeks followed by an individual counselling session	4
Moshki, Baloochi Beydokhti & Cheravi, 2014	NR	NR	240 min	Nine workshops lasting 36 hours in total were held for the experiment group.	3
Norouzi et al., 2013	Primary educated nurse	NR	30 min	0 min	1
Rabiei et al., 2014	Trained instructor	NR	60-90 min	4 weeks	8
Rahman et al., 2008	Lady Health Workers	Integrated into existing health systems in a rural sub-district of Pakistan, that is the routine work of the LHWs	NR	Every week 4 weeks in the last month of pregnancy, three sessions in the first postnatal month and	16

				nine 1 monthly-sessions thereafter	
Rojas et al., 2007	Midwives or nurses for group sessions, doctors for structured pharmacotherapy protocol	The multicomponent intervention was structured similarly to how primary care is organized in most developing settings	50 min	8 weeks	8
Salehi et al., 2016	GCBT and IL was delivered by the same midwife with a Master of Science in counselling in midwifery as the therapist/ counsellor and psychiatrist as group leader and co-therapist	NR	Group counselling and lectures lasted 120-150 min each	2 weeks	4 group counselling sessions, four lectures
Tripathy et al., 2010	A local woman selected on the basis of criteria	NR	NR	80 weeks	20
Zhao et al., 2017	Researchers	NR	90 min	NR	6
Interventions with a secondary focus on maternal mental health					
Aboud et al., 2013	Young women with 10th grade education	For second parenting program, it as part of their duties but they hadn't received any training for it.	10 min	40 weeks	14
Akbarzadeh et al., 2016	NR	Not integrated	60- 90 min	6 weeks	6
Attanasio et al., 2014	Female community leader	An integrated early childhood intervention combining stimulation and micronutrient supplementation	NR	18 months	72
Baker-Henningham et al., 2005	Community health aides-who are paraprofessionals employed in government health centres	Standalone	30 min	48 weeks	50
Cifti & Arikan, 2012	Researcher	NR	60 min	18 weeks	5

Clarke et al., 2014	Local women of reproductive age with at least some high school education were recruited to facilitate group meetings	NR	NR	NR	NR
Cooper et al., 2002	Community health aides-who are paraprofessionals employed in government health centres	NR	60 min	6 months	22
Cooper et al., 2009	Local women	Standalone	NR	20 weeks	16
Chang et al., 2015	Community health worker	Integrated into routine health care visits	19 min	60 weeks	5
Ho et al., 2009	Postpartum ward nurses	Integrated into hospital settings	NR	12 weeks	1
Le-Roux et al., 2013	Community health workers	NR	NR	NR	NR
Morris et al., 2012	Three trained Acholi psychosocial facilitators working together with trained Acholi nutrition support workers.	Integrated with the well-established community-based feeding program for nutritional support for internally displaced infants and their mothers in Kitgum district of Northern Uganda	Group sessions lasted between 90-120 min and home visits lasting 60-120 min	6 weeks	6
Rahman et al., 2009	Lady Health workers	Integration into existing health system	Half day workshop and 15-20 min fortnightly home visits	NR	Half-day workshop with a group

					of mothers, fortnightly home visits
Shariat & Adedinia, 2017	Clinical psychologist	Intervention was provided along with routine pregnancy care	90 min	NR	3
Shrestha et al., 2016	Nurses	Intervention group also received the same routine general newborn care education as the control group	10-15 min	Until discharge with telephone follow up support within two weeks of discharge	NR
Singla, Kumbakumba & Aboud, 2015	Community volunteers	NR	60-90 min for group sessions, home visits lasted 40-50 min	40 weeks	12 sessions + 1-2 home visits

