Women's groups practising participatory learning and action to improve maternal and newborn health in low-resource settings: a systematic review and meta-analysis

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Summary

Background—Maternal and neonatal mortality rates remain high in many low-income and middle-income countries. Different approaches for the improvement of birth outcomes have been used in community-based interventions, with heterogeneous effects on survival. We assessed the effects of women's groups practising participatory learning and action, compared with usual care, on birth outcomes in low-resource settings.

Methods—We did a systematic review and meta-analysis of randomised controlled trials undertaken in Bangladesh, India, Malawi, and Nepal in which the effects of women's groups practising participatory learning and action were assessed to identify population-level predictors of effect on maternal mortality, neonatal mortality, and stillbirths. We also reviewed the cost-effectiveness of the women's group intervention and estimated its potential effect at scale in Countdown countries.

Findings—Seven trials (119 428 births) met the inclusion criteria. Meta-analyses of all trials showed that exposure to women's groups was associated with a 37% reduction in maternal mortality (odds ratio 0·63, 95% CI 0·32–0·94), a 23% reduction in neonatal mortality (0·77, 0·65–

0·90), and a 9% non-significant reduction in stillbirths (0·91, 0·79–1·03), with high heterogeneity for maternal (I^2=58·8%, p=0·024) and neonatal results (I^2=64·7%, p=0·009). In the meta-regression analyses, the proportion of pregnant women in groups was linearly associated with reduction in both maternal and neonatal mortality (p=0·026 and p=0·011, respectively). A subgroup analysis of the four studies in which at least 30% of pregnant women participated in groups showed a 55% reduction in maternal mortality (0·45, 0·17–0·73) and a 33% reduction in neonatal mortality (0·67, 0·59–0·74). The intervention was cost effective by WHO standards and could save an estimated 283 000 newborn infants and 41 100 mothers per year if implemented in rural areas of 74 Countdown countries.

Interpretation—With the participation of at least a third of pregnant women and adequate population coverage, women's groups practising participatory learning and action are a cost-effective strategy to improve maternal and neonatal survival in low-resource settings.

Introduction

Between 1990 and 2010, substantial improvements were noted in maternal and child survival—maternal mortality decreased by 47% and the mortality in children younger than 5 years fell by 37%.[1] However, in 2011, an estimated 273 465 mothers died from complications of pregnancy and childbirth and 2·9 million infants did not survive the first month of life, representing 43% of all deaths in children younger than 5 years.[2,3] Achievement of the Millennium Development Goals 4 and 5 requires a doubling of the reduction in maternal mortality ratio and a renewed focus on neonatal survival.[2] Community-based interventions are crucial for the attainment of these goals.[4]

In a systematic review and meta-analysis of community-based intervention studies, reductions were noted in the neonatal mortality (12 studies, risk ratio 0·76, 95% CI 0·68–0·84), but the evidence of reductions in maternal mortality was inconclusive (ten studies, 0·77, 0·59–1·02).[5] This and other reviews included different approaches to community interventions,[6,7] and the policy implications of their findings are uncertain. One approach involved home visits to counsel mothers, provide newborn care, and facilitate referral.[8,9] Another involved home-based counselling combined with community activities to improve newborn care.[10,11]

A third approach involved women's groups in a four-phase participatory learning and action cycle. Phase 1 was to identify and prioritise problems during pregnancy, delivery, and post partum; phase 2 was to plan and phase 3 implement locally feasible strategies to address the priority problems; phase 4 was to assess their activities.[12–14] Women's groups aimed to increase appropriate care-seeking (including antenatal care and institutional delivery) and appropriate home prevention and care practices for mothers and newborns. The women's group approach was inspired by a commitment to the participation of people in health care after Alma Ata. It also drew on Paolo Freire's work, which provided insights applicable to health: many health problems are rooted in powerlessness, and would be addressed by social and political empowerment; health education is more empowering if it involves dialogue and problem solving, rather than message giving; communities can develop critical consciousness to recognise and address the underlying social and political determinants of health.[15,16] For example, where gender inequity constrains improvements in maternal survival, empowered groups could give women the understanding, confidence, and support to choose a healthy diet in pregnancy, and seek care or advice outside of their homes.

The effects of the different approaches for the improvement of birth outcomes need to be reviewed and population-level predictors of the effects need to be identified to guide policy and practice. We therefore did a systematic review of randomised controlled trials to assess the effect of women's groups practising participatory learning and action. Our objectives were to ascertain the effects of these groups, compared with usual care, on maternal mortality, neonatal mortality, and stillbirths in low-resource settings. We did a meta-analysis of the data retrieved in the systematic review, investigated potential population-level predictors of effect, assessed cost-effectiveness, and estimated how many lives could be saved if the approach was scaled up in the Countdown countries.

Methods

Systematic review

AW and CMa searched databases for literature about interventions with participatory women's groups in low-income and middle-income countries: PubMed, Embase, Cochrane library, CINAHL, African Index Medicus, Web of Science, the Reproductive Health Library, and the Science Citation Index, using the inception date for each database and Oct 13, 2012, as inclusion dates. Search terms were a combination of "community mobilisation", "community participation", "participatory action", "participatory learning and action*", "women* group*", and "women" (appendix p 1). No language restrictions were applied. AW and CMa also sought unpublished data from researchers who were known to be active in this specialty.

