

1 Structured multicomponent community-based program for women's health and
2 infant's health and development in rural Vietnam: a parallel group cluster
3 randomised controlled trial

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26 **Summary**

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28 **Background**

29 Interventions to improve early childhood development have addressed only one or a few risk
30 factors. We aimed to establish whether Learning Clubs a structured, facilitated,
31 multicomponent intervention addressing eight potentially modifiable risk factors, and offered
32 from mid-pregnancy to 12 months postpartum, improved two-year-old children's cognitive
33 development.

34
35 **Methods**

36 Using a cluster-randomized trial design, 84/116 communes (the clustering unit) in HaNam
37 Province were selected randomly and assigned randomly to receive intervention (n=42) or
38 usual care (n=42). Women pregnant at <20 weeks' gestation were eligible. Data sources
39 were standardised, and study-specific questionnaires assessing risks and outcomes,
40 completed in interviews in mid-pregnancy (baseline), late pregnancy, six and twelve months
41 postpartum and at endline when children were two. Mixed-effect models were used to
42 estimate trial effects adjusting for clustering. The primary outcome was Bayley Scales of
43 Infant and Toddler Development Third Edition (Bayley-III) Cognitive Scores. Trial registration
44 ACTRN12617000442303.

45
46 **Findings**

47 Between 28th April and 30th May 2018, 1380 women were approached, 1253 were eligible
48 and 1245 (99.3%) (669 intervention, 576 control) were recruited, Endline data were
49 contributed by 616 women (92%) in the intervention, and 544 (94%) in the control arm and
50 their children. Mean Bayley-III Cognitive Score of intervention children was 99.6 and control
51 children was 95.6. The mean difference 4.0 (95%CI: 2.6;5.4) was significant, with a
52 moderate effect size (Cohen's d 0.41). Fewer children in the intervention (n=19, 3%) than
53 the control (n=32, 6%) group had Bayley-III scores <-1SD, odds ratio 0.54 (95%CI:
54 0.25;1.17). There were no differences between groups in maternal, foetal, newborn or child
55 deaths.

56
57 **Interpretation**

58 A facilitated, structured, community-based, multicomponent group program offered
59 universally, improved early childhood development to the standardised mean in rural
60 Vietnam and could be implemented in other resource-constrained settings.

61
62 **Funding**

63 Australian National Health and Medical Research Council and Grand Challenges Canada
64 Saving Brains Initiative.

Research in context

Evidence before this study

We searched three Lancet Commission Series: Child Development in Developing Countries (2007), Child Development (2011) and Advancing Early Childhood Development: from Science to Scale (2017) for synthesized evidence on risks to early childhood development in resource-constrained settings and interventions to address these. Using key search terms 'early child(hood) development', 'programs', 'trials', and a list of World Bank defined low- and middle-income countries (2017) we also searched PubMed and Web of Science for reports of trials of early childhood development interventions and systematic reviews of interventions for individual risks in these countries from inception to December 31st, 2017.

The Lancet series identified eight potentially modifiable key risks that interact to compromise early childhood development. We found trials from Jamaica, Pakistan, Bangladesh, Kenya and Uganda which each sought to improve children's cognitive development and or growth among selected or unselected groups of young children in home visiting or group-based programs. In Jamaica (for children who were stunted) and Pakistan (for all children in a rural area) factorial trials compared nutritional supplementation, and or educating mothers about activities for cognitive stimulation. In Bangladesh a multicomponent parenting program covering health and hygiene, nutrition, communication, stimulating play, showing affection, and avoiding harsh discipline was compared to usual care in promoting early childhood development. In Western Kenya villages were assigned randomly to receive an equivalent program in a group, or home-visiting, or mixed-method format or to receive the usual standard of care. In Uganda similar content was supplemented with activities informed by cognitive behavioural therapy for maternal mental health. Benefits for children's cognitive development over usual care were found, but fewer to linear growth. There were no studies from Vietnam.

None of the interventions addressed all eight risks. Few mechanisms were elucidated. Apart from the Uganda trial, maternal mental health was either not considered or was expected to benefit indirectly. None sought to improve pregnancy outcomes or breastfeeding or addressed the risks to maternal health of carrying a disproportionate burden of unpaid work or experiencing violence perpetrated by an intimate partner. In general, endline child development scores remained lower than the standardised mean (100). This suggests that interventions focussing on a few risks are probably not enough and that a multicomponent approach is needed.

Added value of this study

In a cluster randomized controlled trial we compared Learning Clubs a multicomponent community-based program for women's health and infant's health and development with the usual standard of care in rural Vietnam. Women accompanied, if they chose, by their husbands and mothers or mothers-in-law, were invited to attend eight locally facilitated sessions in pregnancy and eleven in the first postpartum year and to have one home visit. At age two, in the intervention group, children's cognitive, language and motor development were at the standardised mean and significantly higher than in the control group. The mechanism was through a home caregiving milieu improved in being more responsive, having more age-appropriate and cognitively stimulating play materials and activities, and sensitive and varied parent-child interactions. Women's mental health and nutritional status were better, infant birthweight was higher and prevalence of gender-based violence was lower than we had found in this province five to ten years earlier. National policies for hunger eradication, poverty reduction, and elimination of domestic violence had been implemented prior to trial initiation and were likely to have benefited these aspects of population health.

Implications of all the available evidence

Universal, structured, locally facilitated, group-based parenting education programs initiated in pregnancy and running until the end of the postpartum year are feasible and effective in improving early childhood development to the standardised mean in resource constrained settings. Public policies to improve women's and children's nutrition, household wealth and personal safety are needed alongside programs.

66 Introduction

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68 Human growth and development are governed by interactions among psychosocial,
69 environmental, and biological factors. The first 1000 days from conception to the age of two
70 are vital because physical growth and neurological development, reflected in cognitive,
71 language, motor and social-emotional domains, are rapid and, if sub-optimal, have lasting
72 life-course effects.¹ Eight major risks to early childhood development are: intrauterine growth
73 restriction, stunting, iron deficiency anaemia, iodine deficiency, unresponsive caregiving,
74 insufficient cognitive stimulation, maternal mental health problems and family violence, all
75 worsened by poverty.² Women in low- and middle-income countries (LMICs) who are
76 pregnant experience malnutrition, poverty, gender-based violence, mental health problems
77 and inadequate access to health and social care, at higher rates than women in high-income
78 countries.³ Risks interact and lead to adverse pregnancy outcomes and, via direct and
79 indirect mechanisms, compromised foetal and infant health and development.⁴ In LMICs, it
80 is estimated that more than 250 million young children do not reach their developmental
81 potential annually.^{3,5,6}

82
83 Ante- or post-natal micronutrient or caloric supplementation, food fortification, or
84 breastfeeding education alone have minimal impact on children's motor and mental
85 development.⁷ Nutritional supplementation for selected (stunted) or universal populations
86 confers early benefits to growth.^{8,9} Stimulation leads to significantly better cognitive,
87 language and motor development, but additive benefits of receiving both stimulation and
88 nutrition have not been found.⁸⁻¹⁰

89
90 Multicomponent parenting programs covering health, nutrition, communication, stimulating
91 play and demonstrating affection, delivered in group and or home-visiting formats improve
92 young children's cognitive, receptive language, and socioemotional development, but not
93 maternal mental health.^{11,12}