NR denotes Not reported

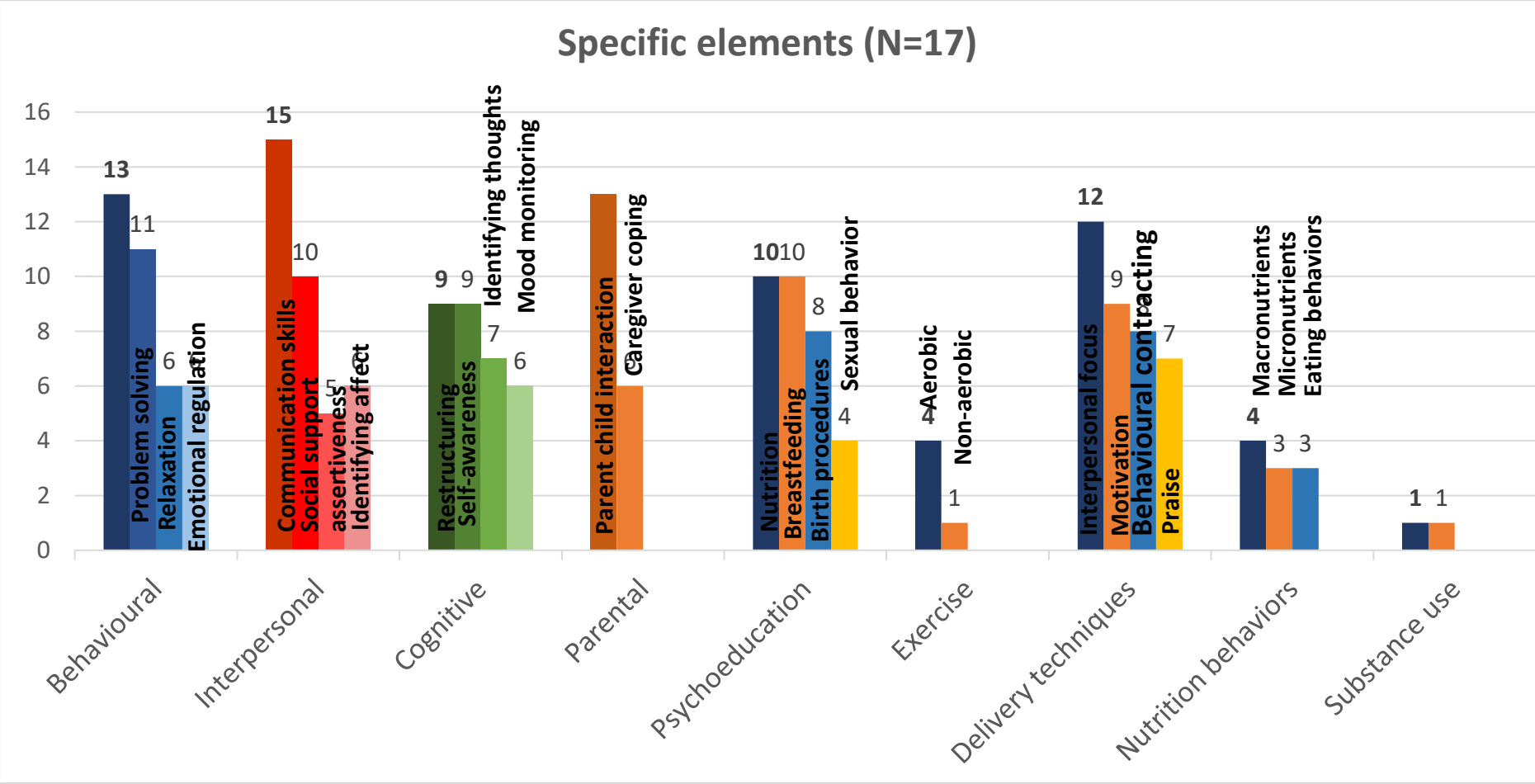


Figure 4: Specific elements employed in psychotherapeutic interventions with a primary focus on maternal mental health

Figure 5: Non-specific elements employed in psychotherapeutic interventions with a primary focus on maternal mental health