Figure 1 summarises the study selection process. AW and CMa reviewed the results of the electronic searches and acquired electronic reports of published studies, and manuscripts of unpublished studies from the respective investigators. AW and CMa made the final decisions about the inclusion or exclusion of reports or manuscripts separately after inspection, and then independently extracted data for the characteristics, quality, and outcomes of each study. Together, the reviewers checked and verified these data. Investigators for the primary studies were contacted for clarification if there were discrepancies in the extracted data.

The four criteria for inclusion of the studies in the systematic review were that they were randomised controlled trials; the intervention contained the stages of a participatory learning and action cycle; most of the participants were women of reproductive age (15–49 years); and the study outcomes included maternal mortality, neonatal mortality, and stillbirths. AW and CMa independently assessed the studies for quality using the CONSORT statement extension for cluster-randomised controlled trials,[17] and risk of bias using the Cochrane Collaboration's tool.[18] The review protocol was not registered in any database.

Meta-analysis

NS and AP extracted study-specific odds or risk ratios for each outcome, using the main estimates reported in each study. These ratios accounted for clustering, stratification, and, where appropriate, adjustments for other covariates. We did not undertake data analysis of individual participants because of differences in methods to adjust for clustering and in the range of variables that were adjusted for in each study. When a required outcome was not reported in a study, we used methods identical to those reported in the original study to calculate an effect size from the trial datasets. We did a meta-analysis of the study-level data with the metan command in Stata (version 12.1) using random-effects models because we assumed that the effects seen in each trial were taken from an underlying distribution.

We planned a-priori meta-analyses to ascertain the effect of women's groups on maternal mortality, neonatal mortality, and stillbirths with all identified trials, followed by subgroup

analyses to identify population-level predictors of effect. We postulated that these might include the population coverage of women's groups, proportion of pregnant women participating, and background mortality and institutional delivery rates as measured in the control areas during the trials. In previous studies, the hypothesis was that having one women's group per 450–750 population and between 30% and 50% of pregnant women attending groups would be key determinants of effect.[14,19] We used meta-regression analysis[20] to assess whether each of the predictors was associated with intervention effects. When there was evidence of statistical heterogeneity ($I^2>50\%$, p<0·05), we separated the trials into groups according to the results of the meta-regression analyses. We assessed potential publication bias and small-study effects using funnel plots and Egger tests.[21]

Cost-effectiveness analysis

To compare the cost-effectiveness of the interventions, we used incremental cost-effectiveness ratios for trials in which significant effects on neonatal mortality rate were reported. We independently assessed the quality of the studies using guidelines adapted from Drummond and Jefferson.[22] In each trial, the economic costs of setting up and running the women's group intervention were gathered from the provider's perspective, using project accounts as the main data source. Costs linked to health-service strengthening, monitoring, and evaluation were excluded. Capital costs were annualised over the expected lifetime of the item and women's groups were allocated a share of any costs incurred jointly with other activities or programmes. We converted the reported US$ back into the local currency using the average exchange rate for that year, and used the local consumer price index to account for inflation in the interim period and calculate the value of the cost in 2011. Local currencies were then converted to international dollars using purchasing power parity conversion factors for 2011, creating ratios comparable across trials at a common timepoint. Cost-effectiveness is expressed as the incremental cost per neonatal death averted and life-year saved. Consistent with WHO-recommended methods, we classified each intervention as highly cost effective if it averted a year of life lost for less than the national gross domestic product (GDP) per person, cost effective if one-to-three times GDP per person, and not cost effective if greater than three times the GDP per person.[23]

Effect in Countdown countries

We estimated the effect of implementation of the intervention in rural areas of all Countdown countries.[1] Mortality rates for deliveries with and without skilled birth attendance (SBA) are very different, and many Countdown countries have higher rates of deliveries with SBA than do the study areas in the trials, so we could not ignore the difference between deliveries with and without SBA. Although the inter vention could reduce the mortality by increasing SBA deliveries or improving their outcomes, its largest effect seems to be on deliveries without SBA. Thus, in estimating the effect, we applied an overall risk ratio derived from the meta-analysis for rural trials in which a third or more of pregnant women participated in groups only to deaths in rural deliveries without SBA. We believe this method provides a conservative estimate of the effect that captures most of the intervention benefit.

We generated two estimates of effect: one in which we assumed that the intervention would have the same effect at scale as that from the meta-analysis of rural trials in which 30% or more of the pregnant women participated in groups, and another in which we assumed a 30% loss of effectiveness for implementation at scale. This estimate was intended to provide a conservative lower bound for effect (appendix pp 2–4 provides a detailed description of assumptions and methods).

Role of the funding source

The funders had no role in the design of the study, data gathering, analysis, interpretation, or writing up of the report. The corresponding author had access to all the data and had final responsibility for the decision to submit for publication.

Results

We found and analysed seven cluster, randomised controlled trials with a total of 119 428 births.[12–14,24–27] Table 1 summarises the characteristics of these trials. The studies were done between 1999 and 2011 in four countries: Bangladesh, India, Malawi, and Nepal.

In all trials, variants of a participatory learning and action cycle were tested. Women's group facilitators, all local women who were not health workers, coordinated between nine and 13 group meetings per month after receiving 7–11 days of basic training in maternal and newborn health and participatory facilitation techniques. In six of seven studies, women's groups had monthly meetings; in the urban trial,[24] groups met fortnightly. In all trials, both intervention and control clusters had context-specific health services strengthening (table 1).