94
95 Interventions in LMICs for women's perinatal mental health have focused mostly on
96 selected, depressed, populations.¹³ Some also sought to improve infant health, growth, or
97 development by strengthening caregiver capabilities or, indirectly, by improving maternal
98 mood. Integrated interventions for depressed or very poor women have short term benefits
99 for children's cognition and language, and maternal depressive symptoms,¹⁴ but these are
100 not maintained long term.¹⁵

101
102 None of the interventions available prior to the initiation of this trial sought to improve
103 pregnancy outcomes or breastfeeding. Education about responsive feeding and nutritional
104 needs was included in most, but only two provided nutritional supplements.^{8,9} Household
105 hygiene was addressed in some,^{11,12,14} but protection from domestic dangers was not.
106 Maternal mental health was either not considered⁸⁻¹⁰ or not addressed.^{11,12} Recognition of
107 maternal mental health problems was not built on local evidence about modifiable
108 determinants.^{11,12,14} None addressed gender-based risks including disproportionate burden
109 of unpaid work, lack of economic autonomy, or experiencing intimate partner violence. The
110 policy context related to antenatal care, poverty reduction, hunger eradication, or gender-
111 based violence that might have influenced outcomes was not considered. Despite the gains,
112 child development scores in intervention groups remained lower than the Bayley-III
113 standardised mean (100). This suggests that interventions focussing on a single or few risks
114 are probably insufficient and that a multicomponent approach is needed.

115
116 The aim was to establish whether a structured, facilitated, community-based,
117 multicomponent intervention for women's health, and infant health and development

118 delivered at the commune level was effective in improving, as the primary outcome, the
119 cognitive development of individual two-year-old children and, as secondary outcomes
120 children's growth, language, motor and social-emotional development in rural Vietnam.
121

122 **Methods**

123 **Study design**

124 We applied a two-arm parallel group cluster-randomised controlled trial to compare our
125 multicomponent (content addressing multiple risks in group sessions and a home visit)
126 complex intervention (Learning Clubs; Box 1) with the usual standard of care which includes
127 antenatal health checks, birth in a medical facility and access to national immunisation and
128 growth monitoring programs.¹⁶ A cluster trial was used because contamination within a
129 commune (cluster unit) was unavoidable.
130

131 Vietnam is a lower-middle income country in Southeast Asia, with a population of
132 approximately 99 million people: 62% living in rural areas. Communes, the primary
133 administrative entity in Vietnam, each have a population of ~7,000–10,000 people and a
134 health centre. In the study site, HaNam, a rural Red River delta province, many pregnant
135 women experience food insecurity, malnutrition, iodine deficiency, iron deficiency anaemia,
136 intimate partner violence and common mental disorders.¹⁷⁻²² Laws and policies relevant to
137 these outcomes have been implemented nationally including: Decree 74/2000/ND-CP (2000)
138 and Decree 21/2006/ND-CP (2006) against marketing and sales of breast milk substitutes;
139 Programme 135 (2004) on Hunger Eradication and Poverty Reduction; Law 73/2006/QH11
140 (2006) on Gender Equality to promote equality in social and family life, and outlaw gender-
141 based discrimination, and Law 11/2007/L-CTN (2007) to ~~prevent and~~ control domestic
142 violence.
143
144

145 **Participants**

146 Women who were pregnant with gestational age <20 weeks, aged at least 18 years, and
147 living in randomly selected communes were eligible. Women with a cognitive, acute
148 psychiatric or severe physical disability (determined by commune health centre staff) that
149 would prevent study participation, were ineligible.
150

151 ~~Approval to conduct the project was provided by~~ Monash University Human Research Ethics
152 Committee, Melbourne, Australia (Certificate Number 20160683) and the Institutional
153 Review Board of the Hanoi School of Public Health, Hanoi, Vietnam (Certificate Number
154 017- 017-377IDD- YTCC) provided approval to conduct the project. Individual consent to
155 participate was given by signing a consent form or, for those with limited literacy, providing
156 a thumb print or witnessed oral consent after having the participant information read to them.
157

158 **Randomisation and masking**

159 The number of clusters and sample size were calculated using the clustersampsi module in
160 Stata V.14.
161

162 A total of 1008 pregnant women from 84 clusters (in each trial arm: 504 women,
163 approximately 12 recruited from each of 42 communes) was needed to detect a difference
164 in the primary outcome (Bayley Scale of Infant and Toddler Development Third Edition
165 (Bayley-III) Cognitive score <-1 SD at 2 years old) of 15% in the control arm and 8% in the
166 intervention arm with 80% statistical power, a significance level of 0.05 and an intracluster
167 correlation coefficient of 0.03.¹⁹ The assumptions were derived from our previous studies in
168 Vietnam.^{4,23,24} Sample size and power calculations considered 20% loss to follow-up from

169 still births (<1%), late abortions (<1%), infant mortality (0.2%), migration (5%) and withdrawal
170 (13%).

171

172 An independent statistician selected 84 communes randomly from the list of 116 communes
173 in HaNam and allocated 42 randomly to each trial arm using random numbers generated in
174 Stata V.14.

175

176 Data collectors, data analysts and laboratory staff were blinded to ~~the~~ assignment of
177 communes to trial arms. Participants were given a code number which identified the
178 commune, but not the trial arm. Trial arm assignment was only made available after
179 unblinding when data collection was complete.

Box 1 Learning Clubs Program

Theory of change and program principles

- Women who are pregnant or caring for very young children have high learning needs, which if unmet, can have adverse effects on their health and caregiving capabilities.
- Modifiable risks for women's health and/or early childhood development include intrauterine growth restriction, stunting, iron deficiency anaemia, iodine deficiency, unresponsive caregiving, insufficient cognitive stimulation, mental health problems and family violence.
- Perinatal stage specific knowledge and skills targeting these risks using a psycho-educational approach can improve maternal mental and physical health, gender empowerment, parenting competence and confidence, and early childhood development.
- Content aligned with Vietnam's national programmes and approved by the Maternal and Child Health Department of the Ministry of Health.

Program content

- Session content drawn from interventions to address at least one risk and trialled in other resource-constrained settings, or WHO guidelines, including about:
 - Maternal, foetal, and infant nutritional needs, food sufficiency and micronutrient deficiencies.
 - Pregnancy health, including occupational safety, safe exercise, safe medication use, signs to seek emergency care, essential vaccinations, and preparation for childbirth in hospital.
 - Newborn care, establishing and maintaining breastfeeding, understanding the baby's sleep needs, soothing, and settling, avoiding breastmilk substitutes.
 - Perinatal mental health, understanding psychological needs and relationships, impact of fatigue, problem solving using cognitive strategies of reframing, and avoiding catastrophising.
 - Gender equity by increasing men's empathy and reducing power disparities in the intimate partner relationship, challenging gender-based stereotypes about division of infant care and household work, promoting more equitable roles and responsibilities, understanding the harms of all forms of violence to maternal and infant health and wellbeing;
 - Infant care, recognising and responding to behavioural cues, cognitive, language and social stimulation through communication and play, preventing stunting, introduction of supplementary foods.
 - Safety, first aid, household hygiene, avoidance of dangers from open hearths, animal bites and fishponds.

