

The Reach Up Parenting Program, Child Development, and Maternal Depression: A Meta-analysis

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1 **Title:** The Reach Up Parenting Program, Child Development, and Maternal Depression: A Meta-
2 analysis

3
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18
19 **Short Title:** The Reach Up Parenting Program: A Meta-analysis

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21 Sally Grantham-McGregor developed the original Jamaica stimulation intervention. Sally
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32
33 **Abbreviations:** Ages & Stages Questionnaire (ASQ), Bayley Scales of Infant and Toddler
34 Development (Bayley's), Child Development Agents (CDA), Center for Epidemiologic Studies
35 Depression Scale (CES-D), Community Health Workers (CHW), Confidence Interval (CI),
36 Denver Developmental Screening Test (Denver), Early Childhood Development (ECD),
37 Edinburgh Postnatal Depression Scale (EPDS), UNICEF's Family Care Indicators (FCI), Grading
38 Recommendations Assessment, Development and Evaluation (GRADE), Griffiths Scales of
39 Mental Development (Griffiths), Home Observation for Measurement of the Environment
40 (HOME), Iron Deficiency Anemia (IDA), Low- and middle-income countries (LMIC), Mental
41 Development Index (MDI), Neither Anemic Nor Iron Deficient (NANI), Preferred Reporting
42 Items for Systematic review and Meta-Analysis (PRISMA), International Prospective Register of
43 Systematic Reviews (PROSPERO), Randomized Controlled Trial (RCT), Standard Deviations
44 (SD), Standardized Mean Difference (SMD), Regional Project on Child Development Indicators
45 (PRIDI), Validated Bengali version of World Health Organization Self-reported Questionnaire-20
46 (WHO-SRQ-20)

1 **Keywords:** Meta-analysis, Parenting Program, Child Development, Reach Up, Maternal
2 Depression

3
4 **Table of Contents Summary:** (max 25 – 25 words) Reach Up parenting program impact in 18
5 studies across 8 countries. Impact moderation by child and implementation characteristics provides
6 evidence for program design and implementation.

7
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9 including information for the sub-group analysis.

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1 **Author Contribution Statement:**

2 Dr Jervis conducted the meta-analysis, contributed to interpretation of findings, writing the
3 analysis and results section, and critically reviewed the manuscript for crucial intellectual content.

4 Dr Coore-Hall conducted the literature search and screening of studies for inclusion, conducted
5 data extraction, assessment of risk of bias and quality of evidence, drafted the methods section and
6 contributed to critical review of the manuscript for crucial intellectual content.

7 Dr Pitchik conducted data extraction, assessment of risk of bias and quality of evidence, drafted
8 the methods section and contributed to critical review of the manuscript for crucial intellectual
9 content.

10 Dr Arnold led the analysis and contributed to the interpretation of findings, writing of the analysis
11 section and discussion.

12 Dr Grantham-McGregor contributed to the conceptualization and design of the review,
13 interpretation of findings, writing of the introduction and discussion and critical review of
14 manuscript for crucial intellectual content.

15 Dr Marta Rubio-Codina contributed to design of the review, interpretation of findings, writing of
16 the discussion and critical review of the manuscript for crucial intellectual content.

17 Dr Baker-Henningham, Dr Fernald, Dr Hamadani, and Dr Trias contributed to design of the
18 review, interpretation of findings and critical review of the manuscript for crucial intellectual
19 content.

20 Dr Smith conducted the literature search and screening of studies for inclusion and contributed to
21 design of the review and critical review of the manuscript for crucial intellectual content.

22 Dr Walker led the review, contributed to conceptualization and design, interpretation of findings,
23 writing of introduction and discussion and critical review of manuscript for crucial intellectual
24 content.

25 All authors approved the final manuscript as submitted and agree to be accountable for all aspects
26 of the work.

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1 **Abstract (250 words max - 250 words)**

2
3 **Context:** Evidence is needed on effective approaches to build parents' ability to promote child
4 development feasible in Low- and Middle-Income Countries (LMIC).

5
6 **Objective:** To synthesize impact of the Reach Up early childhood parenting program, in several
7 LMIC and examine moderation by family and implementation characteristics.

8
9 **Data Sources:** Systematic search using PubMed and Academic Search Elite/EBSCO Host.

10 **Study Selection:** Randomized control trials of the Reach Up program from 1985 to February 2022.

11
12 **Data extraction:** Data was extracted by two independent researchers. Primary outcomes were
13 child cognitive, language, and motor development. Secondary outcomes were home stimulation
14 and maternal depressive symptoms. We synthesized pooled effect sizes using random effect
15 inverse-variance weighting and effect modification by testing pooled subgroup effect estimates
16 using the χ^2 test for heterogeneity.

17
18 **Results:** Average effect size across 18 studies ranged from 0.49 (95% CI 0.32 - 0.66) for cognition,
19 0.38 (0.24 - 0.51) for language and 0.27 (0.13 - 0.40) for motor development; 0.37 (0.21 - 0.54)
20 for home stimulation and -0.09 (-0.19 - 0.01) for maternal depressive symptoms. Impacts were
21 larger in studies targeted to undernourished children, with mean enrolment age >12-months and
22 intervention duration 6-12 months. Quality of evidence assessed with the Cochrane Assessment of
23 Risk of Bias and GRADE system was moderate.

24
25 **Limitations:** Instruments used to assess child development varied. In moderator analyses some
26 subgroups included few studies.

27
28 **Conclusions:** Reach Up benefits child development and home stimulation and is adaptable across
29 cultures and delivery methods. Child and implementation characteristics modified the effects, with
30 implications for scaling.

1 **Introduction (Word Count 3999)**

2 Poor development in children under 5 years in low- and middle-income countries (LMIC)
3 is an enormous public health problem, with life-long consequences for individual educational
4 attainment and future income and implications for national development.¹ Poverty is a major driver
5 of poor child development mediated, in part, by home environments with limited caregiver-child
6 interaction and stimulation.^{1,2} Parenting interventions aimed at building caregiver skills to provide
7 responsive interactions and stimulating home environments have benefited children's
8 development and parenting behaviors³⁻⁶ and there is some evidence of sustained benefits.⁷ The
9 challenge remains taking programs to scale with a need for evidence on family and program
10 implementation characteristics that may modify effectiveness.

11 In this review, we examine the impact of interventions based on the Jamaica stimulation
12 intervention which was designed in the 1970s-80s and aimed to build parents' skills to promote
13 child development.^{8,9} The Reach Up early childhood parenting program is based on the curriculum
14 for the Jamaica stimulation intervention and additional manuals and materials were developed to
15 support program implementation, including adaptation, training and supervision^{9,10}. Implemented
16 in several LMIC, interventions range from small efficacy trials to large scale implementation,
17 including national programs. The model is also the only one developed in LMIC with evidence of
18 long-term gains.¹¹ By focusing on one model, we are able to examine how impact is influenced by
19 family and implementation characteristics, which is critical to guide the design and implementation
20 of programs at scale. Prior reviews have been limited in their ability to do this due to wide
21 variability in content and design of interventions examined.⁶

22 The objectives are to examine 1) the impact of the Jamaica stimulation intervention/Reach
23 Up early childhood parenting program on early childhood development (ECD), home stimulation

1 and maternal well-being; 2) whether intervention impacts on child development or parent
2 outcomes are moderated by characteristics of child and caregiver; and 3) how intervention impact
3 is affected by implementation characteristics.

4 **Methods**

5 We examined randomized controlled trials (RCTs) based on the principles, content and
6 methods of the Jamaica stimulation intervention/Reach Up, a play-based intervention that builds
7 parents' ability to promote child development.⁸ The program uses a structured curriculum designed
8 to facilitate delivery by persons with a minimum of complete primary education. Emphasis is
9 placed on building the delivery staff's relationship with parent- child, parent-child interaction and
10 responsiveness, use of language, and praise for efforts and achievements (Supplementary
11 information 1). The Reach Up program provides weekly and fortnightly curricula for children 0-
12 48 months, detailed training and supervision manuals and guidance on adapting for context.¹⁰
13 Originally delivered through home visits, the intervention has also been adapted for delivery
14 through small groups.¹²⁻¹⁴

15 We follow the Preferred Reporting Items for Systematic review and Meta-Analysis
16 Protocols (PRISMA) 2020 statement and extended checklist. The protocol was registered with the
17 International Prospective Register of Systematic Reviews (PROSPERO), registration number
18 CRD42020206313.

19 **Eligibility Criteria**

20 Original trials, published in English or Spanish, were included if the intervention was
21 delivered to parents and children with enrolment age range 0-36 months. Studies with additional
22 intervention arms (e.g., nutrition) were included only if the effect of the stimulation component
23 could be evaluated separately. Additionally, trials were only included if they included at least one

1 of the primary outcomes of child cognitive, language and motor development. Secondary
2 outcomes were home stimulation and maternal depressive symptoms. We considered child
3 behavior and other aspects of parent well-being, but sufficient data were not available. Peer-
4 reviewed articles and working papers/preprints available in the public domain were considered.

5 **Search Strategy and Study Selection**

6 We developed an electronic search strategy in collaboration with a liaison Health Sciences
7 librarian with expertise in knowledge synthesis. Two researchers (JCH and JS) conducted
8 independent searches covering the period January 1985 to October 2020. The search strategy was
9 piloted using PubMed, Science Direct and Academic Search Elite/EBSCO Host. A few
10 modifications were made to search terms and due to the limited number of Boolean/Phrase
11 connectors possible in ScienceDirect, this database was excluded. A search was also done of
12 electronic databases of The World Bank and Inter-American Development Bank. The search terms
13 are listed in Supplementary information 2. The search was repeated in February 2022, to identify
14 studies published between October 2020 to February 2022.

15 Titles and abstracts of articles identified were screened independently by both researchers
16 and discrepancies resolved through consensus. Full texts of articles selected were read to confirm
17 eligibility for study inclusion. Discrepancies were resolved through consensus and two in
18 consultation with an arbitrator (SW).