Quality assessment and risk of bias appraisals for the seven trials included in the systematic review are described in appendix pp 5–8. The studies were of good quality and had low risk of bias, according to the standards of the CONSORT statement[17] and Cochrane Collaboration's tool[18] for assessing risk of bias in randomised trials, for all items except masking of participants, personnel, and outcome assessment. These shortcomings were due to the nature of the intervention and study designs. In all trials, analyses were by intention to treat—ie, data from all women who had recently delivered in a study cluster, whether they participated in a group or not, were included. According to the CONSORT statement, all trials had appropriate randomisation, accounted for the effect of clustering, and had no loss of clusters at follow-up. The panel shows the outcome definitions used, which were the same in all studies included in the systematic review and meta-analysis.

Figure 2 shows the forest plots for meta-analyses of the effects of women's groups on maternal and neonatal mortality in the seven trials. Exposure to women's groups was associated with a 37% reduction in maternal mortality (figure 2A) and a 23% reduction in neonatal mortality (figure 2B), but with high statistical heterogeneity (figure 2A, B). This heterogeneity warranted further exploration through meta-regression and subgroup analyses. There was no evidence of reduction in stillbirths (odds ratio 0·91, 95% CI 0·79–1·03, I^2=37·7%, p=0·141; appendix p 11). Appendix pp 12–14 show the effects on perinatal mortality, and early and late neonatal mortality rates. Funnel plots for all outcomes were broadly symmetric (appendix pp 14–15). Results of Egger tests suggested no evidence of publication or small-study bias for neonatal mortality (p=0·040), but there was some evidence of maternal mortality (p=0·059).

In all but one study,[26] the coverage of pregnant women in groups was calculated as the proportion of women who had delivered between 28 days and 8 weeks before the interview and reported ever attending a women's group, irrespective of the number of meetings attended. Results of meta-regression analyses indicated that the proportion of pregnant women participating in groups was linearly associated with reduction of both maternal and neonatal mortality (odds ratio −0·023, 95% CI −0·043 to −0·004, p=0·026; −0·008, −0·013 to −0·003, p=0·011, respectively; figure 3). We found no evidence of associations between intervention effects and background mortality or institutional delivery rates (appendix p 17), but did find evidence of an association between the size of the population covered by a women's group and neonatal mortality (0·0003, <0·0001 to 0·0005, p=0·042).

Since the proportion of pregnant women participating in groups was a key predictor of mortality reduction, for our subgroup analyses we separated the trials into categories of high (30% of pregnant women participating in women's groups) and low coverage (<30% participating). Figure 4 shows that in high-coverage studies (48 333 livebirths), exposure to women's groups was associated with a 55% reduction in maternal mortality (figure 4A) and a 33% reduction in neonatal mortality (figure 4B). No effects were noted in the low coverage studies for any of the birth outcomes.

Table 2 shows the behavioural mechanisms, based on reported data, through which the interventions might have affected birth outcomes. In three[12,13,27] of four[14] south Asian trials in which the behavioural mechanisms were reported, women's groups showed strong (including significant and non-significant) effects on clean delivery practices for home deliveries (especially handwashing and use of clean delivery kits), and noticeable effects on breastfeeding (table 2). Use of women's groups resulted in significant increases in the uptake of any antenatal care in two studies,[12,25] and institutional deliveries in one study (table 2).[12] The largest behavioural effects on mortality that were seen in the south Asian studies are likely to have been determined by changes in clean delivery practices for home deliveries and improved immediate postnatal care at home.

Each study had a process evaluation for the interventions, evidence from which enabled us to develop a working hypothesis about the way in which the women's groups bring about improvements in birth outcomes (appendix p 18): the intervention builds the capacities of communities to organise and mobilise to take individual, group, and community action to address the structural and intermediary determinants of health.[29–31]

Although the incremental cost per neonatal death averted differed widely between trials (table 3), according to WHO-recommended standards, women's groups practising participatory learning and action were a highly cost-effective intervention in these trials. Quality assessment for the four trials in table 3 is described in appendix p 19.

We applied the meta-analysis results from rural, high-coverage studies to deliveries in rural areas and without SBA in 74 of 75 Countdown countries. We estimate that the intervention could prevent the deaths of up to 58 800 mothers and 404 000 newborn infants per year if the effect was the same as in the high-coverage trials, and 41 100 mothers and 283 000 newborn infants per year with a 30% loss of efficacy through scale-up. These numbers correspond to upper and lower estimates of 13% and 9% for neonatal deaths and 21% and 15% for maternal deaths for delivery types and rural and urban regions. Appendix pp 20–21 shows the seven countries where the most maternal and newborn deaths would be saved, and those in which the most lives could be saved as a proportion of total deaths for each country. A scale-up of women's groups with adequate coverage in rural areas of two countries (India and Bangladesh) where they have already been tested and implementation guides exist[33] could prevent the deaths of about 130 000 newborn infants and 11 400 mothers, taking into account a 30% loss in effect through scale-up. Appendix pp 22–23 shows the estimated effect for each of the 74 Countdown countries.

Discussion

Women's groups practising participatory learning and action led to substantial reductions in neonatal and maternal mortalities in rural, low-resource settings. The proportion of pregnant women participating in groups and the population coverage of groups were key predictors of the effect. We included stillbirths as an outcome because we anticipated that an intervention that increased care-seeking and self-care for women during pregnancy might have an effect on stillbirths.