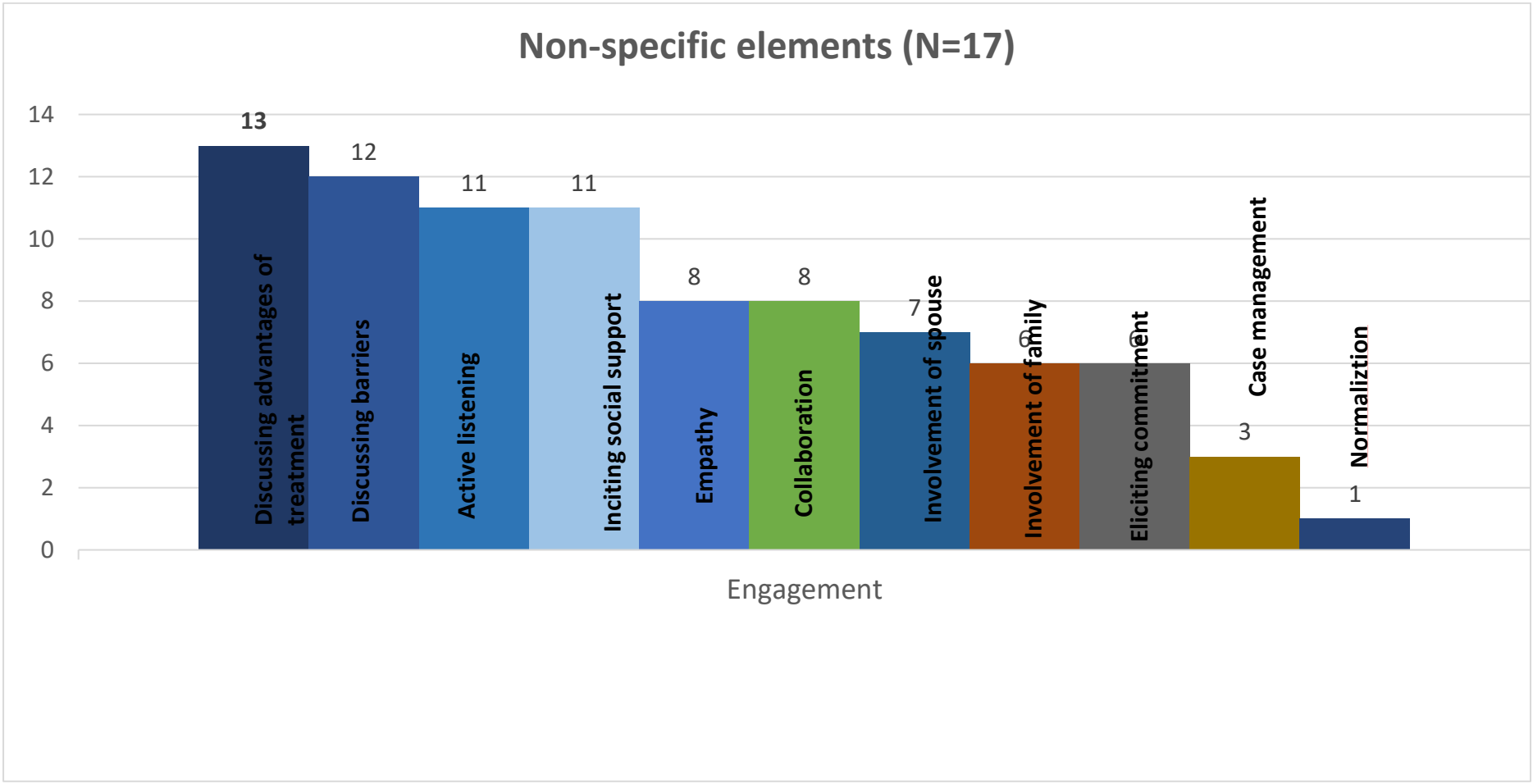


Figure 6: Specific elements employed in interventions with a secondary focus on maternal mental health