Approach

- Follows a structured curriculum comprising stage-specific information and participatory learning opportunities, including brief talks, short videos, scenario-based discussions to understand and promote mental health and gender empowerment, demonstrations of infant caregiving and hands on practice, with coaching, role play, practising on a doll, questions and answers, sharing experiences and discussing solutions, to acquire skills to optimise the caregiving environment and promote child development
- Provided in 19 accessible, facilitated, community-based group sessions (each 60 to 90 minutes, run on a Sunday morning at 7.30am to maximise access) for women, and following birth, their infants, accompanied when feasible by their husbands and other family members, and.
- One home visit by a commune health worker in the first month postpartum to identify and address any post-birth complications, breastfeeding difficulties, and newborn warning signs, to guide the family in how to soothe and settle the baby and to promote early development through play and communication.
- Husbands encouraged to participate in all sessions through direct invitations. Men were given practice and encouragement to care for their babies from the earliest days of their lives, with video demonstrations and hands-on practice.
- Grandparents invited to join sessions about infant care, health, growth, and development.
- Clubs meet every two to four weeks in a commune facility equipped with a data projector.
- Content translated and adapted to ensure cultural appropriateness, field-tested for salience, acceptability, and comprehensibility, and summarised in three illustrated books and a set of posters to take home and discuss.
- Fidelity maintained by a detailed facilitator's handbook and a set of training resources, including the videos, a baby bath and a baby-sized doll, and examples of home-made toys.
- Facilitators were given a small budget for session refreshments, stationery and, if needed, participant fuel costs. They documented and reported attendance at each session.

Facilitators and facilitator training

- Group facilitators were members of the Women's Union, a mass organisation that reaches to village level with responsibility for the welfare of children and families. They were supported by a commune health worker and a kindergarten teacher for some sessions.
- Using a tiered approach to capability building, master trainers (national experts in at least one of the content areas) trained provincial trainers, who then trained and provided supportive supervision to the commune facilitators. Specific training in respectful inclusion of men in potentially unfamiliar activities like discussing equitable division of household work was provided.

182 **Procedures**

183 Pregnancies are registered at the commune health centre. Potential participants were
184 informed of the study during antenatal care or household visits for immunisation, and via
185 commune loudspeaker announcements. Women who were interested in participating were
186 invited to the commune health centre on a specified date to learn about the study and, if
187 interested, give consent before completing baseline assessments.

188
189 Data were collected in five waves: baseline (~~at~~ mid-pregnancy), late pregnancy, ~~at~~ six
190 and twelve months postpartum and ~~at~~ endline when children were aged two ~~years~~. Most
191 outcomes were assessed by trained health researchers from the HaNam Provincial Centre
192 for Disease Control, which was independent of the intervention implementation team and
193 blinded to allocation of communes to trial arms. The completion of self-report questionnaires
194 is an unfamiliar ~~and generally difficult~~ task in this setting, so all psychological and social data
195 were collected using handheld computer devices in confidential individual interviews lasting
196 about 30 minutes. Bayley-IIIs were administered by trained psychologists from a Hanoi child
197 health clinic. Anthropometric and biological data were collected by trained health workers at
198 the commune health centre. Apart from the HOME Inventory, completed at a home visit,
199 assessments were undertaken in private rooms at the local commune health centre.

200
201 **Outcomes**

202 Our primary outcome was the cognitive development of two-year old children indicated by
203 the mean (SD) score on the Bayley-III Cognitive scale and the proportion scoring <-1SD.
204 Cognitive development is the strongest indicator of a child's future learning and earning
205 potentials and it is linked to capabilities in other development domains. A cut-off <-1SD is
206 the best indicator for moderate to severe developmental delay.^{25,26} Secondary outcomes
207 were infant motor, language and socio-emotional development, anthropometric indices and,
208 post hoc, the home environment at age two years. (see Table 1).

209
210 **Ancillary analyses**

211 We sought in prespecified ancillary analyses to ascertain whether ~~defined factors:~~ home
212 environment, maternal mental health, father's involvement in household tasks and infant
213 care, and infant anaemia at one year postpartum might have mediated the relationship
214 between the intervention and the child development outcomes.¹⁶

215
216 The multicomponent Learning Clubs intervention sought, through knowledge and skills-
217 building, to change behaviours. These included, women's self-managed health promotion
218 and healthcare participation, caregiving capabilities, and sensitivity and responsiveness to
219 their infants, and men's provision of care and avoidance of controlling behaviours towards
220 their wives, their participation in household work, and caregiving for their infants (see
221 ~~Supplementary Supplement~~ Table 1). Between-~~group~~ comparisons of these were made in
222 post hoc ~~ancillary~~ analyses.

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Table 1 Assessment tools		
Variable	Tool	Description
Primary outcome		
Cognitive development of children aged 24 months	Bayley Scales of Infant and Toddler Development 3rd Ed ²⁷ (Bayley-III), Cognitive Subscale	Direct child assessments. We have previously translated ⁴ the Bayley-III into Vietnamese, adapted materials where necessary and trained local expert administrators. The Cognitive subscale consists of 91 items. The total raw score is the number of items completed. The raw scores were then converted to standardised scores using age and sex matched norms. Reference standardised mean score is 100 (SD=15, range from 45 to 155).
Secondary outcomes		
Cognitive development of children aged 12 months	Bayley-III ²⁷ Cognitive Subscale	Direct child assessments.
Motor, language, and social-emotional development of children aged 12 and 24 months	Bayley-III ²⁷ Motor, language, and social-emotional subscales	Direct child assessments of motor and language development and parent completed checklist of social-emotional development. Reference standardised mean score is 100 (SD=15, range from 45 to 155).
Anthropometric indices of children aged 12 and 24 months	Mother–infant scale (Seca 876); portable stadiometers & length boards (Shorr Board)	Infant height-for-age, weight-for-age, and weight-for-height z scores will be calculated by WHO methods ²⁸ using length and weight based on infant's age and sex.
Home environment when children are aged 24 months (post hoc)	Infant/Toddler Home Observation for Measurement of the Environment (HOME) Inventory ²⁹	Comprises 45 items grouped into six subscales: Responsivity (11 items), Acceptance (8 items), Organisation (6 items), Learning Materials (9 items), Involvement (6 items), and Variety (5 items). Quality and quantity of stimulation and support available to a specific 0 – 24-month-old child at home assessed through direct observation and semi-structured parent interviews at home. The sub-scale scores are the numbers of items endorsed.

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Statistical analyses

We examined ~~the~~ baseline characteristics of individual women and newborns in each trial arm to assess randomisation. Data were analysed in three steps. First, ~~we conducted~~ descriptive analyses to identify differences in primary and secondary outcomes and mediators between trial arms. Second, mixed-effect logistic regression models for the binary outcomes or mediators and mixed-effect linear regression models for continuous outcomes or mediators were conducted ~~to estimate effects~~. In each of these models, a fixed effect for trial arm (intervention effect) was estimated adjusting for the effect of the commune (a random effect). Finally, to identify whether specific intervention components might have influenced the child development outcomes, mediation analyses were conducted using structural equation modelling. All analyses were by intention-to-treat and performed at individual level using Stata, V.16 and Mplus V.7.4. Cohen's d effect sizes ~~(adjusted mean difference over the pooled standard deviation)~~ were calculated for significant continuous outcomes. Missing data were treated with pairwise deletion for the mixed-effect models and the Full Information Maximum Likelihood method for structural equation modelling ~~(Please see Supplementary Supplement file for a more detailed account)s of the analyses.~~

Role of the funding sources

This research was funded by Australian National Health and Medical Research Council ~~Project Grant (GNT1100147)~~ and Grand Challenges Canada under the Saving Brains Initiative (seed funding 2014-2015, and TTS-1803-22331). The funders had no part in trial design, implementation, analysis, interpretation, or publication of findings.