Our analysis has four important limitations. First, the systematic review and meta-analysis included only seven trials, thereby restricting our analyses of potential sources of heterogeneity and bias. More studies would have increased the accuracy of assessments of bias and enabled multivariate meta-regression analyses and analyses of non-linear associations. Second, the complex nature of the intervention means that the attribution of mortality reductions to discrete mechanisms is not straightforward. Many of the factors that might have been linked to reductions in maternal deaths—eg, increased awareness of danger signs and increased individual and community responsiveness to them—were not measured in impact evaluations. Contextual and implementation factors are likely to have altered the effect sizes, and need further cross-site analysis. Third, we were unable to undertake meta-regression analysis of individual participants because the trials adjusted for different sets of covariates and used a mix of individual-level and cluster-level analyses to address clustering. Individual patient data analysis would have allowed us to investigate sources of heterogeneity in more depth. Nevertheless, we think that our hypothesis linking pregnant women and population coverage to the effect of the intervention is both operationally plausible and supported by our meta-regression analyses. Last, the comparative cost-effectiveness analysis presented here constitutes only a starting point. Comparison of the determinants of differences in costs, or the effect of scale on cost, was not possible but they are a priority for future work.

The effect on neonatal mortality in the four high-coverage studies was greater than the overall pooled effect for all community trials analysed in a recent Cochrane review (odds ratio 0·76, 95% CI 0·68–0·84).[5] This result is not unexpected because the interventions aggregated were very different (training of birth attendants, health education, and home visits) and the studies had high heterogeneity (I^2=69%, p=0·0001). The effect on neonatal mortality is inferior to that in the most intensive home-based newborn-care programme,[8] but similar to effect sizes in the less intensive home visits trials.[9] When extrapolated to rural areas of Countdown countries, the overall effect of the women's group intervention compares well with others. For example, according to the results of a 2011 study, broad coverage of basic and comprehensive emergency obstetric care could prevent an estimated 591 000 neonatal deaths per year.[34] By comparison, we estimate that the women's group intervention could save 283 000 lives (assuming no effect on deliveries attended by SBA) and might be easier to implement where health services are weak. A reasonable assumption is that where SBA delivery rates in rural regions are high, the participatory learning and action cycle could have an effect on birth outcomes following SBA deliveries too. In this case, the effect for such countries could be higher than the estimate in appendix pp 22–23.

The results of our study raise three important issues. First, is the potential of community-based, participatory interventions to reduce maternal mortality. The only intervention found to affect maternal mortality so far has been training of birth attendants with antenatal and intrapartum home visits (relative risk 0·70, 95% CI 0·51–0·96).[5] For women's groups, we hypothesise that reduction of maternal mortality might be driven by reduced infection through improved uptake of antenatal care and hygiene during delivery, and small changes in the rapidity of response and care-seeking that make the difference for survival. This last hypothesis is supported by data for the process evaluation that showed that groups discussed danger signs, raised community-wide support for maternal health, organised transport for pregnant women, and contributed to emergency funds for transport and health-care costs.[35–37] However, the reduction seen in the high-coverage studies is large and included two trials that had populations of less than 200 000.[12,25] Therefore, even with adequate coverage of pregnant women, it is plausible that effects at scale would be smaller than those in the subgroup analysis for high-coverage interventions.

Second, the results of the analysis raise the question of whether participatory learning and action have a role in maternal and newborn health in urban contexts. Rates of antenatal care and institutional delivery tend to be higher in cities, delays in care-seeking shorter, and mortality rates lower, making them potentially less amenable to non-clinical interventions. There is an argument for focusing on improved links between communities and facilities, and on the quality of clinical care.[24] Collective action could be instrumental in achieving these objectives, but might require moving beyond women's groups as the main agents of change if urban women are more isolated and reluctant to commit to group action.

Last, we should consider how community strategies that were shown to be effective in small-to-mediumsized trials, including home visits and collective action through women's groups, could be combined at scale. Using participatory women's groups as a community engagement strategy for maternal and newborn health alongside other evidence-based strategies, including home visits, could alter both the demand and supply side of health care. An intervention from Pakistan combined meetings with women's groups and home visits led to a large improvement in newborn survival within existing health system structures.[11] Can models now be taken to scale and fully integrated within health systems?

With the participation of at least a third of pregnant women and population coverage of 450–750 per group, women's groups practising participatory learning action are a cost-effective strategy to improve maternal and neonatal survival in resource-poor settings. Their implementation in rural areas of Countdown countries could save many lives. In these settings, policy makers should consider women's groups as a core strategy complement efforts made to improve safer motherhood and newborn care through better midwifery obstetric care.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Footnotes

Acknowledgments

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Panel: Definitions[28]

- Miscarriage: cessation of a presumptive pregnancy before delivery of the baby's head at less than 22 weeks of gestation.

- Neonatal death: death of a liveborn infant within 28 completed days of birth.

- Early neonatal death: deaths arising within 6 completed days of birth.

- Late neonatal death: deaths arising from 7 to 28 completed days of birth.