19 **Data Extraction**

20 Data were extracted independently by two researchers (JCH and HOP) using structured
21 forms designed for this review. Discrepancies were resolved by consensus and an arbitrator (SW),
22 when necessary. Data extracted included the study title, publication year, country, sample size in
23 the intervention and control groups, timelines for measurements (baseline and endline),

1 instruments used to measure outcomes, means and standard deviations, effect size, p-values and
2 adjustment covariates for the outcome measures of child development, home stimulation and
3 maternal depressive symptoms. We also extracted information on sample characteristics such as
4 maternal education, child age on enrolment and nutritional status, and implementation information
5 such as frequency, duration, training, supervision, and characteristics of delivery staff (defined as
6 home visitors/group facilitators). Information required for analysis but not included in the article
7 were requested from authors.

8 **Assessment of Study Quality**

9 The quality of the included studies was assessed independently by two researchers (JCH
10 and HOP) using the Cochrane risk of bias tools for randomized (RoB 2) and cluster-randomized
11 trials (RoB 2 CRT) to assess risk of bias from the randomization process, identification of
12 recruitment participants, deviations from the intended intervention, missing outcome data,
13 measurement of the outcome and selection of the reported results. The risk of bias judgment for
14 each randomized controlled trial was scored as “low”, “high” or “some concerns” (Supplementary
15 information 3). The quality of the evidence was then evaluated using the Grading of
16 Recommendations Assessment, Development and Evaluation (GRADE) system, on the following
17 components: risk of bias, consistency of results across studies, indirectness, imprecision and
18 publication bias.¹⁵

19 **Statistical Analysis**

20 For each study, effect estimates of endline mean differences comparing intervention to
21 control were transformed to standardized mean differences (SMD, i.e., effect sizes) using Hedges’
22 g with a pooled standard deviation (SD) if available,¹⁶ otherwise they were standardized with
23 control group or baseline standard deviations. For cluster-randomized trials, sufficient information

1 about the clustering and intra-cluster correlation is often unavailable. Consequently, we calculated
2 a cluster adjusted Hedges' g only when there was a substantive disparity between the study
3 reported effect size and Hedges' g. Pooled effect sizes were then synthesized using a random effect
4 inverse-variance weighting approach and heterogeneity was assessed by I^2 statistics. As studies
5 use instruments that either report cognition alone (e.g., Bayley Scales of Infant and Toddler
6 Development (Bayley)-III) or combined cognition and language (e.g., Bayley-II Mental
7 Development Index (MDI), Regional Project on Child Development Indicators (PRIDI)), we
8 present analyses for: i) studies that report cognition alone; and ii) studies that report cognition
9 alone plus studies that report combined cognition and language. We use this approach also for
10 language and motor development. In the former, some studies report language alone and some
11 report combined cognition and language. In the latter, some studies report fine and gross motor
12 development alone and some report them combined.

13 *Analysis of subgroups*

14 Subgroup analyses included characteristics that the literature suggested may affect
15 intervention impact and data was available. Individual-level heterogeneity analysis by maternal
16 education was able to be assessed within each study. We use two cut-points to define maternal
17 education groups. The first splits into groups of mothers/caregivers who have primary level or less
18 education, or mothers/caregivers with more than primary school education. The second splits the
19 groups into mothers/caregivers in the lower half of education for each study sample, or in the upper
20 half of education. Child characteristics evaluated at study level included mean child age on
21 enrolment and whether the intervention was targeted to undernourished children. Study
22 implementation characteristics evaluated include duration of intervention, frequency of contacts,
23 size of program, delivery by home visits or mother/caregiver and child groups, whether the

1 intervention is a stand-alone program or home visitors/group facilitators are paid by government,
2 frequency of supervision provided to staff delivering the intervention (observations of home visits
3 or group sessions) and urban or rural location. Effect modification was assessed by using the
4 intervention effect estimates from each of the effect modifier subgroups. These estimates were
5 pooled within subgroup to generate the pooled subgroup effect estimate and heterogeneity between
6 subgroups was assessed using the χ^2 test for heterogeneity.

7 **Results**

8 Figure 1 presents the flow diagram of the identification, screening, and selection of RCTs.
9 A total of 2,029 records were identified from search of the databases. Three additional articles
10 were identified based on communication from review authors. We excluded 1,986 records based
11 on titles and abstracts. Full text of 46 papers were reviewed and 28 excluded as they did not meet
12 eligibility criteria leaving a final sample of 18 studies.

13 Studies are summarized in Table 1 and information on primary and secondary outcome
14 measures presented in Table 2. Thirteen studies were cluster randomized and 5 individually
15 randomized. Three studies had two parallel intervention arms^{13,31,38} giving a maximum of 21 trials.

16 Figure 2 shows the overall effect size for each outcome using the Hedges' g SMD, and the
17 effect sizes in SDs of the instruments used for each study and the percentages of total weight for
18 each study, with the weights representing study precision. For cognition (Panel A) the overall
19 effect size is 0.49 (Confidence Interval (CI) 0.32 - 0.66; $p < 0.00$; $I^2 = 90.46\%$) for 14 trials. Adding
20 trials that report cognition alone with those that report combined cognition and language, the
21 overall effect size is 0.39 (CI 0.24 - 0.53; $p < 0.00$; $I^2 = 89.70\%$) and the number of trials is 20. For
22 language (Panel C) the overall effect size is 0.38 (CI 0.24 - 0.51; $p < 0.00$; $I^2 = 87.12\%$) for 15 trials.
23 Panel D shows analysis adding trials that report language alone with those that report combined

1 cognition and language with an overall effect size of 0.31 (CI 0.20 - 0.43; $p < 0.00$; $I^2 = 85.27\%$) for
2 21 trials. Eight trials assessed fine motor (Panel E) and the overall effect size is 0.29 (CI 0.12 -
3 0.47; $p < 0.00$; $I^2 = 75.44\%$). The overall effect size for gross motor for six trials is 0.05 (CI -0.05 -
4 0.15; $p < 0.11$; $I^2 = 33.33\%$), (Panel F). Adding trials that report fine motor alone with those that
5 report combined fine and gross motor (Panel G), the overall effect size is 0.27 (CI 0.13 - 0.40;
6 $p < 0.00$; $I^2 = 87.96\%$) for 19 trials.

7 The effect sizes for the secondary outcomes - home stimulation (Panel H, 17 trials) and
8 maternal depressive symptoms (Panel I, 12 trials) - are 0.37 (CI 0.21 - 0.54; $p < 0.00$; $I^2 = 92.79\%$)
9 and -0.09 (CI -0.19 - 0.01; $p < 0.00$; $I^2 = 62.61\%$), respectively.

10 Table 3 shows the heterogeneity analysis stratified by maternal education at the individual-
11 level using two different classifications of education. There were no significant differences in
12 effects on child outcomes, home stimulation and maternal depressive symptoms when using sub-
13 groups defined by either education classification.

14 Table 4 shows the study-level heterogeneity by the nine possible moderator variables
15 described in the analysis section. We do not include fine motor and gross motor separately as there
16 are only 8 and 6 trials respectively leading to some subgroups with < 3 trials. Average effect sizes
17 were larger in subgroups with mean child age on enrolment > 12 -months for cognition, language
18 and combined motor development, and larger in studies targeted to undernourished children in all
19 domains.

20 We identified multiple variations in the implementation of the Reach Up program across
21 the 18 studies for which we defined nine types of stratification, specifically, by enrolment age of
22 children, child targeted to undernourished, number of children receiving intervention, type of
23 delivery, frequency of visits, frequency of supervision, who pay the program staff and geographic

1 location. These implementation methods were also significant moderators. Delivery by groups
2 showed significantly larger effect sizes compared with home visits for cognition and combined
3 cognition and language, language and language and combined cognition and language and $p < 0.07$
4 for cognition. Trials with duration ≤ 12 -months showed larger effect sizes than those with longer
5 duration for cognition, language, and motor development. Where delivery staff were paid by a
6 project, there was a tendency for effect sizes to be larger which was significant for motor
7 development and $p < 0.09$ for cognition and language.

8 The only moderators that significantly affected impact on home stimulation were
9 undernutrition and group delivery and targeting undernutrition was the only moderator that
10 affected maternal depressive symptoms, reducing it for mothers of undernourished children.

11 For the remaining four variables (number of children receiving intervention, frequency of
12 visits, frequency of supervision, geographic location), there was no significant heterogeneity.

13 Six of the 18 studies had a low overall risk of bias and 12 were rated as “some concerns”
14 (Supplementary information 3). The domains that included some concerns were Selection bias
15 (4/18 studies), Performance bias (4/18 studies) and Reporting bias (11/18). Risk of reporting bias
16 was due to lack of a pre-analysis plan for these studies (Supplementary information 3). The
17 GRADE assessment for the primary outcomes showed that heterogeneity was rated low on five
18 outcomes ("cognition", "cognition and combined cognition and language", "language", "language
19 and combined cognition and language" and "fine motor and combined fine and gross motor") and
20 imprecision was rated high for three outcomes ("language", "language and combined cognition
21 and language" and "fine motor and combined fine and gross motor"). All outcomes were rated
22 high for indirectness and moderate for risk of bias and publication bias. The overall quality of the
23 evidence for all outcomes was moderate (Table 5).

1 **Discussion**

2 The impacts of the Reach Up intervention on child development, in 18 studies across 8
3 countries, were generally comparable with results from LMIC from two recent reviews of ECD
4 programs with the largest benefits on cognition followed by language then fine motor
5 development.^{3,6} The average effect size for cognition is somewhat higher while that for language
6 is similar to Jeong et al.⁶ The earlier reviews report combined fine and gross motor development.
7 We find a slightly larger effect size for studies with fine motor development separately than when
8 combined with studies reporting an overall motor score. The effect size for the combined motor
9 analysis is similar to that in Jeong et al.⁶ and larger than the earlier review.³

10 The overall effect size of 0.37 SD for home stimulation was lower than in the two prior
11 reviews.^{5,6} Increased stimulation in the home is an expected mechanism leading to gains in child
12 development. Only one of 17 trials reporting on home stimulation examined mediation, finding
13 that increased home stimulation partially mediated gains in development.¹⁷ Mediation by
14 stimulation in the home has been demonstrated for a few other parenting interventions in LMIC.¹⁸⁻
15 ²⁰ Further evidence on mediation is needed, which, if consistent, may allow use of change in
16 stimulation in the home to monitor implementation at scale.