Results

Enrolment commenced on 28th April 2018 and was completed on 30th May 2018. In total 1380 women were screened, among whom 1253 were eligible and 1245 (99.3%) were recruited and contributed baseline data (Figure 1). Collection of endline data was slowed, and extended, because there were restrictions on internal travel, numbers of people from Hanoi allowed to visit HaNam Province, and permitted duration of interviews or home visits due to COVID-19 pandemic restrictions. It was completed on 17th January 2021. Endline data were contributed by 94.4% (544) of participants in the control and 92.1% (616) in the intervention arm

The sociodemographic, reproductive health, household, and infant characteristics of the participants in control and intervention arms of the trial were well matched (Table 2).

Table 2 – Baseline characteristics of participants in each study arm

	Control group (N=544 women)	Intervention group (N=616 women)
Women		
Gestational age at baseline in weeks, Mean (SD)	15.0 (4.5)	14.7 (4.4)
Age in years, Mean (SD)	27.1 (5.4)	27.6 (5.3)
Education level, n (%)		
<i>Secondary (up to completion of Year 9)</i>	209 (38)	234 (38)
<i>High school (up to completion of Year 12)</i>	163 (30)	188 (31)

<i>Post-secondary education or training</i>	172 (32)	194 (31)
Occupation, n (%)		
<i>Farmer</i>	39 (7)	34 (5)
<i>Factory worker / manual labourer</i>	231 (43)	289 (47)
<i>Trader, handicraft worker, self-employed shop / stall / freelance / other</i>	90 (16)	109 (18)
<i>Private company worker / government officer, professional</i>	105 (19)	110 (18)
<i>Fulltime unpaid household work / not currently engaging in income-generating activity</i>	79 (15)	74 (12)
Parity, Mean (SD)	1.0 (0.9)	1.0 (0.9)
Any history of miscarriage, stillbirth or neonatal deaths, n (%)	113 (21)	119 (19)
Depression Anxiety and Stress 21 item Scale Vietnam Validation (DASS-V 21), Median score (25 th percentile, 75 th percentile)	10 (4, 19)	10 (4, 22)
DASS-V 21 Mean score (SD)	13.6 (13.9)	14.9 (15.8)
Clinically significant symptoms of common mental health problems (DASS-V 21 > 33) n (%)	61 (11)	69 (11)
Ferritin level (mcg/l), Median (25 th percentile, 75 th percentile)	62.5 (37, 102)	65.5 (37, 103)
Iron deficiency (ferritin level < 15 mcg/l), n (%)	31 (6)	43 (7)
Haemoglobin level (g/l), Mean (SD)	123.3 (122.2, 124.4)	122.1 (121.2, 123.1)
Anaemic (haemoglobin < 110 g/l), n (%)	68 (13)	83 (14)
Women's Body mass index, Mean (SD)	21.2 (2.7)	21.2 (2.6)
Partners		
Age in years, Mean (SD)	31.0 (5.7)	31.1 (5.6)
Education level, n (%)		
<i>Secondary (up to Year 9)</i>	240 (44)	257 (42)
<i>High school (up to Year 12)</i>	176 (32)	192 (31)
<i>Post-secondary education or training</i>	128 (24)	167 (27)
Occupation, n (%)		
<i>Farmer / not currently engaging in income-generating activity</i>	27 (5)	23 (4)
<i>Factory worker / manual labourer</i>	134 (25)	175 (28)
<i>Trader, handicraft worker, self-employed shop /stall /freelance / other</i>	302 (55)	326 (53)
<i>Private company worker / government officer, professional</i>	81 (15)	92 (15)
Quality of relationship with intimate partner		
Intimate Bonds Measure – Care subscale, Median (25 th percentile, 75 th percentile)	32.5 (28, 35)	32.0 (28, 35)

Intimate Bonds Measure – Control subscale, Median (25 th percentile, 75 th percentile)	5.0 (1, 9)	4.0 (1, 9)
Family		
Number of household members, Mean (SD)	4.3 (1.2)	4.4 (1.3)
Wealth index quintile, n (%)		
Quintile 1 (poorest 20%)	112 (21)	117 (19)
Quintile 2	112 (21)	122 (20)
Quintile 3	125 (23)	112 (18)
Quintile 4	96 (17)	134 (22)
Quintile (Richest 20%)	99 (18)	131 (21)
Characteristics of newborns	Control group (N=546 babies)	Intervention group (N=622 babies)
Singleton or Multiple birth, n (%)		
Singleton	542 (99)	610 (98)
Twin	4 (1)	12 (2)
Sex ^a , n (%)		
Girl	266/541 (49)	316/618 (51)
Birthweight ^b in grams, Mean (SD)	3239 (404)	3212 (437)
Gestational age at birth ^c , Mean (SD)	39.2 (1.2)	38.9 (1.7)

^aMissing 9 cases; ^bMissing 44 cases; ^cMissing 32 cases.

Participation in the Learning Clubs sessions

Overall, 93% (574) eligible women participated in at least one antenatal and 98% (603) one postnatal session; 98% (603) had a home visit in the first postpartum month. A third (35%, 214) of men participated in at least one antenatal and 55% (340) a postnatal session. One in five grandmothers (22%, 114) participated in any antenatal and 75% (464) any postnatal session. Overall, 42% (259) of women attended at least 80% of the sessions and another 33% (203) attended 50% - 75% of sessions.

Participant safety

One woman (from the control arm) died during pregnancy of a pre-existing cancer. There were no significant differences between groups in foetal, newborn or child deaths. All these serious adverse events were reported to the Monash University Human Research Ethics Committee who determined that none were related to the [intervention Learning Clubs program](#).

Primary outcome

In intention-to-treat comparisons between trial arms, adjusted for clustering effects we found that on average two-year old children in the intervention arm had a significantly higher Bayley-III Cognitive score than those in the control arm. There were fewer children with Bayley-III cognitive scores <-1 SD, but this difference was not statistically significant (Table 3).

Secondary outcomes

288 Children in the intervention arm had significantly higher mean Bayley-III Cognitive scores at
289 the age of one, but there were no differences between groups in other development
290 domains. At age two mean Motor and Language scores were significantly higher in the
291 intervention arm. The difference in mean Bayley-III Social-Emotional scores favoured the
292 intervention but was not significant (Table 3).

293
294 There were no differences between trial arms in the growth indicators of height and weight
295 or stunting or wasting when children were one or two years old (Table 3). HOME Inventory
296 assessments when the infants were two years old were significantly better in the intervention
297 than the control arm. The significant differences were in four of the six subscales:
298 Responsivity which assesses quality of communication and emotional responses (attending,
299 talking to, and reacting to cues) of the parent towards the child; Learning Materials which
300 assesses the availability to the child of age-appropriate cognitively stimulating toys and
301 activities; Involvement, how parents interact with the child and Variety, how daily routines
302 incorporate social interactions with others and activities inside and outside the house.

303 304 **Mediators**

305 Home environment

306 HOME Inventory assessments when the infants were twelve months old were significantly
307 better overall in the intervention than the control arm ([Supplementary Supplement Table 4](#)).
308 The significant differences were in the Learning Materials, Involvement and Variety
309 subscales.

310 311 Maternal mental health

312 There were no differences between groups in maternal mental health as indicated by mean
313 [DASS-V](#) symptom scores ~~on the DASS-V at~~ one year postpartum or proportion with scores
314 higher than the local cut off for clinically significant symptoms ([Supplementary Supplement](#)
315 Table 4).