- Stillbirth: the International Classification of Diseases and Related Health Problems, 10th revision, defines fetal death as "death prior to the complete expulsion or extraction from its mother of a product of conception, irrespective of the duration of pregnancy". In all studies included in the systematic review, stillbirths were classified on the basis of verbal autopsies in which no sign of breathing, heartbeat, or any other evidence of life was reported at birth.

- Perinatal death: a stillbirth or early neonatal death.

- Maternal death: death of a woman while pregnant or within 42 days of cessation of pregnancy from any cause related to the pregnancy or its management, but not from accidental causes.

Figure 1. Flow chart of the study selection process

A

	Years	Livebirths in intervention group	Deaths in intervention group	Livebirths in intervention group	Deaths in control group	Livebirths in control group	Percentage of pregnant women attending groups (numerator/denominator)	Population per group	Percentage of institutional deliveries in control group	Control maternal mortality ratio		Odds ratio (95% CI)	Percentage weight
Colbourn et al,[26] 2013 (Malawi)	2008–10	19986	22	10055	25	9931	10 (estimated)	1200	67	251·7		0·91 (0·51–1·63)	14·77
More et al,[24] 2012 (India)	2006–09	15703	15	7944	16	7759	2 (118/5996)	788	87	206·2		1·41 (0·51–3·87)	3·03
Azad et al,[14] 2010 (Bangladesh)	2005–07	29889	55	15153	32	14736	3 (477/15695)	1414	16	217·2		1·74 (0·97–3·13)	6·38
Fottrell et al,[27] 2013 (Bangladesh)	2009–11	17421	14	8819	23	8602	36 (3326/9109)	309	27	255·8		0·74 (0·34–1·64)	12·64
Manandhar et al,[12] 2004 (Nepal)	2001–03	6125	2	2899	11	3226	37 (1123/3036)	756	2	341		0·20 (0·04–0·91)	18·27
Tripathy et al,[13] 2010 (India)	2005–08	18449	49	9469	60	8980	37 (3544/9577)	468	20	668·2		0·70 (0·46–1·07)	22·38
Lewycka et al,[25] 2013 (Malawi)	2006–09	6338	5	3074	23	3264	51 (1273/2503)	440	47	705		0·26 (0·10–0·70)	22·53
Overall (I^2=58·8%, p=0·024)												0·63 (0·32–0·94)	100·00

0·03 1·0 3·9

B

	Years	Livebirths in intervention group	Deaths in intervention group	Livebirths in intervention group	Deaths in control group	Livebirths in control group	Percentage of pregnant women attending groups (numerator/denominator)	Population per group	Percentage of institutional deliveries in control group	Control neonatal mortality rate		Odds ratio (95% CI)	Percentage weight
Colbourn et al,[26] 2013 (Malawi)	2008–10	19986	286	10055	308	9931	10 (estimated)	1200	67	31·0		0·90 (0·75–1·09)	16·84
More et al,[24] 2012 (India)	2006–09	15703	132	7944	88	7759	2 (118/5996)	788	87	11·3		1·42 (0·99–2·04)	4·59
Azad et al,[14] 2010 (Bangladesh)	2005–07	29889	515	15153	557	14736	3 (477/15695)	1414	16	37·7		0·90 (0·73–1·10)	15·92
Fottrell et al,[27] 2013 (Bangladesh)	2009–11	17421	187	8819	271	8602	36 (3326/9109)	309	27	31·5		0·62 (0·43–0·89)	13·37
Manandhar et al,[12] 2004 (Nepal)	2001–03	6125	76	2899	119	3226	37 (1123/3036)	756	2	36·9		0·71 (0·53–0·95)	14·46
Tripathy et al,[13] 2010 (India)	2005–08	18449	406	9469	531	8980	37 (3544/9577)	468	20	59·1		0·68 (0·59–0·78)	21·46
Lewycka et al,[25] 2013 (Malawi)	2006–09	6338	55	3074	95	3264	51 (1273/2503)	440	47	29·1		0·59 (0·40–0·86)	13·37
Overall (I^2=64·7%, p=0·009)												0·77 (0·65–0·90)	100·00

0·4 1·0 2·1

Mortality reduction Mortality increase

Figure 2. Meta-analysis of the effect of women's groups practising participatory learning and action on maternal mortality (A) and neonatal mortality (B)
Weights are from random-effects analysis.

Figure 3. Meta-regression analysis of the effect of women's groups by percentage of pregnant women participating in groups for (A) maternal mortality and (B) neonatal mortality
Green triangles show the predicted effect with random-effects meta-regression to allow for between study variation.