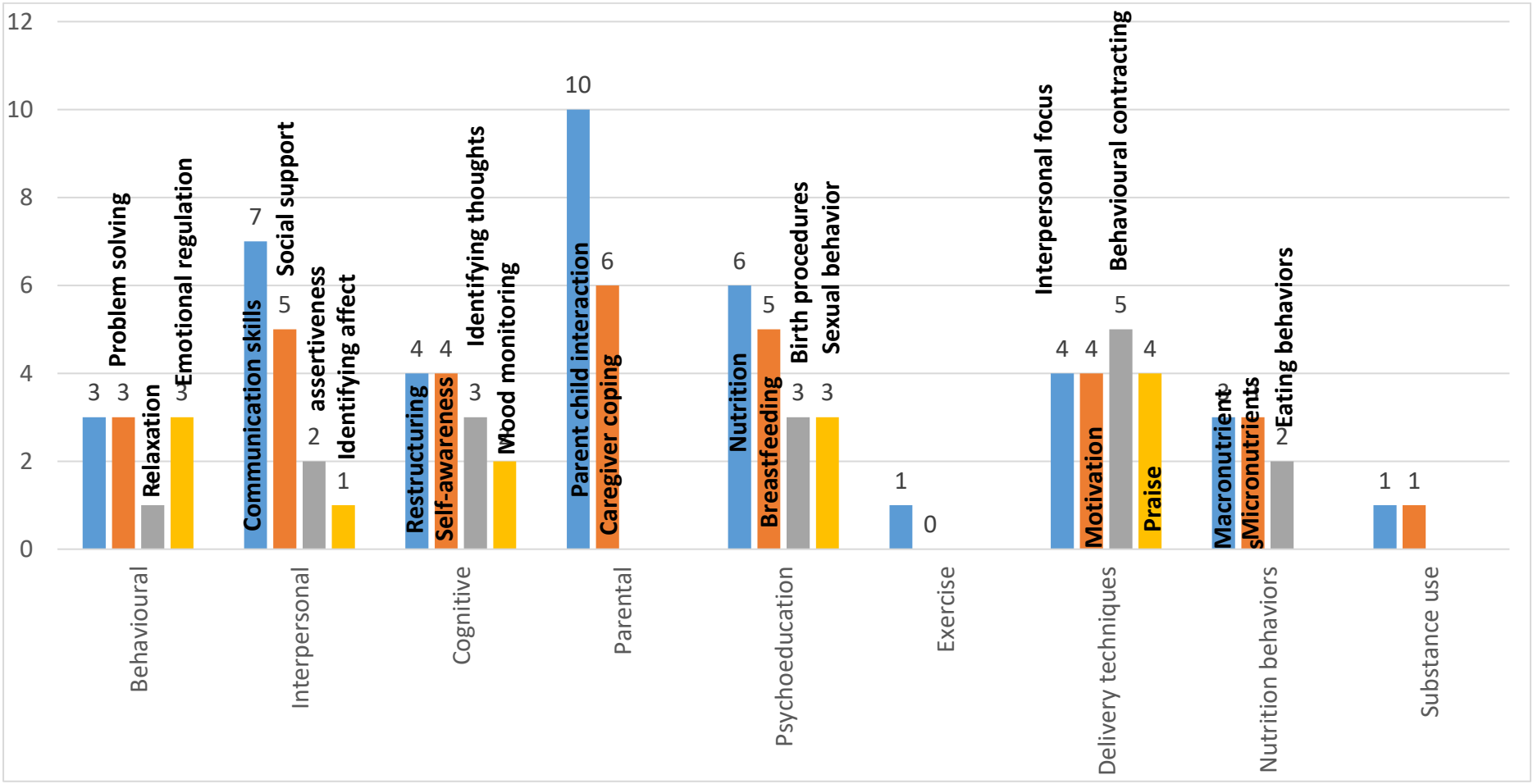
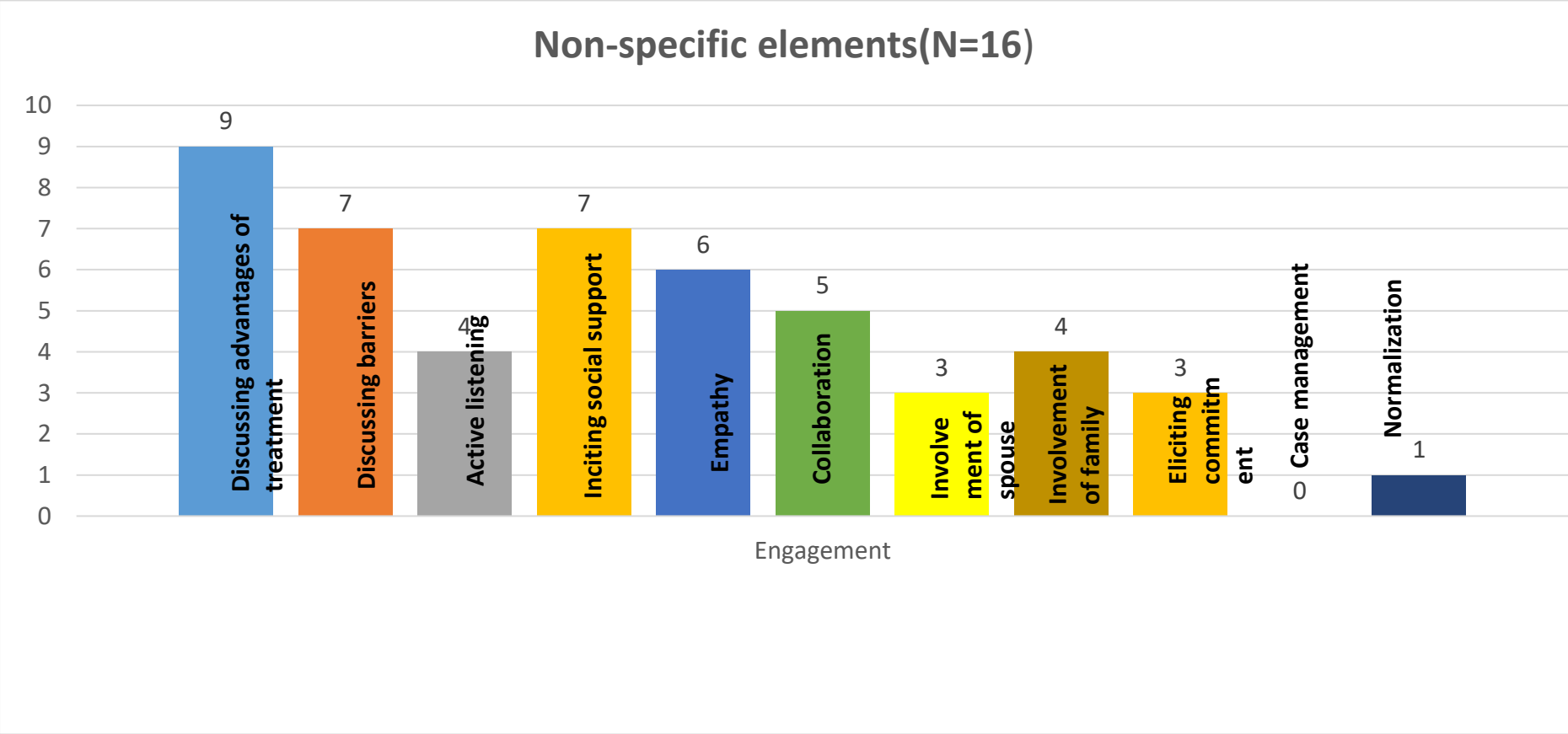