316 317 Maternal micronutrient levels

318 There were no differences between trial arms in mean maternal serum ferritin or proportions
319 with low ferritin (<15 mcg/L), or in mean serum haemoglobin and proportions with low
320 haemoglobin (<110 g/l) or in mean urinary iodine concentration or proportions with low iodine
321 concentration (UIC < 150 mcg/L) in late pregnancy ([Supplementary Supplement Table 4](#)).

322 323 Fathers' involvement

324 There were no differences between trial arms in women's experiences of their husbands'
325 sharing of household work and infant care one year postpartum ([Supplementary Supplement](#)
326 Table 4).

327
328
329

330 Table 3 – Odd Ratios or mean differences of the outcomes and mediators between trial arms

	Control group n (%) or mean (SD)	Intervention group n (%) or mean (SD)	Odds Ratio or Mean difference ^(a) (95%CI)	p-value	Cohen's d effect size ^(c)
Primary outcome					
Bayley Scales of Infant and Toddler Development (Bayley-III) Cognitive score at 2 years old < - 1 SD	32 (6%)	19 (3%)	0.55 (0.26; 1.17)	0.119	
Bayley Scales of Infant and Toddler Development (Bayley-III) Cognitive score	95.6 (9.4)	99.6 (9.7)	4.0 (2.6; 5.4)	<0.001	0.41
Secondary outcomes					
Bayley-III Motor score at 2 years old	101.2 (8.9)	103.9 (9.3)	2.7 (1.2; 4.2)	<0.001	0.29
Bayley-III Language at 2 years old	96.9 (13.3)	99.4 (13.3)	2.48 (0.55; 4.41)	0.012	0.19
Bayley-III Social-emotional score at 2 years old	99.4 (18.3)	102.6 (19.0)	2.3 (-1.5; 6.0)	0.234	
Bayley-III Cognitive score at 1 year old	112.0 (10.9)	113.6 (9.6)	1.5 (0.20; 2.84)	0.024	0.15
Bayley-III Motor score at 1 year old	102.3 (9.6)	103.5 (9.1)	1.13 (-0.05; 2.32)	0.060	
Bayley-III Language at 1 year old	97.3 (9.1)	98.4 (9.1)	1.03 (-0.14; 2.21)	0.086	

Bayley-III Social-emotional score at 1 year old	96.1 (19.7)	99.4 (19.3)	2.7 (-0.28; 5.84)	0.075	
HAZ at 1 year old	-0.5 (1.0)	-0.5 (0.9)	-0.01 (-0.13; 0.12)	0.980	
Stunting (HAZ < -2) at 1 year old	36 (7%)	34 (6%)	0.79 (0.44; 1.41)	0.431	
HAZ at 2 years old	-0.65 (1.0)	-0.72 (0.9)	-0.06 (-0.19; 0.06)	0.311	
Stunting (HAZ < -2) at 2 years old	40 (8%)	51 (9%)	1.16 (0.76; 1.79)	0.489	
WAZ at 1 year old	-0.27 (1.0)	-0.28 (1.0)	-0.02 (-0.13; 0.10)	0.777	
Underweight (WAZ < -2) at 1 year old	23 (4%)	20 (4%)	0.76 (0.41; 1.42)	0.390	
WAZ at 2 years old	-0.42 (0.9)	-0.42 (0.9)	0.01 (-0.10; 0.12)	0.850	
Underweight (WAZ < -2) at 2 years old	23 (5%)	24 (3%)	0.54 (0.27; 1.06)	0.072	
WHZ at 1 year old	-0.03 (1.0)	-0.05 (1.0)	-0.02 (-0.14; 0.10)	0.760	
Wasting (WHZ < -2) at 1 year old	7 (1%)	14 (2%)	1.8 (0.71; 4.48)	0.211	
WHZ at 2 years old	-0.16 (0.9)	-0.09 (0.9)	0.06 (-0.06; 0.19)	0.314	
Wasting (WHZ < -2) at 2 years old	7 (1%)	7 (1%)	0.90 (0.31; 2.56)	0.846	
HOME Inventory total score at 2 years old^(b)	34.4 (4.2)	36.5 (4.1)	1.94 (1.09; 2.79)	<0.001	0.45
HOME Inventory Responsivity Subscale	9.1 (1.6)	9.8 (1.5)	0.63 (0.26; 1.02)	0.001	0.40
HOME Inventory Acceptance Subscale	6.8 (0.8)	6.7 (0.8)	-0.07 (-0.23; 0.08)	0.367	
HOME Inventory Organization Subscale	5.5 (0.7)	5.5 (0.7)	-0.01 (-0.16; 0.13)	0.853	

HOME Inventory Learning Materials Subscale	5.9 (1.8)	6.6 (1.7)	0.62 (0.32; 0.92)	<0.001	0.34
HOME Inventory Involvement Subscale	4.3 (1)	4.7 (1)	0.30 (0.10; 0.51)	0.003	0.29
HOME Inventory Variety Subscale	2.8 (1.1)	3.3 (1.2)	0.51 (0.26; 0.76)	<0.001	0.43

^(a)Cluster-effects were taken into account, OR's are in plain text and mean differences are italicised; ^(b)143 cases missing; ^(c) calculated for significant coefficients only; HAZ: Height-for-age z-score; WAZ: Weight-for-age z-score; WHZ: Weight-for-height z-score; HOME: Home Observation for Measurement of the Environment; DASS-V: Depression Anxiety and Stress Scale 21 items, Vietnam Validation

Mediation effects

The structural equation model (Supplementary Supplement Table 5) fits the data well. ~~Effects of the intervention on the developmental outcomes could not be attributed to individual mediators. The indirect effects of the intervention on each of the child development outcomes through the mediators were not found to be statistically significant. There were effects of the intervention on the developmental outcomes, but these could not be attributed to individual mediators.~~

Ancillary analyses

We ~~compared~~ ~~examined~~ ~~differences~~ ~~in~~ indicators of stage-specific behaviours, knowledge, and experiences at each ~~of the~~ follow up assessments ~~and report these in and report these in Supplementary Supplement~~ Table 6.

More women in the intervention arm ~~used~~ ~~were~~ ~~using~~ recommended pregnancy care and were aware of risks to pregnancy health and signs to seek emergency healthcare. More adhered to pregnancy nutrition recommendations about volume and variety of foods and use of micronutrient supplements. More gave birth by caesarean, but their babies were healthier, with less jaundice. Differences favouring the intervention were found in immunisation rates, home hygiene practices, awareness of the benefits to the baby of living in a clean environment and confidence in first aid skills. There were however no differences in prevalence of childhood illness symptoms among six- or twelve-month old infants.

~~The~~ Learning Clubs ~~intervention~~ had a significant impact on ~~the~~ children's home environments and the caregiving milieu. More parents were sensitive to their infant's developmental needs for soothing, and age-appropriate cognitive stimulation, and engaged in responsive and mutually pleasurable social exchanges. More children were given cognitively stimulating activities, play materials and opportunities to explore. These differences between trial arms were apparent when the children were aged one, and, despite the program being completed at that age, the differences in caregiving and the home environment were maintained and increased in being more responsive, in the child's second year ~~of life~~.