A

	Years	Livebirths	Deaths in intervention group	Livebirths in intervention group	Deaths in control group	Livebirths in control group	Percentage of pregnant women attending groups (numerator/denominator)	Population per group	Percentage institutional deliveries in control group	Control maternal mortality ratio	Odds ratio (95% CI)	Percentage weight
<30% of pregnant women participating in groups												
More et al,[24] 2012 (India)	2006–09	15703	15	7944	16	7759	2(118/5996)	788	87	206·2	1·41 (0·51–3·87)	8·05
Azad et al,[14] 2010 (Bangladesh)	2005–07	29889	55	15153	32	14736	3(477/15695)	1414	16	217·2	1·74 (0·97–3·13)	19·48
Colbourn et al,[26] 2013 (Malawi)	2008–10	19986	22	10055	25	9931	10 (estimated)	1200	67	251·7	0·91 (0·51–1·63)	72·47
Subtotal (I^2=0·0%, p=0·383)											1·11 (0·64–1·59)	100·00
≥30% of pregnant women participating in groups												
Fottrell et al,[27] 2013 (Bangladesh)	2009–11	17421	14	8819	23	8602	36(3326/9109)	309	27	255·8	0·74 (0·34–1·64)	13·59
Manandhar et al,[12] 2004 (Nepal)	2001–03	6125	2	2899	11	3226	37(1123/3036)	756	2	341	0·20 (0·04–0·91)	22·79
Tripathy et al,[13] 2010 (India)	2005–08	18449	49	9469	60	8980	37(3544/9577)	468	20	668·2	0·70 (0·46–1·07)	31·61
Lewycka et al,[25] 2013 (Malawi)	2006–09	6338	5	3074	23	3264	51(1273/2503)	440	47	705	0·26 (0·10–0·70)	32·00
Subtotal (I^2=51·3%, p=0·104)											0·45 (0·17–0·73)	100·00

Scale: 0·3   1·0   3·9

B

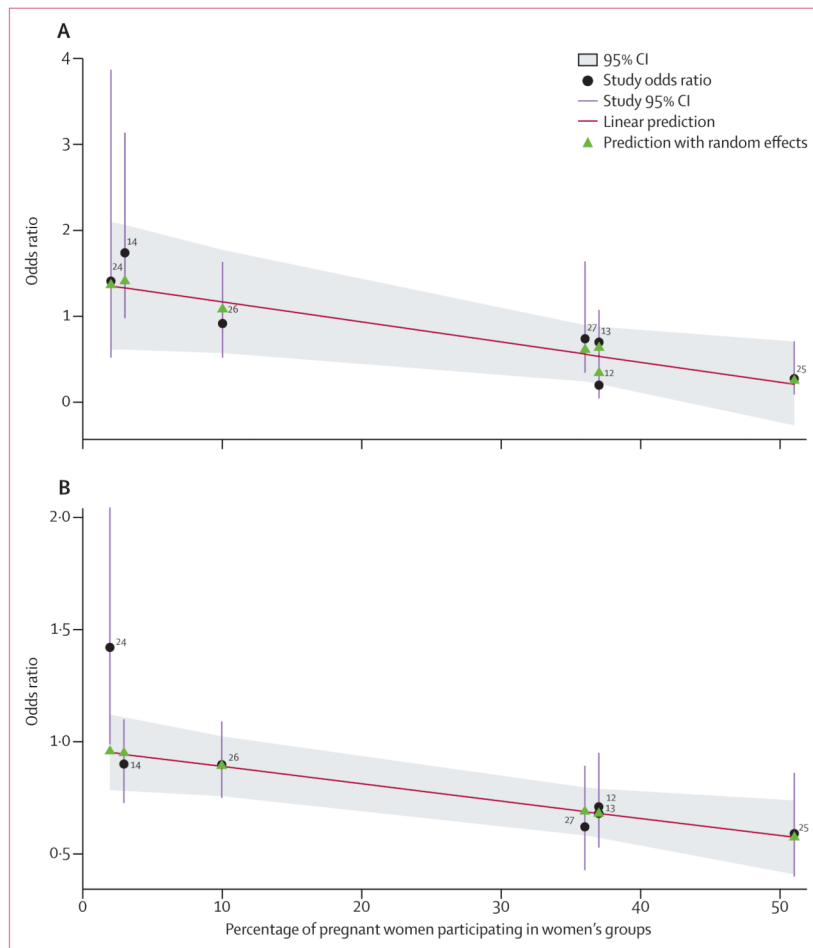|	Years	Livebirths	Deaths in intervention group	Livebirths in intervention group	Deaths in control group	Livebirths in control group	Percentage of pregnant women attending groups (numerator/denominator)	Population per group	Percentage institutional deliveries in control group	Control neonatal mortality rate	Odds ratio (95% CI)	Percentage weight
<30% of pregnant women participating in groups												
More et al,[24] 2012 (India)	2006–09	15703	132	7944	88	7759	2(118/5996)	788	87	11·3	1·42 (0·99–2·04)	10·41
Azad et al,[14] 2010 (Bangladesh)	2005–07	29889	515	15153	557	14736	3(477/15695)	1414	16	37·7	0·90 (0·73–1·10)	43·18
Colbourn et al,[26] 2013 (Malawi)	2008–10	19986	286	10055	308	9931	10 (estimated)	1200	67	31·0	0·90 (0·75–1·09)	46·40
Subtotal (I^2=43·9%, p=0·168)											0·95 (0·77–1·14)	100·00
≥30% of pregnant women participating in groups												
Fottrell et al,[27] 2013 (Bangladesh)	2009–11	17421	187	8819	271	8602	36(3326/9109)	309	27	31·5	0·62 (0·43–0·89)	11·04
Manandhar et al,[12] 2004 (Nepal)	2001–03	6125	76	2899	119	3226	37(1123/3036)	756	2	36·9	0·71 (0·53–0·95)	13·24
Tripathy et al,[13] 2010 (India)	2005–08	18449	406	9469	531	8980	37(3544/9577)	468	20	59·1	0·68 (0·59–0·78)	64·69
Lewycka et al,[25] 2013 (Malawi)	2006–09	6338	55	3074	95	3264	51(1273/2503)	440	47	29·1	0·59 (0·40–0·86)	11·04
Subtotal (I^2=0·0%, p=0·844)											0·67 (0·59–0·74)	100·00