Figure 7: Non-specific elements employed in interventions with a secondary focus on maternal mental health



List of included RCTs

Interventions with a primary focus on maternal mental health

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Table 11: Definitions of therapeutic techniques employed in psychosocial interventions

Sr #	Name of Skill	Definition of skill
1.	Involvement of family	The family members are involved in the intervention.
2.	Involvement of significant other	The significant other or spouse is involved in the intervention.
3.	Active listening	The skillful listens to the speaker with full concentration to understand what is being said [1].
4.	Collaboration	Working with others
5.	Inciting social support	Providing insight of how others can provide help or support [2].
6.	Case management	Planning, facilitating and coordination of different options regarding the patient [3].
7.	Normalization	To communicate that the person's experiences also happen to other people [4].
8.	eliciting commitment	Motivating the client to take active part in intervention.
9.	Discussing advantages	Identifying advantages to take the intervention.
10.	Discussing barriers	Identifying difficulties to take the intervention.
11.	Identifying affect	Identifying feeling or emotion [5].
12.	identifying and eliciting social support	Providing consideration of how others could change their behaviour to offer the person help or support [6].
13.	Communication skills	These are set of skills which improve the dissemination, reception and exchange of information, opinions or ideas making sure that the intended message is completely understood by those involved [7].
14.	Assertiveness training	To train people for effective communication without being passive or aggressive.
15.	Assessing relationships	To assess the relationships with people around.
16.	Problem solving	To solve a problem by carefully defining problem and weighing different options to solve the problem.
17.	Relaxation	To apply various techniques for relaxation.
18.	Awarding positive behaviour	Applying different methods to encourage recurrence of a positive behaviour [8].
19.	Exposure	Confronting previously avoided objects, situations, unwanted thoughts or feelings while not avoiding or escaping from it [9].
20.	Emotional regulation	Tendency to manage and responding to emotional experience [10].
21.	Stress management	May involve a variety of techniques that do not target a specific behaviour but seek to reduce anxiety and stress [6].
22.	Decision making	Process of making choices by identifying decision, gathering information, and assessing alternative resolutions [11].
23.	self-monitoring	The person keeps a record of one's own behaviour [6].
24.	Delay awards	A process of deferring initial reward for a better reward later [12].
25.	Caregiver coping (e.g., management skills for the parents of children)	Mechanism through which the caregiver manages the stress [13].
26.	Parent-child Interaction Coaching (e.g., positive 1-on-1, attending to children modeling, etc)	The parent applies a new skill with the child and the therapist provides immediate feedback [14].
27.	Birth procedures	Knowledge about different ways of giving birth [15].