17 The small non-significant reduction in maternal depressive symptoms is consistent with
18 previous studies.^{5,6} This suggests that improving maternal depression will require additional
19 content targeting this objective.

20 Intervention effects did not vary by maternal education using two approaches to define
21 lower and higher education. This suggests the intervention benefits child outcomes and home
22 stimulation across the range of maternal education seen in the studies in this review. This is

1 consistent with prior examination of differences in intervention impact by maternal education in
2 individual studies in this review^{12,21,23,26} except one²² and with other recent evidence.^{23, 24}

3 Benefits to child outcomes were seen in both younger and older children. However,
4 children with mean age greater than 12-months on enrolment had larger benefits to cognitive,
5 language and motor development than younger children. This is important for planning of
6 programs where it may not be possible to reach all children or the youngest children. A prior meta-
7 analysis also found larger cognitive and language benefits in children over 12-months⁶.
8 Intervention impact on home stimulation did not vary by child age.

9 The Reach Up program aims to improve the development of disadvantaged children. The
10 studies reviewed recruited families from poor areas, with some identifying them through social
11 protection programs. Some studies targeted undernourished children (low height- or weight-for-
12 age), and one study children born low birthweight at term. We found larger average benefits to
13 child outcomes in these studies (cognition as high as 0.83 SD) and to stimulation in the home, and
14 the undernourished subgroup was the only one to show significant reduction in maternal depressive
15 symptoms. Individual study reports showed larger benefits for children stunted on enrolment in
16 one study²⁵ but effects did not differ by height-for-age on enrolment in contexts where the
17 prevalence of stunting was high.^{21,26} These findings have strong policy implications and suggest
18 that targeting undernourished children identifies the most disadvantaged families who benefit more
19 from intervention. Consequently, where resources are limited, targeting should be considered.

20 There were only three studies¹²⁻¹⁴ with delivery by mother-child groups and these had
21 higher average effect sizes than home visits delivery. One study randomized mothers and children
22 to home visits or groups of 8 and found similar effects in the two delivery methods with groups
23 being more cost-effective.¹³ The other two studies involved pairs of mothers or groups of 4 and

1 had large effects. In contrast, a significant but small benefit was reported for overall development
2 from group-based delivery of Reach Up,²⁸ no differences by delivery mode were reported in the
3 meta-analysis by Jeong et al⁶ and a recent meta-analysis of ECD interventions in China reported
4 greater benefits from home visits than center-based interventions, even though one-on-one as well
5 as group sessions were provided in the centers.³⁰ More studies are needed, but the evidence
6 suggests that the Reach Up intervention remains effective when delivered through groups. Use of
7 groups may be an important strategy for scaling, efforts may be needed to ensure access by the
8 most disadvantaged families and sustain participation.

9 Interventions in which delivery staff were project-funded tended to have larger effects than
10 those integrated with government services, where staff were paid by the government. This likely
11 reflects the challenges faced as interventions scale, as government constraints impact resources for
12 implementation, timely hiring and training of staff, and lack of monitoring of implementation
13 quality. In addition, in most cases where staff are paid by an existing service, which in most cases
14 is the government, they have many other duties and their workload impacts intervention delivery.
15 An extreme case of this is the study in Brazil where home visits by community health workers
16 employed in government primary care centers was attempted. Very few visits were made with
17 83% of families receiving no visits.³¹ In the national program in Peru, 34% of children initially
18 randomized to treatment received no visits because the program never operated in some areas and
19 there was a small increase in effect size to 0.15 SD when those children were excluded from
20 analyses.²¹

21 There were larger average effect sizes where intervention duration was 12-months or less
22 compared with longer duration. It is possible that initial impacts are greater, and that gains are
23 maintained but may not increase substantially as programs continue. Most of the shorter duration

1 studies continued for 12-months with only one with duration of 6-months and one 9-months so the
2 finding does not apply to very short programs. It remains uncertain whether longer duration is
3 important for sustainability of benefits. Sustainability of impact has been examined in three
4 studies, all with interventions of 18-24 months duration. One showed medium³² and another long-
5 term benefits,¹⁰ however one study did not show benefits at 2-year follow-up.²² There are few
6 follow-up studies of other early stimulation interventions.⁶ Follow-up of a two-year ECD
7 intervention delivered by lady health workers in Pakistan showed benefits to child cognitive,
8 language and motor skills two years later.³³

9 There were significant benefits to child outcomes and home stimulation and little evidence
10 of heterogeneity in the remaining implementation characteristics whether visits/group sessions
11 were weekly or fortnightly, in rural or urban areas, whether numbers of children targeted was small
12 (<300) or larger, and if supervision was monthly or less compared with more frequent. For scaling,
13 this provides further evidence that fortnightly contacts can be expected to lead to benefits. Despite
14 lack of significant differences, effect sizes tended to be smaller with increasing numbers of
15 children reached. Further, many of these larger interventions were not at large scale and reached
16 between 350 and 850 children. Nonetheless, this does provide some evidence that significant
17 impact can be attained as programs increase in size. Finally, although effect size did not vary by
18 frequency of supervision, frequency was less than monthly in few studies.

19 We were not able to examine some other variables that may be important for
20 implementation such as training, as all except two studies used recommended training duration,
21 and education level of delivery staff which was not consistently reported. In one study it was not
22 possible to leave play materials in the homes which may have contributed to the lack of significant
23 benefits.³⁴

1 This review has multiple strengths. First, it uses data from intervention trials that followed
2 the same curriculum and were evaluated using RCTs which facilitates making comparisons.
3 Furthermore, most studies assessed cognitive, motor and language development with direct
4 assessment. Only two studies used the Ages & Stages Questionnaire (ASQ) relying on both
5 observations and maternal/caregiver's reports which may be biased if mothers who received the
6 intervention over-report on children's developmental progress compared to control mothers.
7 However, Araujo and colleagues²¹ did not detect this bias as larger effects were found for items
8 collected by direct observation (0.13 SD) than by maternal report (0.07 SD). Moreover, we were
9 able to examine several implementation characteristics that may affect intervention outcomes
10 including targeting, frequency of visits, duration and integration with government services.
11 Finally, all the multiple levels of trials characteristics evidence how the Reach Up program could
12 be adapted across contexts.

13 There are strengths and limitations to using a meta-analysis approach in a systematic
14 review. The trials vary in the instruments used, processes of standardization or variable adjustment
15 used during analysis, and the calculation of effect sizes that we could extract from publications.
16 This common limitation of meta-analyses was addressed by calculating a SMD, in this case
17 Hedges' g, using the information available in each publication. Care was taken to be consistent in
18 data extraction, which was crosschecked by two persons, as was SMD calculation. For this
19 analysis, we used commonly measured outcomes and most frequently methodological analytic
20 approaches across trials. Interpretation of SMD effect sizes may differ across trials due to
21 differences in tools used and population assessed but the strength of this study approach is to
22 estimate an overall intervention effect interpretable in SD units for any given population.

1 In a few cases, study level estimates seemed to differ in magnitude from most of the other
2 trials. A limitation of the current analysis is that the relatively small number of studies made it
3 difficult to interpret whether these studies were truly different or simply differed due to chance.
4 However, we were able to explore heterogeneity by factors expected to influence intervention
5 effects when groups of studies could be classified together for effect modification testing.

6 There is a need for additional evaluations of group delivery and further research on how
7 intervention benefits are modified by the implementation variables evaluated here as well as others
8 that could not be included. This will require that future studies include consistent reporting of
9 implementation methods and adaptations.⁴⁰ There is also a need for follow-up studies to examine
10 how differences in implementation methods affect sustainability of benefits.

11 In conclusion, the Reach Up program, adapted across 8 countries, delivered by home visits
12 or small groups and at varying scale, had benefits for child development and home stimulation in
13 the majority of trials. Targeting undernourished children yielded larger benefits and beginning
14 interventions when children are 12-months or older did not diminish impact. Findings suggest
15 small group delivery is a promising strategy for scaling and that interventions of 12-months
16 duration yield benefits as good or greater than longer programs. This evidence on implementation
17 methods that affect impact can inform decision making as programs are taken to scale.