Scale: 0·4   1·0   2·1

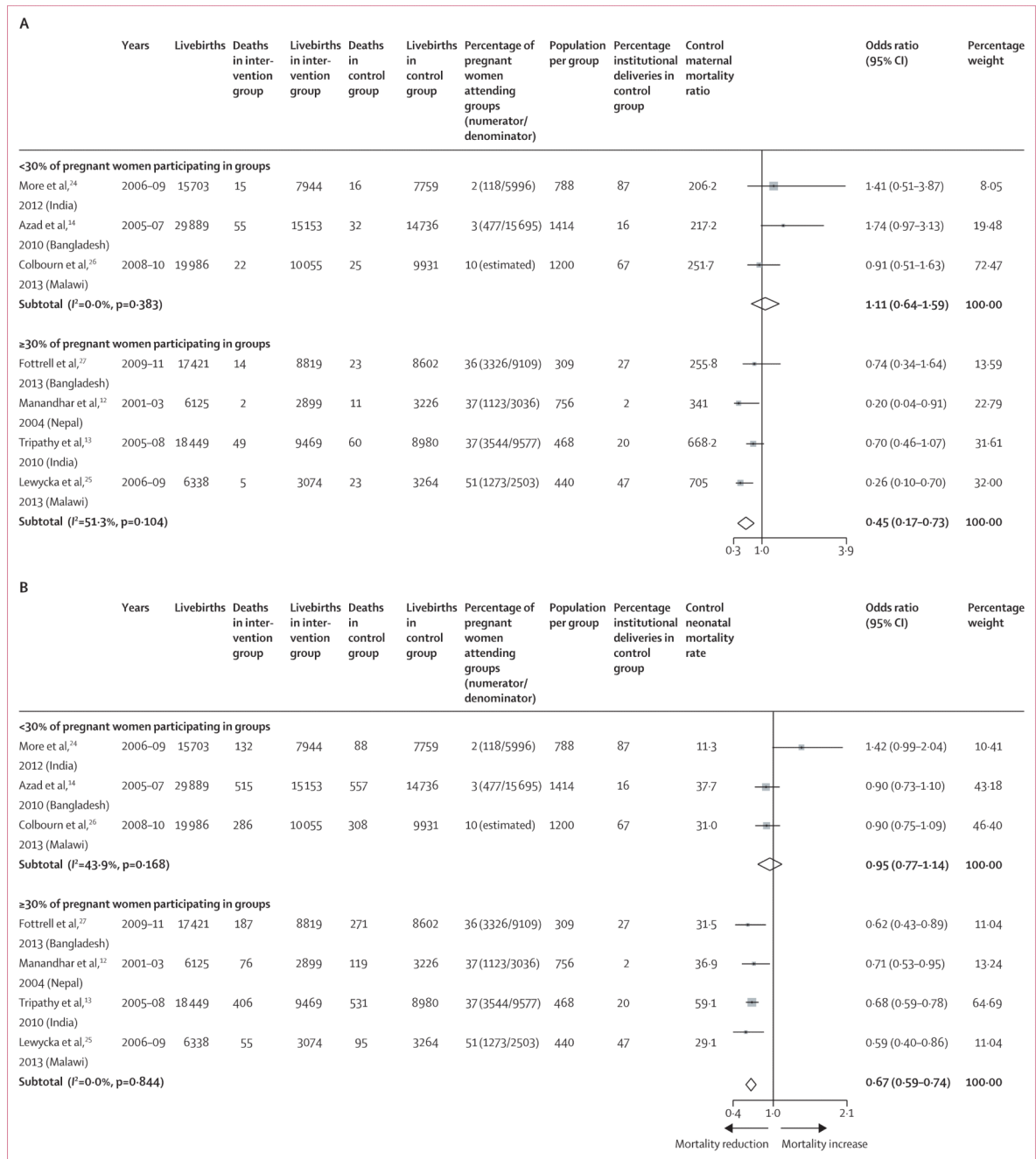Mortality reduction ← → Mortality increase

Figure 4. Subgroup analysis of the effect of women's groups on maternal mortality (A) and neonatal mortality (B), by percentage of pregnant women participating in groups
Weights are from random-effects analysis.

Table 1

Characteristics of cluster-randomised controlled trials included in the systematic review and meta-analysis