Discussion

We found that two-year old children in rural Vietnam whose mothers had participated in Learning Clubs from pregnancy through the first postpartum year had statistically significantly better cognitive, language and motor development than children of mothers who had received usual care. Cognitive development of the whole population of children in the Learning Clubs trial arm was at the standardised mean compared to those in the usual ~~care~~ arm where it was 0.26 SD below. ~~SA~~ similar but slightly smaller effects ~~were~~ ~~as~~ found for ~~the~~ language and motor ~~development~~ domains. Social-emotional development also appeared to have benefited ~~from the intervention~~, but the difference was not statistically significant. This indicator relies on parent report rather than direct observation and is ~~therefore~~ vulnerable to social desirability bias, which might have diminished between group differences. We had estimated that 15% of two-year-olds in the control ~~group~~, and 8% in the intervention group would have Bayley-III scores <-1SD but overall prevalence of this indicator at trial endline was lower. The difference between trial arms in Bayley-III <-1SD favoured the intervention but was not statistically significant and it is probable that the trial was underpowered to detect a difference between groups at this lower prevalence.

Most trials of interventions in LMICs to improve ~~the~~ cognitive development ~~among~~ ~~of~~ very young children assessed outcomes with Bayley-III, but ~~most~~ ~~most~~ findings were presented as raw¹¹ or scaled^{12,14} rather than composite scores, limiting direct comparisons. Yousafzai et al (2014) reported that ~~at~~ ~~24~~ ~~month~~ ~~olds~~ children in the responsive stimulation group had mean Bayley-III Composite Cognitive scores of 81.7(14.7) and in the control 74.1(13.5). The mean difference and effect size (0.6)

390 were larger than we found, but the mean scores were more than a standard deviation
391 lower than the standardised mean.

392

393 **Are the differences meaningful and likely to last?**

394 ~~In Cohort studies in high-income-country cohort studies, we have found that~~ cognitive
395 capacities ~~at two in the first two years of life~~ are stable and predict intellectual
396 capabilities in late childhood^{30,31} and young adulthood.³²

397

398 One LMIC cohort has been followed long term. Participants (~~all~~ severely malnourished
399 at inception) in the Jamaica study were ~~re-assessed followed~~ (without further
400 intervention) ~~up~~ at the ages of 5, 12,³³ 17,^{34,35} 22,³⁶ and 31 years.³⁴ When aged 22,
401 the ~~group that had received~~ responsive stimulation ~~group~~ had higher IQs and
402 educational achievements, better general knowledge, ~~fewer symptoms of depression~~
403 ~~and social shyness and~~ were less likely to perpetrate violence ~~and had fewer~~
404 ~~symptoms of depression and social shyness~~. At age 31 ~~statistically~~ significant
405 differences favouring the intervention group were still found in IQ (mean difference of
406 5.98 points on Wechsler Adult Intelligence Full Scale scores). They also had
407 ~~statistically significantly~~ better executive function, fewer depressive symptoms, ~~risk-~~
408 ~~taking behaviours or substance use problems~~, higher self-esteem, ~~were more~~
409 ~~conscientious and were more conscientious~~ ~~had fewer risk-taking behaviours or~~
410 ~~substance use problems~~.

411

412 The impact on ~~future~~ lifetime wages of ~~improvements improved in the~~ cognitive abilities
413 ~~among of~~ young children ~~was~~ ~~ere~~ ~~modelled~~ ~~estimated~~ in the ~~Kenya parenting~~
414 ~~intervention~~ ~~trialled in Kenya~~.³⁷ ~~They calculated that~~ ~~A~~ one SD increase in cognitive
415 scores at age two ~~was is associated with~~ ~~estimated to be associated with~~ 39.7%
416 increase in adult annual wages, ~~and concluded that~~ ~~L~~ long-term program benefits
417 could outweigh associated costs ~~15-fold by a factor of 15~~.³⁷ ~~Together~~ these indicate
418 that improvements in cognitive development in early life have lasting benefits ~~through~~
419 ~~for~~ the ~~subsequent~~ life course,³⁸ but mechanisms ~~of effect~~ are less clear.

420

421 The World Health Organization's Nurturing Care Framework for Early Childhood
422 Development

423 (<https://apps.who.int/iris/bitstream/handle/10665/272603/9789241514064-eng.pdf>)

424 was launched in May 2018 after this trial was initiated. The trial has nevertheless
425 demonstrated how, in a resource-constrained country, each of the Framework's
426 dimensions ~~:- nutrition, health, responsive care, safety and security, and early learning~~
427 ~~opportunities~~ can be addressed in a structured multi-component psycho-educational
428 intervention for community groups facilitated by trained lay-workers.

429

430 **Nutrition**

431 More women in the intervention arm adhered to pregnancy nutrition
432 recommendations, but this behaviour change was not reflected in ~~between-group~~
433 differences in prevalence of iron, or iodine deficiencies or body mass, or ~~on~~ the
434 birthweight of babies ~~between groups~~. On average women's early pregnancy body
435 mass index, 21.1kg/m² was higher than the 19.9 kg/m² we found six years earlier in
436 ~~HaNam~~ ~~this province~~. Similarly, ~~A~~ average birthweight (3226 grams) was ~~also~~ higher
437 (3150 gram)⁻¹⁹ indicating that population ~~-~~ level maternal nutrition had improved in the
438 province.

439

440 Most women were using iodised salt in daily cooking ~~almost daily~~, but almost all were
441 iodine deficient in late pregnancy. Vietnam's salt iodisation program faltered with
442 cessation of government support in 2005. Median late ~~pregnancy~~ urinary iodine
443 concentration (63.6-µg/l) was lower than the 70-µg/l we had found in HaNam in 2011.²¹
444 A higher proportion (90.9%) had a urinary iodine concentration lower than WHO's
445 recommendation than ~~we found~~ in 2011 (82.6%) indicating that iodine deficiency is
446 pervasive and probably preceded pregnancy.

447
448 Vietnam is committed to promoting breastfeeding, with legislation³⁹ to prohibit
449 advertising and distribution of infant formula samples, but implementation is weak.
450 While more newborns in the intervention arm had received breastmilk as the first food
451 and been breastfed within an hour of birth, over one third were given infant formula in
452 hospital. Fewer babies were receiving any formula one week after birth, more were
453 predominantly breastfed in the first six months postpartum, and solid foods were
454 introduced later in the intervention than the control group.

455
456 ~~At age 12 months~~ More mothers were aware of appropriate infant feeding, but this
457 did not influence child growth, with similar proportions of children in each group being
458 underweight, wasted, and stunted. HaNam ~~Province's~~ economy is growing rapidly.
459 Fewer families are experiencing absolute poverty. However, despite recognising ~~the~~
460 need, some families are ~~still~~ unable to provide sufficient nutritious food for their
461 children.

462 **Health**

463
464 Some ~~indicators of~~ maternal and infant health indicators and protective health
465 behaviours were statistically significantly better in the intervention than the control
466 arm, but this was not reflected in lower illness rates among children.

467
468 The mental health of women who are pregnant or caring for young children influences
469 their capacities for self-care, social and economic participation, and provision of
470 nurturing care. We had postulated that by increasing parenting capabilities,
471 confidence, and gender equity, and reducing intimate partner violence, ~~prevalence of~~
472 symptoms of mental health problems would be lower among women in the intervention
473 than the control arm, but these were not.

474
475 We have formally validated the Depression, Anxiety and Stress Scale against the gold
476 standard of psychiatrist-administered diagnostic interviews to establish clinical cut-off
477 scores for Vietnam.⁴⁰ However, we have not established its sensitivity to change and
478 it is possible that relevant changes were not detected. At endline a very high proportion
479 scored zero, an unusual outcome, and we are uncertain whether this is a true reflection
480 of women's mental health or reflects testing fatigue.