18

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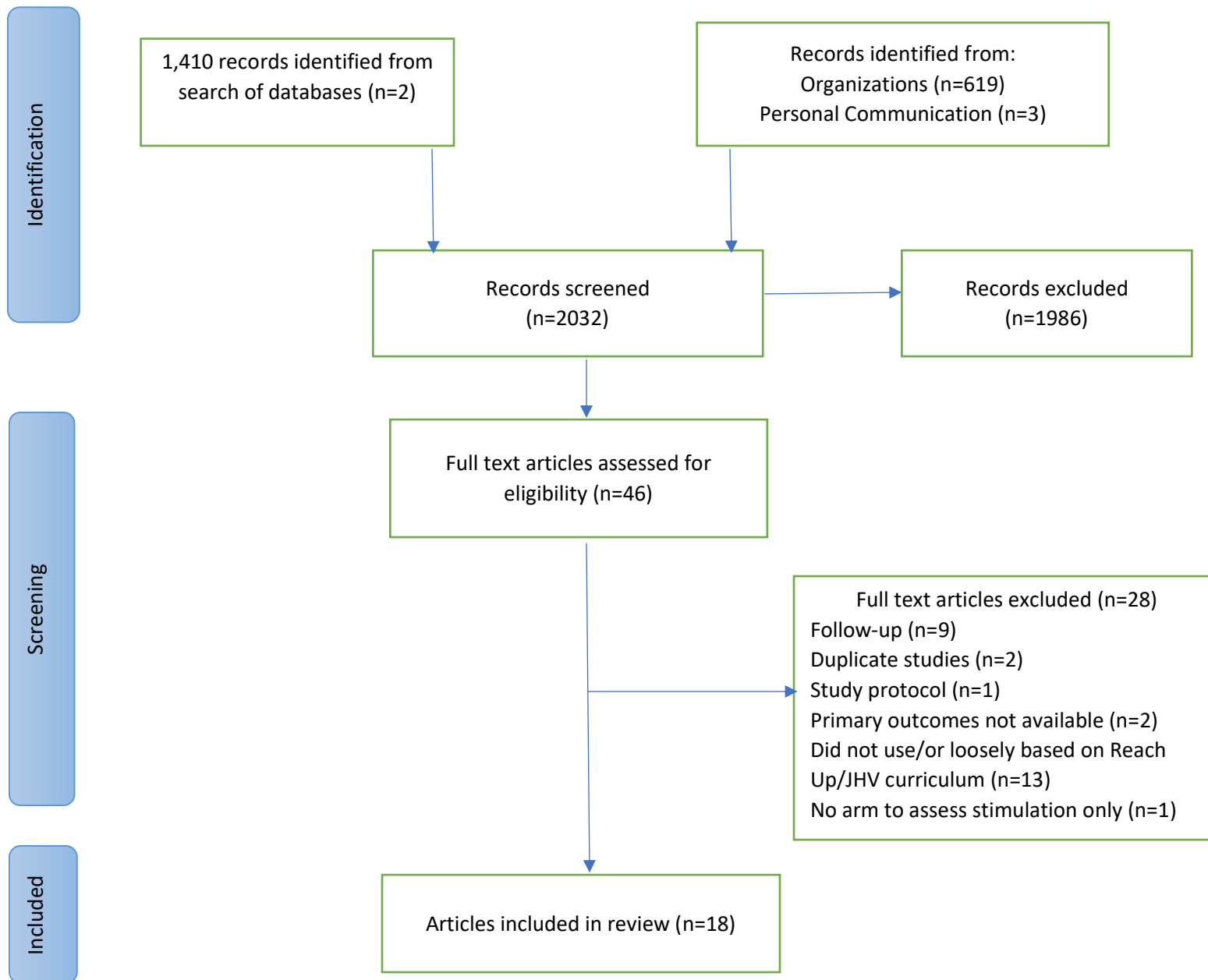
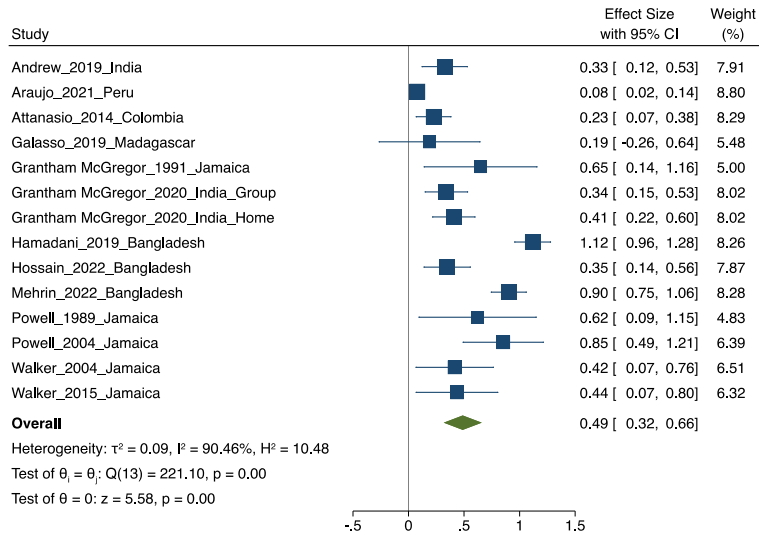


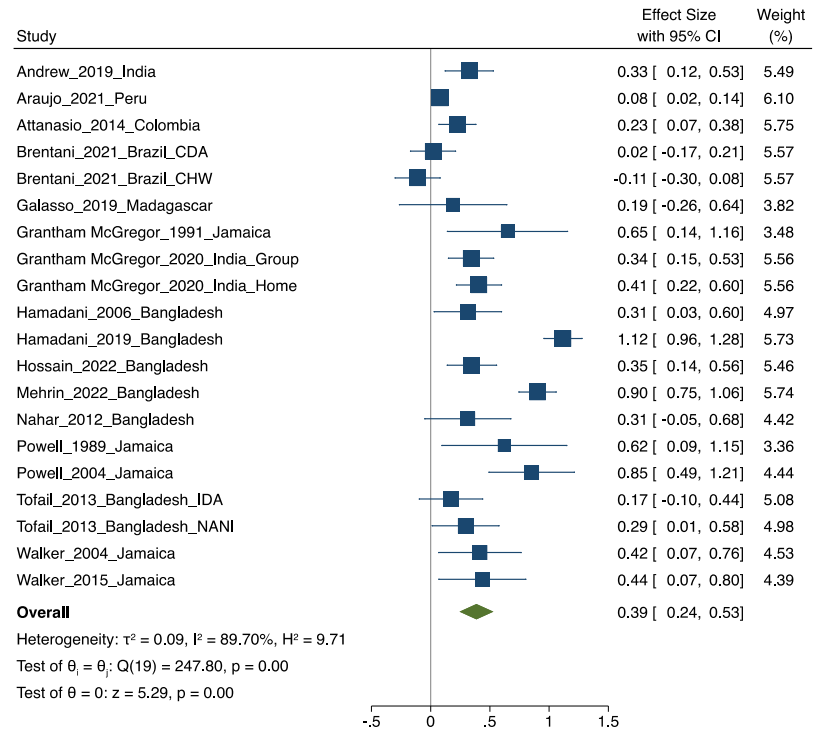
Figure 1: PRISMA flow diagram of the identification, screening, and selection of RCTs in this review.

Panel A: Cognition



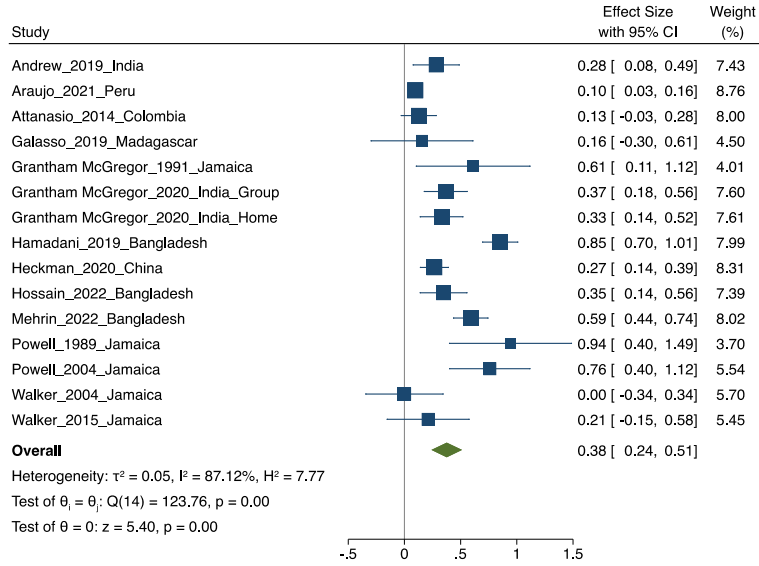
Random-effects REML model
 Note: Total number of trials is 14. Bayley Scales of Infant and Toddler Development (Bayley)-III is present in seven trials, Griffiths Scales of Mental Development (Griffiths) in five and Ages and Stages Questionnaire (ASQ) in two trials. Two trials are internally standardized.

Panel B: Cognition and combined cognition and language



Random-effects REML model
 Note: Total number of trials is 20. Bayley-III is present in seven trials, Bayley-II in four, Griffiths in five, ASQ in two and Regional Project on Child Development Indicators (PRIDI) in two trials. Four trials are internally standardized.

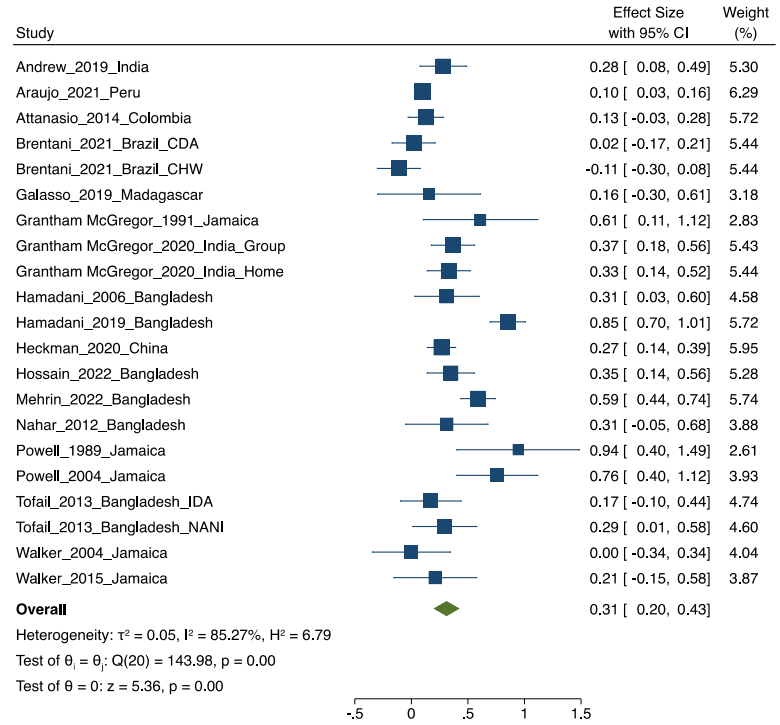
Panel C: Language



Random-effects REML model

Note: Total number of trials is 15. Bayley-III is present in seven trials, Griffiths in five, ASQ in two and Denver Developmental Screening Test (Denver)-II in one trial. Three trials are internally standardized.

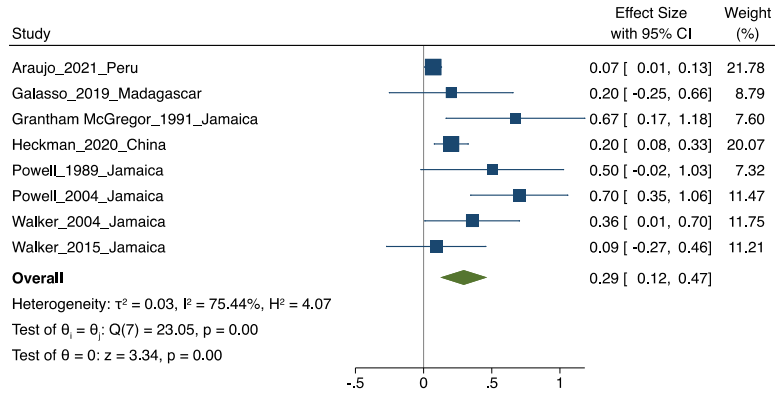
Panel D: Language and combined cognition and language



Random-effects REML model

Note: Total number of trials is 21. Bayley-III is present in trials studies, Bayley-II in four, Griffiths in five, ASQ in two, PRIDI in two and Denver-II in one trial. Five trials are internally standardized.