28.	Specific health areas of children (e.g., nutrition, breastfeeding, SRH, etc)	If the intervention targeted the specific dimensions of health areas in children.
29.	Nutrition	Education regarding recommended nutrition practices.
30.	Breastfeeding	Education regarding recommended breastfeeding practices.
31.	Sexual behaviour	Avoidance of risky sexual behaviours.
32.	Identifying thoughts, behaviours, and their links (e.g., identifying negative thoughts, thought diary, etc.)	Realizing what thoughts cross one's mind by number of ways [16].
33.	Cognitive restructuring (e.g., reattribution, weighing evidence, logical questioning, etc.)	Identifying and disputing maladaptive thoughts [2].
34.	Distraction	Paying attention to some other stimuli rather than the unhelpful thoughts [17].
35.	Self-talk	Use of self-instruction and self-encouragement to support action [6].
36.	Self-praise	To boast one's self esteem by expressing approval or admiration [18].
37.	Mood monitoring	Paying attention toward one's mood states by means of different methods [19].
38.	Mindfulness	Paying attention towards experiences in the present moment within body and mind and accepting the happenings [20].
39.	Self-awareness	Conscious awareness of becoming the object of one's own awareness [21].
40.	Aerobics	Aerobic exercise also known as "cardio" exercises include running, swimming, walking, hiking, aerobics classes, dancing, cross country skiing, and kickboxing.
41.	Non-aerobic exercise	Anaerobic ("without oxygen") exercise is any physical activity that causes you to be quickly out of breath, like sprinting or lifting a heavy weight.
42.	Motivational enhancement	To increase internal motivation in order to make long lasting change [22].
43.	Praise	Praising for positive behaviour or accomplishment.
44.	Role play	Performing role of a person in a situation [23].
45.	Behavioural contracting	Agreement of a contract specifying behaviour to be performed so that there is a written record of the person's resolution witnessed by another [6].
46.	Assigning homework	Assigning tasks pertaining to interventions, to be performed at home.
47.	Interpersonal focus	Focus on maintaining relationships with other people [24].
48.	Behavioural experiments	To test out the negative thoughts and re-evaluate underlying beliefs by performing an action [25].
49.	Motivational interviewing	Prompting the person to provide self-motivating statements and evaluation of their own behaviour to minimize resistance [6].
50.	Direct suggestions	Providing directions of how to act, behave or handle a situation [26, 27].
51.	Goal setting	Identifying an aim or goal to achieve in a session or therapy [28].
52.	Giving sick role	Assigning role of a sick person to the participant, to understand the circumstances, particular rights and responsibilities of those who are ill.
53.	Empathy	To understand and share other's feeling or situation [29].
54.	Macronutrients	Food groups needed in large amounts [30].
55.	Micronutrient	Food groups needed in small amounts [30].
56.	Eating behaviours	The food choices and eating practices [31],
57.	Alcohol use	Education about minimal use and harms of alcohol misuse.
58.	Substance misuse	Harmful use of substances for non-medical purposes [32].

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