481 **Responsive care and opportunities for early learning**

482
483 Despite the lack of discernible effect on women's experiences of depression or
484 anxiety, there was promising evidence of ~~significant~~ impact on other psychological
485 dimensions, in particular, sensitive, and responsive maternal caregiving from late
486 pregnancy. In the intervention arm, statistically significantly more women talked or
487 played music to the foetus; talked and showed things to, bathed, and soothed their
488 newborns; engaged in stimulating activities like play with homemade toys, reading
489 books, taking the baby outside, talking and singing, and mimicking the facial

490 expressions and sounds of their infants. In this arm more fathers showed affection to,
491 provided care for, and engaged in cognitively stimulating play with their babies.
492 Together these demonstrate that positive parenting behaviours are not merely a
493 reflection of mental health and are modifiable independent of mood or anxiety in ways
494 that improve young children's early experiences and development.

495

496 **Safety, security, and gender empowerment**

497 Promoting gender empowerment and reducing gender-based violence were key
498 program components. Prenatal involvement is among the strongest predictors of
499 paternal engagement when children are five.⁴¹ Father care, play and communication
500 in the first two years improve language and cognitive development, self-esteem and
501 social competence and reduce maladaptive behaviours among primary-school
502 children.⁴² Changes in men's involvement in family life are yet to occur in most LMICs,
503 attributed to traditional beliefs that pregnancy and birth are quintessentially feminine
504 activities, and that men cannot care for young children.⁴³

505

506 The Learning Clubs intervention took a rights-based approach. It emphasised the
507 benefits to women's health of a relationship with the intimate partner characterised by
508 commitment to the pregnancy, and later, the infant, and kindness, affection and trust,
509 and the harms of criticism, coercive control, threats, and violence. Similarly, the
510 benefits to infant health and growth of experiencing sensitive, responsive care from
511 both parents and the harms of witnessing or experiencing violence were ~~presented~~
512 ~~and~~ discussed. Women's husbands were invited to all Learning Clubs meetings. There
513 was explicit training for facilitators in inclusive approaches, and in strategies for
514 increasing empathy, non-adversarial problem solving and fair sharing of ~~unpaid the~~
515 ~~work of infant care and household tasks~~. These appear to have been effective in
516 increasing gender equity as reflected in men's ~~participation in sharing of~~ household
517 work and ~~active participation in infant~~ care ~~of the baby~~ in the early weeks, and six and
518 twelve months postpartum.

519

520 However, they ~~were appear to have been~~ insufficient to reduce controlling behaviours,
521 or emotional, physical, or sexual abuse perpetrated by some men against their wives.
522 The average prevalence of experiencing any form of abuse during pregnancy (14%)
523 was ~~similar to like~~ the 15% found in a 2021 cohort study of 150 women in Hue City,
524 and within the range of 6% to 33% found in a systematic review of eight Vietnam
525 studies.⁴⁴

526

527 In 2019, implementation of ~~laws on~~ gender equality and ~~violence~~ elimination ~~laws of~~
528 ~~violence~~ was found to be poorly co-ordinated among departments, ~~with inadequate~~
529 budgetary ~~allocation or support was inadequate and~~ support systems for violent
530 victimisation ~~had not been developed~~.⁴⁵ Nevertheless, in secondary analyses of data
531 collected using identical surveys in HaNam we found that women reported ~~statistically~~
532 significantly lower levels of coercive control in 2010 than in 2006.⁴⁶ Vietnam's
533 Women's Union has a core responsibility to operationalise these laws, promote gender
534 equality, and protect women and children from domestic abuse. In HaNam the
535 Women's Union runs community-wide family education programs about the harms of
536 violence, including one that coincided with this trial. Learning Clubs facilitators were
537 members of the Women's Union. These suggest that local policy and social contexts
538 in which family violence is not condoned, ~~might have~~ ~~led to been influential in~~

539 reductions ~~in~~ing these harmful behaviours in the community and ~~might~~, through the
540 coincidental program, have eliminated differences between ~~the two~~-trial armsgroups.

541
542 We were surprised that children in the intervention arm were more likely to experience
543 ~~the risks of touch~~ing dangerous objects or ~~be~~ing left (probably in the care of an older
544 child) without adult supervision. While this requires further investigation, we speculate
545 that parents experience children who have had the development-promoting benefits
546 of the program, as ~~be~~ing interested and inquisitive, but also ~~as~~-capable and
547 independent.

548 549 **Approach**

550 There ~~is has been~~ uncertainty about whether interventions for early childhood
551 development in resource-constrained settings are as effective when delivered in
552 facilitated groups ~~as or~~ home visits. }Grantham-McGregor et al.⁴⁷ compared home
553 visit and group delivery modes for a nutrition plus or minus play education program, in
554 a cluster RCT in Odisha, India. ~~There were no differences in impact, but G~~groups
555 were ~~much~~ more cost effective than home visits without differences in impact.
556 Women's preferences were not ascertained, but Grantham-McGregor concluded that
557 ~~in addition to cost benefits~~, there were additional benefits of social support and shared
558 problem solving in group approaches
559 (Please see Supplement for a more detailed discussion of potentially influential policy
560 contexts ~~which might have influenced these findings~~ and (dis-)similarities to prior
561 research).

562 563 **Summary**

564 The Learning Clubs program which began in mid-pregnancy and continued until
565 children were aged onetwelve months old, had substantial meaningful population-level
566 benefits for early childhood development sustained to at least 24 months.
567 Improvements in the home environment and responsive parental caregiving were
568 influential. ~~We could not detect S~~specific independent contributions of improved
569 nutrition, especially breastfeeding, positive health behaviours, and increased gender
570 equity were not detected but it is probable that these interacted to influence the
571 outcome. The program was however insufficient to influence iron or iodine deficiencies
572 experienced by women and infants, stunting, and wasting among young children, or
573 perpetration of intimate partner violence against women. Micronutrient deficiencies are
574 an obdurate problem that can be addressed effectively with sustained whole-of
575 population-wide supplementation, ~~but this has to be sustained~~.⁴⁸ Program impact
576 might be greater in settings where ~~the~~ local infrastructure and services are weaker and
577 needs for caregiving knowledge and parenting skills are even higher than in HaNam
578 Province.

579 580 **Strengths and limitations**

581 Trial strengths are that communes, the clustering unit, were selected randomly from
582 the provincial list, and then allocated randomly to trial arms by an independent
583 statistician; recruitment and retention rates were high; ~~the~~ standardised data sources
584 were translated, culturally verified, and formally validated for Vietnam; all assessors
585 were blind to trial arm allocation, and the study was adequately powered to detect
586 differences between groups in ~~all~~ outcomes. Unusually, wWe report post-intervention
587 HOME inventories, ~~which is uncommon~~.¹¹ There were no ~~baseline~~ differences in
588 baseline participant characteristics between ~~trial~~ arms. The Learning Clubs

589 intervention is manualised, with facilitator materials, a tiered training program for
590 provincial trainers and community-based facilitators and readily replicated. All
591 recommended parenting education approaches ~~awere~~ used.^{2,49}

592
593 We acknowledge the limitations that the Bayley-III has not been formally validated
594 against blinded neurodevelopmental assessments in Vietnam and that pandemic
595 restrictions limited ~~how many the numbers of~~ people ~~who~~ could visit a ~~household~~
596 for the HOME inventory assessments so ~~that~~ inter-rater reliability could not be
597 established. We acknowledge potential for social desirability, selection,
598 misclassification, and missing data biases, but sought to mitigate these, and do not
599 believe they influenced the findings (see Supplement). We also acknowledge that
600 factors beyond researcher control, specifically that six communes, including ~~those~~
601 from different trial arms were merged administratively, and that a province-wide
602 domestic violence reduction program was implemented during the trial. These might
603 have reduced differences in participant experiences between trial arms.