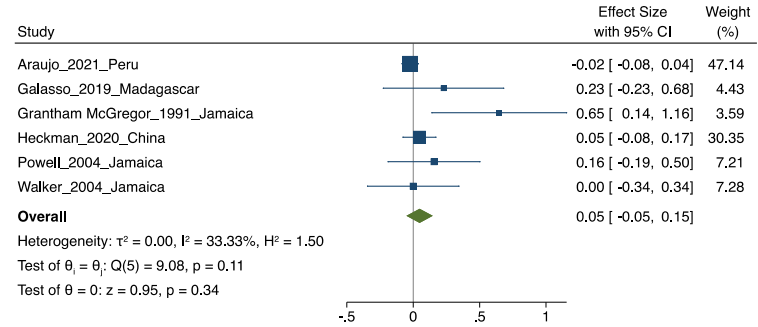
Panel E: Fine Motor



Random-effects REML model

Note: Total number of trials is eight. Griffiths is present in five trials, ASQ in two and Denver-II in one trial. Three trials are internally standardized.

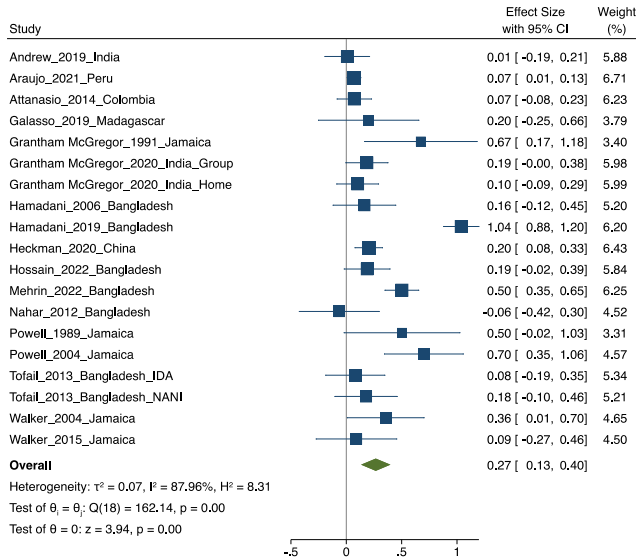
Panel F: Gross Motor



Random-effects REML model

Note: Total number of trials is six. Griffiths is present in three trials, ASQ in two and Denver-II in one trial. Three trials are internally standardized.

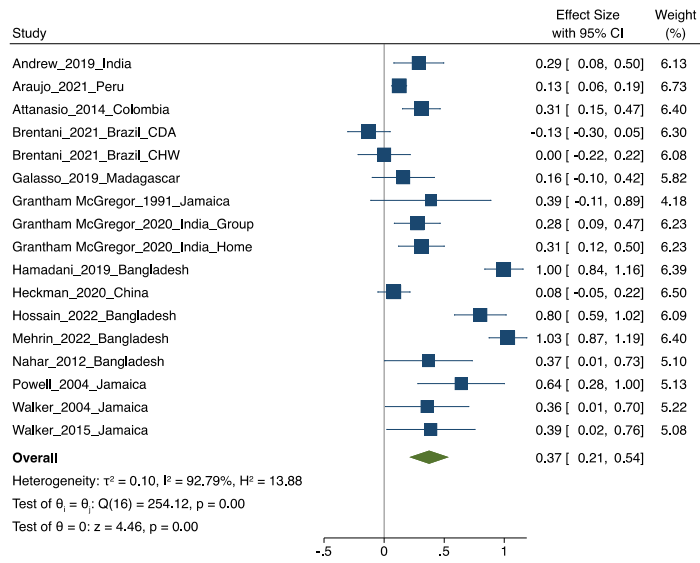
Panel G: Fine Motor and combined fine and gross Motor



Random-effects REML model

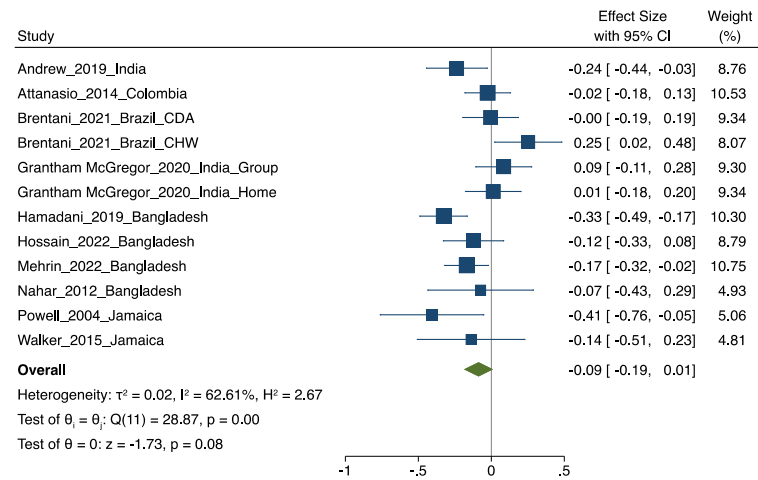
Note: Total number of trials is 19. Bayley-III is present in seven trials, Bayley-II in four, Griffiths in five, ASQ in two and Denver-II in one trial. Three trials are internally standardized.

Panel H: Home Stimulation



Random-effects REML model
 Note: Total number of trials is 17. Home Observation for Measurement of the Environment (HOME) is present in ten trials and UNICEF's Family Care Indicators (FCI) in seven trials.

Panel I: Maternal Depressive Symptoms



Random-effects REML model
 Note: Total number of trials is 12. Center for Epidemiologic Studies Depression Scale (CES-D) is present in nine trials, Edinburgh Postnatal Depression Scale (EPDS) in two and the Validated Bengali version of World Health Organization Self-reported Questionnaire-20 (WHO-SRQ-20) in one trial.

Figure 2: Forest plots for the effect of interventions on child outcomes, home stimulation and maternal depressive symptoms. SMD, standardized mean difference. Blue squares represent the SMD for each trial, with the size of the square being proportional to the trial weight. The whiskers extending from each side of the square represent the range of 95% confidence interval (CI). The green diamond shows the overall pooled effect size using a random-effect model, which is centered at the point estimate and the diamond width representing the 95% CI. Data and other materials used in this study are available upon request.

Table 1. Summary of the Studies (in alphabetical order by author)

Author Country	Study design/No. of clusters	Trial description	Delivered through government system	Frequency and modality	Enrolled sample	Analysis sample ¹	Age at enrolment (range in mths)	Program duration (mths)
Andrew, A. et al, ²⁵ India	Cluster randomized controlled trial (RCT) 27 slums per trial arm	<ul style="list-style-type: none"> ● Peri-urban slums in Cuttack ● Intervention delivered by local women hired to the project 	No	Weekly home visits	Intervention = 209 Control = 212	Intervention = 191 Control = 187	10 – 20	18
Araujo, et al, ²¹ Peru	Cluster RCT 60 districts per trial arm	<ul style="list-style-type: none"> ● Rural districts with high levels of poverty and stunting. ● Districts assigned to first wave received intervention and districts assigned to second wave were the controls ● Intervention delivered by local women hired to the Cuna Mas program 	Yes; Cuna Mas	Weekly home visits	Intervention = 3,894 Control = 2,003	Intervention = 3,192 Control = 1,493	0 – 24	24
Attanasio, O. et al, ²³ Colombia	Cluster RCT 24 areas per trial arm	<ul style="list-style-type: none"> ● Rural municipalities in Bogotá ● 4-arm trial: psychosocial stimulation (PS), micronutrient supplementation (MS), psychosocial + supplementation (PS + MS) and Control. ● Intervention delivered by mother leaders on 	No	Weekly home visits	Intervention (PS) = 360 Control = 351	Intervention (PS) = 318 Control = 318	12 – 24	18

¹ Group specific analytic sample sizes were not in the published manuscript for all outcomes. In these cases the study flow diagram was used to approximate sample size.

		cash-transfer program hired to the project						
Brentani A., et al, ³¹ Brazil	Individual RCT Parallel trial	<ul style="list-style-type: none"> Urban areas of Sao Paulo Parallel trials: Community health workers (CHW) delivered Intervention in areas covered by the national primary care program; new cadre of child development agents (CDA) delivered intervention in areas not covered by the program. Excluded children already enrolled in full-time day care at baseline 	Yes; National home-based primary care program	Fortnightly home visits	<p>Intervention (CHW) = 164</p> <p>Control (CHW) = 164</p> <p>Intervention (CDA) = 249</p> <p>Control (CDA) = 249</p>	<p>Intervention (CHW) = 145</p> <p>Control (CHW) = 149</p> <p>Intervention (CDA) = 211</p> <p>Control (CDA) = 215</p>	9 – 17	12
Galasso, E. et al, ³⁴ Madagascar	Cluster RCT 25 regions per trial arm	<ul style="list-style-type: none"> Rural regions 5-arm trial: Control (T0), Intensive nutrition counselling (T1), T1 + lipid-based nutrient supplementation (LNS) to children aged 6-18 months (T2), T1 + LNS to pregnant women, lactating mothers of children aged 0-5 months and children aged 6-30 months (T3) and T1 + stimulation to children aged 6-30 months (T4). Intervention delivered by community health 	Yes; National nutrition program	Fortnightly home visits	<p>Intervention (T4) = 750</p> <p>Control (T0) = 747</p>	<p>Intervention (T4) = 719</p> <p>Control (T0) = 732</p>	0 – 11	24

		workers hired to the project						
Grantham-McGregoet al, ⁸ Jamaica	Individual RCT	<ul style="list-style-type: none"> ● Poor urban neighbourhoods in Kingston ● 4-arm trial: supplementation only, stimulation only, supplementation + stimulation and control. ● Targeted stunted children (height-for-age <- 2 SD) ● Intervention delivered by community health workers hired to the project 	No	Weekly home visits	Intervention (stim only) = 30 Control = 33	Intervention (stim only) = 30 Control = 33	12 – 24	24
Grantham-McGregoet al, ¹³ India	Cluster RCT 48 villages per trial arm	<ul style="list-style-type: none"> ● Rural villages in Cuttack, Salepur and Bolangir ● 4-arm trial: Control, nutritional education, nutritional education + home visits, nutritional education + group sessions. ● Intervention delivered by local women hired to the project 	No	Weekly home visits or weekly group sessions of 7-8 mother/child pairs	HVs + nutr. edu. = 357 Groups + nutr. edu. = 346 Control = 353	HVs + nutr. edu. = 332 Groups + nutr. edu. = 323 Control = 320	7 – 16	24
Hamadani, J, et al, ²⁶ Bangladesh	Cluster RCT 10 community nutrition centers per trial arm	<ul style="list-style-type: none"> ● Poor rural area of Monohardi subdistrict ● Targeted children with moderate and severe undernutrition (weight for age < -2 standard deviations (SD)) 	No	Group meetings: weekly for 10 mths and fortnightly for two mths	Intervention = 104 Control = 102	Intervention = 92 Control = 101	6 – 24	12

		<ul style="list-style-type: none"> ● Intervention delivered by local women hired to the project 		Home visits: twice weekly for 8 mths and weekly for 4 mths				
Hamadani, J. et al, ¹² Bangladesh	Cluster RCT 45 community clinics per trial arm	<ul style="list-style-type: none"> ● Rural sub-districts in Narsingdi ● Targeted underweight children (weight for age < -2 SD) ● Intervention delivered by government health workers at community clinics 	Yes	Group sessions (pairs of mothers)	Intervention = 358 Control = 360	Intervention = 343 Control = 344	5 – 24	12
Heckman, et al, ²⁹ China	Cluster RCT 55 villages per trial arm	<ul style="list-style-type: none"> ● Rural villages in Hauchi County ● Targets disadvantaged families ● Intervention delivered by home visitors hired by the project 	No	Weekly home visits	Intervention = 715 Control = 852	Intervention = 541 Control = 547	0 – 24	22
Hossain, et al, ³⁵ Bangladesh	Cluster RCT 11 areas per trial arm	<ul style="list-style-type: none"> ● Poor rural sub-district of Ullapara ● 3-arm trial: psychosocial stimulation (PS) + unconditional cash transfer (UCT), UCT only and standard care group (comparison). ● Intervention delivered by female village health workers hired by project 	Yes; Government maternity allowance program	Fortnightly home visits	PS+UCT = 197 UCT only = 188	PS+UCT = 182 UCT only = 179	6 – 16	12
Mehrin, et al, ¹⁴ Bangladesh	Cluster RCT 20 community	<ul style="list-style-type: none"> ● Rural district of Kishorganji ● Children with weight for age < -1.5 SD, not 	Yes	Fortnightly group sessions	Intervention = 419	Intervention = 396	5 – 23	12

	clinics per trial arm	<p>hospitalized or requiring constant monitoring, and lived within 30-minute walk from clinic</p> <ul style="list-style-type: none"> ● Intervention delivered by government health workers at community clinics 		Groups of 4 mother/child pairs	Control = 366	Control = 319		
Nahar, B., et al, ²⁷ Bangladesh	Individual RCT	<ul style="list-style-type: none"> ● Urban slums in Dhaka city ● 4-arm trial: psychosocial (PS), food supplementation (FS), psychosocial + food stimulation (PS + FS), clinic control (CC) and hospital control (CH). ● Targeted severely malnourished children (weight for age < -3 SD) without acute infections or requiring hospitalization ● Intervention delivered by local women hired to the project 	No	Fortnightly One or more mother/child pair at community clinic	Intervention (PS) = 102 Control (CC) = 99	Intervention (PS) = 59 Control (CC) = 59	6 – 24	6
Powell, et al, ³⁶ Jamaica	Individual RCT	<ul style="list-style-type: none"> ● Poor urban area in Kingston ● Intervention delivered by community health workers from neighborhood clinic ● Two studies are reported, however only study 2 (an RCT) is included in this evaluation. 	Yes	Weekly home visits	Intervention = 29 Control = 29	Intervention = 29 Control = 29	16 – 30	12

Powell, et al, ³⁷ Jamaica	Cluster RCT 11 (Intervention) and 7 (Control) nutrition clinics	<ul style="list-style-type: none"> Urban areas of Kingston and St. Andrew Targeted undernourished children weight for age < -1.5 SD and < - 2 SD in the past three months Intervention delivered by community health aides from primary health nutrition clinics 	Yes	Weekly home visits	Intervention = 70 Control = 69	Intervention = 65 Control = 64	9 – 30	12
Tofail, et al, ³⁸ Bangladesh	Cluster RCT 15 villages per trial arm	<ul style="list-style-type: none"> Rural villages in Monohordi subdistrict. Parallel trials - children who had iron deficiency anaemia (IDA) and children neither anaemic nor iron deficient (NANI). In addition to the psychosocial stimulation, iron syrup was given to children with IDA for the first 6 months. Intervention delivered by local women hired to the project 	No	Weekly home visits	Intervention (IDA) = 117 Control (IDA) = 108 Intervention (NANI) = 106 Control (NANI) = 103	Intervention (IDA) = 110 Control (IDA) = 106 Intervention (NANI) = 104 Control (NANI) = 92	6 – 24	9
Walker, et al, ¹⁷ Jamaica	Individual RCT	<ul style="list-style-type: none"> Urban areas of Kingston and St Andrew Targeted term low-birth weight (LBW) infants, gestational age ≥ 37 weeks, birth weight < 2,500 g, Intervention: Phase 1 - first eight weeks after 	No	Weekly home visits	Intervention = 70 Control = 70	Intervention = 63 Control = 67	birth	19

		<p>birth; Phase 2 - from age 7 months to 24 month.</p> <ul style="list-style-type: none"> ● Intervention delivered by community health workers hired to project 						
Walker, et al, ³⁹ Jamaica	Cluster RCT 5 centers per trial arm	<ul style="list-style-type: none"> ● Children attending health centers in urban areas of Kingston and St. Andrew ● 4 trial arms: Health center, Home visits, Health center + home visits and Control. ● Delivered by health center community health workers 	Yes	Fortnightly home visits	<p>Intervention (home visits) = 50</p> <p>Control = 150</p>	<p>Intervention (home visits) = 38</p> <p>Control = 123</p>	6	12

Table 2: Primary and secondary outcomes across studies

Author/Country	Primary Outcomes			Secondary Outcomes	
	Cognition	Language	Motor	Home stimulation	Maternal Depressive Symptoms
Andrew, A. et al, ²⁵ India	Bayley ² -III	Bayley-III	Bayley-III	FCI ³	CES-D-6 ⁴
Araujo, et al, ²¹ Peru	ASQ ⁵ -3	ASQ-3	ASQ-3	FCI & HOME ⁶	
Attanasio, O. et al, ²³ Colombia	Bayley-III	Bayley-III	Bayley-III	FCI	CES-D-10
Brentani A., et al, ³¹ Brazil	PRIDI ⁷	PRIDI	PRIDI	FCI	EPDS ⁸
Galasso, E. et al, ³⁴ Madagascar	ASQ-I	ASQ-I	ASQ-I	FCI	
Grantham-McGregor, et al, ⁸ Jamaica	Griffiths ⁹	Griffiths	Griffiths	HOME	
Grantham-McGregor, et al, ¹³ India	Bayley-III	Bayley-III	Bayley-III	FCI & IT-HOME ¹⁰	
Hamadani, J, et al, ²⁶ Bangladesh	Bayley-II	Bayley-II	Bayley-II		
Hamadani, J. et al, ¹² Bangladesh	Bayley-III	Bayley-III	Bayley-III	FCI	CES-D-6
Heckman, et al, ²⁹ China	Denver ¹¹ -II	Denver-II	Denver-II	IT-HOME	
Hossain, et al, ³⁵ Bangladesh	Bayley-III	Bayley-III	Bayley-III	FCI	WHO-SRQ-20 ¹²
Mehrin, et al, ¹⁴ Bangladesh	Bayley-III	Bayley-III	Bayley-III	FCI	CES-D-6

²Bayley Scales of Infant and Toddler Development

³UNICEF's Family Care Indicators

⁴Center for Epidemiologic Studies Depression Scale, six items

⁵Ages and Stages Questionnaire

⁶Home Observation for Measurement of the Environment

⁷Regional Project on Child Development Indicators (specifically Eagle's Scales of Child Development)

⁸Edinburgh Postnatal Depression Scale

⁹Griffiths Scales of Mental Development

¹⁰Infant-Toddler Home Observation for Measurement of the Environment

¹¹Denver Developmental Screening Test

¹²Validated Bengali version of World Health Organization Self-reported Questionnaire-20

Nahar, B., et al, ²⁷ Bangladesh	Bayley-II	Bayley-II	Bayley-II	HOME	CES-D ¹³
Powell, et al, ³⁶ Jamaica	Griffiths	Griffiths	Griffiths		CES-D
Powell, et al, ³⁷ Jamaica	Griffiths	Griffiths	Griffiths	HOME	CES-D-20
Tofail, et al, ³⁸ Bangladesh	Bayley-II	Bayley-II	Bayley-II	FCI	
Walker, et al, ¹⁷ Jamaica	Griffiths	Griffiths	Griffiths	HOME	
Walker, et al, ³⁹ Jamaica	Griffiths	Griffiths	Griffiths	HOME	CES-D

¹³Center for Epidemiologic Studies Depression Scale, adapted version used by Baker-Henningham, et al (2005).