604 **Implications for public policies**

605 Policies about hunger eradication, poverty reduction, and to counter intimate partner
606 violence were operationalised in the last ten years.⁴⁶ Women's mental health and
607 nutritional status were better, infant birthweight was higher and prevalence of gender-
608 based violence was lower than we had found in this province five to ten years earlier,
609 indicating that independent of the trial, these policies had a beneficial impact on these
610 aspects of population health.

611
612 These ~~findings~~ suggest that the policy context is highly relevant to ~~strategies to~~
613 ~~improvements in~~ women's health and early childhood development and needs to be
614 optimised and implemented effectively alongside evidence-informed, local programs.

615 **Implications for future research**

616
617 Questions arise ~~from this study~~ that warrant further research. Investigation of which
618 program components are the most effective, what minimal 'dose' might be sufficient
619 and whether alternative methods of delivery, including online, ~~workare needed~~.
620 Potential harms including developmentally inappropriate expectations associated with
621 children's increased capacities ~~require warrant further~~ investigation. Although nutrition
622 education improved parent knowledge, ~~strategies to elimination of~~ micronutrient
623 deficiencies, stunting and wasting appear to require supplementation, but the most
624 effective and cost-effective resourcing and distribution methods ~~have to must~~ be
625 established. Sustainability of the benefits of this program through childhood and
626 adolescence can be examined with follow-up studies, including of this well
627 characterised cohort.

628
629 We sought to modify eight risks to early childhood development at population level.
630 The structural equation models indicate that it is the integrated content, delivery
631 method and duration of the program, rather than specific sub-components, that was
632 influential. Together these findings indicate that structured, multicomponent universal
633 programs and public policies, including those beyond the health sector, can address
634 caregiver needs and improve early childhood development in resource-constrained
635 settings in the first 1000 days from conception when care is most usually provided at
636 home. The Learning Clubs program is readily applicable to other resource-constrained
637 settings. The Learning Clubs program is readily applicable to other resource-constrained
638 settings.

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654 program, and conducted the facilitator training. We appreciate the work of the HaNam
655 Provincial Centre for Disease Control who collected the data and the staff from the
656 Green Pine Clinic who conducted child development assessments. The work of the
657 national and provincial trainers, and the community members who reviewed program
658 content was invaluable. We appreciate the expertise and time of the Data Safety
659 Monitoring Board. Finally, we very much appreciate the time and commitment of all
660 the facilitators and the participants.

661

662 **Authors' contributions**

663 JF, ThaT, HT, SL, DH, HS, JS, SH, BAB and TuT secured funding and contributed to
664 the conceptual framework and the study design. HT led the implementation of the
665 program in the intervention communes in HaNam Province. ThuT, TuT oversaw data
666 collection. HN and ThuT managed the data. ThaT and HN conducted analyses. JF
667 prepared the first draft. ThaT, SL, DH, JS, and BAB contributed to revisions. All
668 authors reviewed and agreed on the content of the final submitted version. JF, ThaT,
669 HN, and ThuT have accessed and verified the data. JF and ThaT were responsible for
670 the decision to submit the manuscript.

671

672 **Competing interests**

673 None declared.

674

675 **Availability of data and material**

676 The data, analytic methods (code) used in the analysis, and materials used to conduct
677 the research will be made available under a datasharing agreement to any researcher
678 for purposes of reproducing the results or replicating the procedure on request to the
679 corresponding author.

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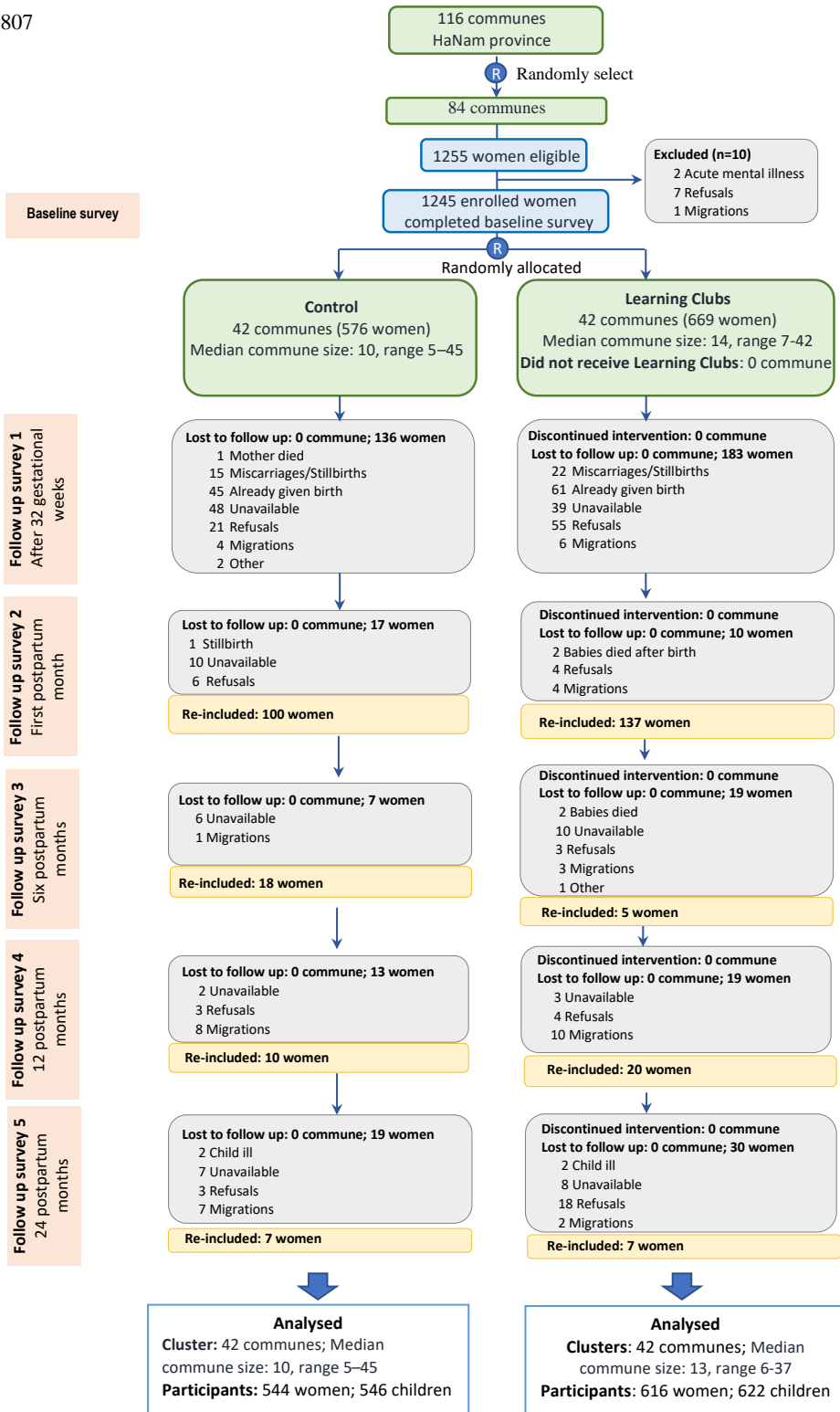


Figure 1 Trial profile