Table 3: Subgroup results for the effect of interventions on child outcomes, home stimulation and maternal depressive symptoms stratified by maternal education

Moderator	Cognition			Cognition and combined cognition and language			Language			Language and combined cognition and language			Fine motor and combined fine and gross motor			Home stimulation			Maternal Depressive Symptoms		
	N	SMD (95% CI)	p value	N	SMD (95% CI)	p value	N	SMD (95% CI)	p value	N	SMD (95% CI)	p value	N	SMD (95% CI)	P value	N	SMD (95% CI)	p value	N	SMD (95% CI)	p value
<i>Definition 1</i>																					
Primary education or less	8	0.55 (0.15, 0.94)	0.98	14	0.37 (0.12, 0.62)	0.75	9	0.39 (0.14, 0.64)	0.97	15	0.29 (0.12, 0.46)	0.65	14	0.18 (-0.03, 0.38)	0.56	13	0.38 (0.22, 0.55)	0.40	10	-0.09 (-0.18, 0.00)	0.65
More than primary education	8	0.54 (0.11, 0.96)		14	0.31 (0.01, 0.60)		9	0.39 (0.14, 0.65)		15	0.23 (0.03, 0.43)		14	0.27 (0.03, 0.51)		13	0.28 (0.10, 0.46)		10	-0.05 (-0.20, 0.09)	
<i>Definition 2</i>																					
Lower half education	10	0.58 (0.27, 0.88)	0.91	16	0.41 (0.19, 0.63)	0.89	11	0.44 (0.21, 0.66)	0.73	17	0.33 (0.17, 0.50)	0.70	16	0.28 (0.09, 0.46)	0.90	15	0.40 (0.24, 0.55)	0.35	11	-0.11 (-0.20, -0.01)	0.46
Upper half education	10	0.55 (0.18, 0.92)		16	0.39 (0.14, 0.64)		11	0.38 (0.13, 0.63)		17	0.29 (0.11, 0.46)		16	0.26 (0.02, 0.49)		15	0.29 (0.14, 0.44)		11	-0.04 (-0.18, 0.09)	

Note: N= number of trials represented in subgroup analysis. SMD, standardized mean difference. p value corresponds to test of subgroup differences. Bolded values indicate significant moderator effect (p<0.1). CI – confidence interval.

Table 4: Subgroup results for the effect of interventions on child outcomes, home stimulation and maternal depressive symptoms stratified by trial level characteristics

Moderator	Cognition			Cognition and combined cognition and language			Language			Language and combined cognition and language			Fine motor and combined fine and gross motor			Home stimulation			Maternal Depressive Symptoms		
	N	SMD (95% CI)	p value	N	SMD (95% CI)	p value	N	SMD (95% CI)	p value	N	SMD (95% CI)	p value	N	SMD (95% CI)	p value	N	SMD (95% CI)	p value	N	SMD (95% CI)	p value
<i>Trials stratified by enrolment age</i>																					
mean age ≤12 months	7	0.29 (0.16, 0.43)	0.01	8	0.29 (0.17, 0.42)	0.26	7	0.23 (0.11, 0.34)	0.02	8	0.23 (0.12, 0.34)	0.20	8	0.10 (0.04, 0.17)	0.02	8	0.34 (0.18, 0.50)	0.71	5	-0.02 (-0.12, 0.08)	0.27
>12 months	7	0.67 (0.40, 0.94)		12	0.44 (0.21, 0.66)		8	0.52 (0.31, 0.73)		13	0.37 (0.19, 0.54)		11	0.36 (0.16, 0.57)		9	0.40 (0.12, 0.68)		7	-0.12 (-0.27, 0.03)	
<i>Trials stratified by child targeted to undernourished</i>																					
No	9	0.29 (0.18, 0.39)	0.00	13	0.23 (0.12, 0.33)	0.00	10	0.25 (0.16, 0.34)	0.04	14	0.21 (0.12, 0.30)	0.02	12	0.11 (0.06, 0.17)	0.01	11	0.23 (0.09, 0.37)	0.00	8	-0.02 (-0.11, 0.08)	0.00
Yes	5	0.83 (0.59, 1.07)		7	0.67 (0.42, 0.93)		5	0.58 (0.28, 0.87)		7	0.50 (0.28, 0.73)		7	0.49 (0.21, 0.77)		6	0.67 (0.40, 0.94)		4	-0.24 (-0.37, -0.12)	
<i>Trials stratified by number of children receiving intervention</i>																					
<300	8	0.60 (0.37, 0.82)	0.17	13	0.41 (0.21, 0.60)	0.75	8	0.48 (0.25, 0.72)	0.14	13	0.34 (0.16, 0.52)	0.62	11	0.34 (0.12, 0.55)	0.23	10	0.41 (0.18, 0.64)	0.63	8	-0.13 (-0.27, 0.02)	0.33
>=300	6	0.36 (0.12, 0.61)		7	0.36 (0.15, 0.57)		7	0.28 (0.14, 0.42)		8	0.28 (0.16, 0.41)		8	0.18 (0.07, 0.30)		7	0.33 (0.09, 0.57)		4	-0.03 (-0.14, 0.07)	
<i>Trials stratified by type of delivery</i>																					
HV	11	0.36 (0.23, 0.49)	0.07	17	0.28 (0.17, 0.39)	0.03	12	0.28 (0.17, 0.40)	0.03	18	0.23 (0.14, 0.33)	0.01	16	0.15 (0.08, 0.21)	0.09	14	0.27 (0.14, 0.40)	0.05	9	-0.06 (-0.17, 0.05)	0.52
Group	3	0.79 (0.34, 1.24)		3	0.79 (0.34, 1.24)		3	0.61 (0.34, 0.88)		3	0.61 (0.34, 0.88)		3	0.61 (0.34, 0.88)		3	0.58 (0.09, 1.06)		3	0.77 (0.29, 1.25)	
<i>Trials stratified by the duration of the intervention</i>																					
≤12 months	6	0.73 (0.47, 0.99)	0.00	12	0.44 (0.22, 0.66)	0.22	6	0.60 (0.39, 0.82)	0.00	12	0.37 (0.19, 0.56)	0.14	10	0.35 (0.12, 0.57)	0.06	8	0.52 (0.20, 0.83)	0.07	8	-0.12 (-0.26, 0.02)	0.38
>12 months	8	0.28 (0.16, 0.40)		8	0.28 (0.16, 0.40)		9	0.22 (0.13, 0.31)		9	0.22 (0.13, 0.31)		9	0.12 (0.06, 0.19)		9	0.22 (0.14, 0.29)		4	-0.04 (-0.16, 0.09)	
<i>Trials stratified by the frequency of visits</i>																					
Fortnightly	6	0.52 (0.18, 0.87)	0.52	9	0.37 (0.09, 0.65)	0.90	6	0.39 (0.14, 0.64)	0.72	9	0.28 (0.07, 0.49)	0.86	7	0.31 (0.02, 0.60)	0.43	9	0.42 (0.13, 0.71)	0.39	7	-0.09 (-0.23, 0.05)	0.90
Weekly	8	0.41 (0.28, 0.53)		11	0.35 (0.27, 0.44)		9	0.34 (0.20, 0.48)		12	0.30 (0.21, 0.39)		12	0.19 (0.10, 0.27)		8	0.28 (0.18, 0.39)		5	-0.08 (-0.22, 0.06)	
<i>Trials stratified by the frequency of supervision (observations)</i>																					
Weekly or fortnightly	4	0.50 (0.22, 0.77)	0.94	4	0.50 (0.22, 0.77)	0.38	4	0.40 (0.26, 0.55)	0.81	4	0.40 (0.26, 0.55)	0.27	4	0.21 (-0.01, 0.42)	0.56	4	0.48 (0.11, 0.85)	0.50	4	-0.08 (-0.22, 0.07)	0.87

Monthly or less often	10	0.48 (0.26, 0.71)		16	0.36 (0.19, 0.52)		11	0.37 (0.18, 0.56)		17	0.29 (0.15, 0.43)		15	0.29 (0.12, 0.45)		13	0.34 (0.15, 0.53)		8	-0.09 (-0.24, 0.05)	
<i>Trials stratified by who pay home visitors/group facilitators</i>																					
Paid by government	7	0.33 (0.25, 0.41)	0.09	12	0.29 (0.21, 0.37)	0.19	8	0.27 (0.20, 0.34)	0.09	13	0.25 (0.18, 0.32)	0.23	12	0.15 (0.09, 0.21)	0.04	10	0.29 (0.13, 0.45)	0.31	7	-0.04 (-0.12, 0.03)	0.37
Paid by project	7	0.61 (0.30, 0.92)		8	0.51 (0.19, 0.83)		7	0.50 (0.24, 0.77)		8	0.42 (0.15, 0.70)		7	0.45 (0.17, 0.74)		7	0.48 (0.16, 0.80)		5	-0.15 (-0.38, 0.07)	
<i>Trials stratified by geographic location</i>																					
Rural	8	0.46 (0.20, 0.72)	0.76	11	0.41 (0.21, 0.61)	0.69	9	0.35 (0.19, 0.52)	0.65	12	0.33 (0.20, 0.47)	0.74	12	0.25 (0.09, 0.42)	0.80	9	0.45 (0.20, 0.70)	0.20	6	-0.10 (-0.22, 0.02)	0.91
Urban	6	0.51 (0.33, 0.69)		9	0.35 (0.14, 0.56)		6	0.43 (0.16, 0.71)		9	0.29 (0.07, 0.51)		7	0.29 (0.05, 0.53)		8	0.25 (0.07, 0.44)		6	-0.08 (-0.27, 0.10)	

Note: N= number of studies represented in subgroup analysis. SMD, standardized mean difference. p value corresponds to test of subgroup differences. Bolded values indicate significant moderator effect (p<0.1). CI – confidence interval.

Table 5. GRADE¹⁴ summary of findings

Primary Outcomes	Absolute effect (95% CI)	n participants (trials)	Heterogeneity <i>I</i>²	Quality of evidence (GRADE)
Cognition	0.49 (0.32 - 0.66)	10,401 (14)	0.90	Moderate
Cognition and combined cognition and language	0.39 (0.24 - 0.63)	11,657 (20)	0.90	Moderate
Language	0.38 (0.24 - 0.51)	11,398 (15)	0.87	Moderate
Language and combined cognition and language	0.31 (0.20 - 0.42)	12,551 (21)	0.85	Moderate
Fine motor	0.29 (0.12 - 0.54)	7,682 (8)	0.75	High
Gross motor	0.05 (-0.08 - 0.31)	7,463 (6)	0.33	High
Fine motor and combined fine and gross motor	0.27 (0.12 - 0.39)	12,130 (19)	0.88	Moderate
			Overall rating	Moderate

* CI – confidence interval.

¹⁴ Grading Recommendations Assessment, Development and Evaluation.

Supplementary information 1

Reach Up program materials

Materials	Description
Adaptation and planning manual	Provides guidelines on adapting the intervention for context and steps needed in planning for the intervention.
Training manual and demonstration videos	<p>Provides detailed guidance for trainers using a 10-day training schedule. Includes program background and objectives, aims and activities for each training session. Training is highly interactive. Topics include developmental domains, how to conduct a home visit and how to use the curriculum.</p> <p>Three 15-min films (produced in Jamaica, Peru, and Bangladesh) demonstrate key steps in a home visit and 28 short films (2–3 min) show methods used and demonstrate specific play and language activities.</p>
Curriculum	A weekly and fortnightly curriculum are available for ages 0-48 months. Designed for use by community workers, the curriculum provides activities and goals for each visit. Information for each visit includes materials needed, objectives of the visit, and how to do the activity. Suggested dialogue is included, as well as some reminders of steps in introducing an activity and varying levels of difficulty for the activity.
Toy manual and Templates	The toy manual provides step-by-step illustrated instructions on how to make the play materials. Templates for soft toys, books, puzzles and other games are also available.
Supervisor training manual	Guidelines for training of supervisors. Includes topics on qualities of a supervisor, and their responsibilities the use of the evaluation checklist for observing home visits and how to provide supportive feedback. Short scenarios that depict challenges that supervisors and visitors may encounter are incorporated in the sessions.
Supervisor Handbook	Provides supervisors with content on supervisory techniques and methods, and guidelines on conducting individual and group meetings and observing field visits.

Access

Use of 'Reach Up: An early childhood parenting programme' is governed by a Creative Commons License Attribution-NonCommercial-ShareAlike 4.0 International (CC BY-NC-SA 4.0).

Information on Reach Up and sample materials are available on the Reach Up website: www.reachupandlearn.com . To maintain implementation quality full program materials are provided only to agencies that agree to use an experienced Reach Up trainer to assist with adaptation of the program and in training of trainers.

A Reach Up Home Visit

Home Visits begin with a greeting and a brief chat with the mother catching up with how the family has been. The visitor then reviews with the mother how she and child have played together with activities from the previous visit. In the next step the home visitor introduces new activities, first observing what the child does, then demonstrating and describing the activity to mother and child, helping the child with the activity, and encouraging mother and child to do the activity together. For language activities, home visitors encourage mothers to respond to their children's vocalizations and actions, demonstrate ways the mother can talk about and show her child objects and activities in their environment, or how to look at books together and talk about the pictures and stories to encourage vocalization and introduce new words. Throughout the visit, home visitors provide feedback, promote giving praise to both mother and child, celebrate the mother's and child's achievements and efforts, and encourage showing love. Toys and books, developed as part of the program, are used and are left with families and exchanged at the next visit. At the end of the visit, the home visitor and mother recap the new activities and the home visitor encourages the mother to continue doing them as part of her daily routines. Home visitor, mother and child then sing and act out an appropriate action song.

Supplementary Information 2

Search terms for study selection

The search strategy included the following terms:

(Jamaica Home Visiting) OR (Reach Up parenting) OR (Jamaica) OR (stimulation) OR
(group sessions) OR (home visits)

AND

(early child development) OR (cognitive development) OR (cognition) OR
(Intelligence Quotient) OR (Developmental Quotient) OR (parenting practices) OR
(parent behaviour) OR (child behaviour) OR (psychosocial stimulation) OR (home
environment) OR (early stimulation)

AND

(impact evaluation) OR (effectiveness) OR (treatment group) OR (effect size)

AND

(randomized controlled trials) OR (cluster-randomized controlled trials)

AND

(Caribbean) OR (Latin America) OR (South Asia) OR (Jamaica) OR (Peru) OR
(Colombia) OR (India) OR (Madagascar) OR (Guatemala) OR (China) OR (Africa) OR
(Bangladesh)

Supplemental Information 3

Summary of Findings: Risk of Bias Assessment¹

Author/Year/Country	Selection bias		Performance bias	Attrition bias	Detection bias	Reporting bias	Overall
	Adequacy of randomization	Participant Recruitment (C-RCT) ²	Blinding of participants and personnel	Incomplete outcome data	Blinding of outcome assessors	Selective reporting	
Andrew, A. et al, ²⁵ India	Low	Low	Low	Low	Low	Low	Low
Araujo, et al, ²¹ Peru	Low	Low	Low	Low	Low	Some concerns	Some concerns
Attanasio, O. et al, ²³ Colombia	Low	Low	Low	Low	Low	Low	Low
Brentani A., et al, ³¹ Brazil	Low	N/A	Low	Low	Low	Some concerns	Some concerns
Galasso, E. et al, ³⁴ Madagascar	Low	Low	Low	Low	Low	Low	Low
Grantham-McGregoet al, ⁸ Jamaica	Some concerns	N/A	Low	Low	Low	Some concerns	Some concerns
Grantham-McGregoet al, ¹³ India	Low	Low	Low	Low	Low	Low	Low
Hamadani, J, et al, ²⁶ Bangladesh	Low	Low	Low	Low	Low	Some concerns	Some concerns

¹ Cochrane risk of bias tools for randomized (RoB 2).

² Assessed using the cluster-randomized trials tool (RoB 2 CRT).

Hamadani, J. et al, ¹² Bangladesh	Low	Low	Low	Low	Low	Low	Low
Heckman, et al, ²⁹ China	Some concerns	Low	Some concerns	Low	Low	Some concerns	Some concerns
Hossain, et al, ³⁵ Bangladesh	Low	Low	Some concerns	Low	Low	Low	Some concerns
Mehrin, et al, ¹⁴ Bangladesh	Low	Low	Low	Low	Low	Low	Low
Nahar, B., et al, ²⁷ Bangladesh	Low	N/A	Low	Low	Low	Some concerns	Some concerns
Powell, et al, ³⁶ Jamaica	Some concerns	N/A	Some concerns	Low	Low	Some concerns	Some concerns
Powell, et al, ³⁷ Jamaica	Low	Low	Low	Low	Low	Some concerns	Some concerns
Tofail, et al, ³⁸ Bangladesh	Some concerns	Low	Low	Low	Low	Some concerns	Some concerns
Walker, et al, ¹⁷ Jamaica	Low	N/A	Some concerns	Low	Low	Some concerns	Some concerns
Walker, et al, ³⁹ Jamaica	Low	Low	Some concerns	Low	Low	Some concerns	Some concerns

Supplementary Information 4

Amendments to information provided in the protocol

Protocol registered	Final Manuscript
Search Strategy	
<p>Studies conducted from 1985 to 2020 will be compiled using the following electronic databases PubMed, Science Direct and Academic Search Elite/EBSCO Host.</p>	<p>Initial search covered the period January 1985 to October 2020, then repeated in February 2022, to identify studies published between October 2020 to February 2022.</p> <p>The search strategy was piloted using PubMed, Science Direct and Academic Search Elite/EBSCO Host. Due to the limited number of Boolean/Phrase connectors possible in ScienceDirect, this database was excluded.</p>
Search terms	
<p>The following search terms will be included:</p> <p>(Jamaica Home Visiting) OR (Reach Up parenting) OR (Jamaica stimulation)</p> <p>AND</p> <p>(early child development) OR (cognitive development) OR (cognition) OR (Intelligence Quotient) OR (Developmental Quotient) OR (parenting practices) OR (parent behaviour) OR (child behaviour) OR (stimulation) OR (home environment)</p> <p>AND</p> <p>(impact evaluation) OR (effectiveness) OR (randomized controlled trial) OR (treatment group) OR (effect size)</p> <p>AND</p> <p>(Caribbean) OR (Latin America) OR (South Asia) OR (Jamaica) OR (Peru) OR (Colombia) OR</p>	<p>Search terms modified as indicated in blue:</p> <p>(Jamaica Home Visiting) OR (Reach Up parenting) OR (Jamaica) OR (stimulation) OR (group sessions) OR (home visits)</p> <p>AND</p> <p>(early child development) OR (cognitive development) OR (cognition) OR (Intelligence Quotient) OR (Developmental Quotient) OR (parenting practices) OR (parent behaviour) OR (child behaviour) OR (psychosocial stimulation) OR (home environment) OR (early stimulation)</p> <p>AND</p> <p>(impact evaluation) OR (effectiveness) OR (treatment group) OR (effect size)</p> <p>AND</p> <p>(randomized controlled trials) OR (cluster-randomized controlled trials)</p>

Protocol registered	Final Manuscript
(India) OR (Madagascar) OR (Guatemala) OR (China) OR (Africa)	AND (Caribbean) OR (Latin America) OR (South Asia) OR (Jamaica) OR (Peru) OR (Colombia) OR (India) OR (Madagascar) OR (Guatemala) OR (China) OR (Africa) OR (Bangladesh)
Outcomes measured	
<p><u>Our Primary Outcomes</u> are Child cognitive, language and motor development.</p> <p><u>Secondary Outcomes</u> include Child behaviour; parenting behaviours such as responsiveness, providing stimulating environment; parent wellbeing.</p>	<p>No change</p> <p>We considered child behavior and other aspects of parent well-being but sufficient data were not available, so these outcome were not included</p>
Analysis of subgroups or subsets	
<p>Depending on availability of data, subgroup analysis will include:</p> <ul style="list-style-type: none"> - Child characteristics – gender, age on enrolment, nutritional status, stunting - Socioeconomic status - Maternal education - Implementation characteristics - duration, frequency of contacts, size of program and modality - Other factors - stand-alone program or home visitors/group facilitators are paid by government and level of supervision 	<p>Subgroup analyses included:</p> <ul style="list-style-type: none"> - Child characteristics – mean child age on enrolment, nutritional status - Maternal education - Implementation characteristics – duration, frequency of contacts, size of program and modality - Other factors - stand-alone program or home visitors/group facilitators are paid by government, frequency of supervision, geographic location