	Study population and setting	Intervention	Control	Outcomes
Manandhar et al,[12] 2004 (Nepal)	24 clusters; population of about 7000 per cluster Closed cohort of married women of reproductive age (15–49 years) living in Makwanpur district, rural Nepal; pregnancies registered during Nov 1, 2001, to Oct 31, 2003, were followed up	12 clusters (2972 births) Each cluster had a local literate female facilitator who was given a brief training in perinatal health issues and a facilitation manual; facilitators supported women's groups through ten monthly meetings using a participatory learning and action cycle and a picture card game that addressed prevention and treatment for typical problems in mothers and infants; one supervisor supported three facilitators Health service strengthening and training of traditional birth attendants were as in the control group	12 clusters (3303 births) Health service strengthening activities and training of traditional birth attendants: primary health centres given resuscitation equipment, phototherapy units, and warm cots; essential newborn-care training for local health staff and traditional birth attendants; and newborn-care kits given to community-based workers	Primary: neonatal mortality rate Secondary: stillbirth rate, maternal mortality ratio, uptake of maternity services, care practices at home, neonatal morbidity, and health-care seeking
Tripathy et al,[13] 2010 (India)	36 clusters; mean population 6338 per cluster (SD 2101) Open cohort of women aged 15–49 years, living in rural areas of three districts of Jharkhand and Orissa, eastern India, who gave birth between July 31, 2005, and July 30, 2008	18 clusters (9770 births) A local woman facilitated 20 monthly meetings with women's groups after 7 days of training; each facilitator convened 13 groups per month; groups followed a four-phase participatory learning and action cycle and were open to all members of the community though primarily targeting pregnant women and new mothers Facilitators and group members used stories, participatory games, and picture cards to facilitate discussions about prevention and care-seeking Health service strengthening was as in the control group	18 clusters (9260 births) Health service strengthening activities: health committees formed so community members could express opinions about local health services; committees met every 2 months to discuss maternal and newborn health entitlement issues; and workshops using appreciative inquiry provided to frontline government health staff	Primary: neonatal mortality rate and maternal depression scores Secondary: stillbirths, maternal mortality ratio, and perinatal mortality, uptake of maternity services, care practices at home, and health-care seeking
Azad et al,[14] 2010 (Bangladesh)	18 clusters; mean population 27 953 per cluster (SD 5953) Open cohort of women aged 15–49 years living in three rural districts of Bangladesh, who gave birth between Feb 1, 2005, and Dec 31, 2007	Nine clusters (15 695 births) A local woman facilitated groups using a participatory learning and action cycle after receiving five training sessions that covered communication, maternal and neonatal health issues; she visited every tenth household in the intervention clusters and invited married women of reproductive age to join the groups; mothers-in-law, adolescent girls, and other women joined at a later date Health service strengthening and training of traditional birth attendants were as in the control group	Nine clusters (15 257 births) Health service strengthening activities and training of traditional birth attendants: improvements to referral systems and links between communities and health services; and provision of basic and refresher training in essential maternal and newborn care	Primary: neonatal mortality rate Secondary: maternal mortality ratio, stillbirths, perinatal mortality rate, uptake of maternity services, care practices at home, neonatal morbidity, and health-care seeking
More et al,[24] 2012 (India)	48 clusters; mean population 5865 per cluster (SD 1077) Women were recruited between Oct 1, 2006, and Sept 30, 2009, in urban Mumbai slums; women from transient communities and areas for	24 clusters (9155 births) A facilitator (local woman with secondary education and leadership skills) set up ten groups in a cluster of 1000 households; groups met fortnightly, and the facilitator met weekly with other facilitators and her supervisor; women's groups followed a cycle of	24 clusters (9042 births); no details were provided about control clusters	Primary: stillbirths, neonatal mortality rate and extended perinatal mortality rate, perinatal care, and maternal morbidity Secondary: maternal

	Study population and setting	Intervention	Control	Outcomes
	which resettlement was being negotiated were excluded	36 meetings and were open to all women. Participatory methods with seven phases, based on the principles of appreciative inquiry, were used in the meetings		mortality ratio, antenatal care, institutional delivery, breastfeeding, and care-seeking for newborn illness
Lewycka et al,[25] 2013 (Malawi) [*]	48 clusters; mean population 3958 per cluster (SD 404) A cohort of women aged 10–49 years in Mchinji district, rural Malawi, who delivered a child between Feb 1, 2006, and Jan 31, 2009	24 clusters and 9374 births in factorial analysis, 12 clusters and 3129 in stratified analysis for women's groups Women's groups were supported by a female facilitator through a participatory learning and action cycle of 20 meetings Facilitators were local, literate women aged 20–49 years; they were trained for 11 days, with refresher training every 4 months, and supported by one supervisor per six facilitators Meetings followed a four-phase participatory learning and action cycle; group membership was restricted to women, but expanded to men in later stages Health service strengthening was as in the control group	24 clusters and 9749 births in overall analysis; 12 clusters and 3329 births in stratified analysis for women's groups Health service strengthening activities: health workers received training in essential newborn care and safe motherhood; neonatal resuscitation equipment donated to all facilities; a project for prevention of mother-to-child transmission of HIV introduced in 2005 was scaled up to all facilities by 2008	Primary: neonatal, perinatal, and infant mortality rates, and maternal mortality ratio Secondary: maternal and infant morbidity, use of skilled maternity services, immunisation, malaria prophylaxis, use of prevention of mother-to-child transmission services, and breastfeeding
Colbourn et al,[26] 2013 (Malawi) [†]	32 clusters; mean population of 3934 per cluster (SD 1332) An open cohort of pregnant women was recruited from three rural districts of Malawi between Oct 1, 2008, and Dec 31, 2010; women were excluded if they were living in urban areas, or areas with facilities providing comprehensive emergency obstetric care or non-functioning facilities	15 clusters (10329 births); 81 volunteer facilitators supported by nine MaiKhanda study staff, each formed a women's group that followed a participatory learning and action cycle to improve maternal and neonatal health	17 clusters (10 247 births): no details reported	Primary: maternal mortality ratio, and perinatal, and neonatal mortality rates Secondary: institutional delivery, percentage of maternal deaths subjected to audit, case fatality rates, practice of signal obstetric-care functions
Fottrell et al,[27] 2013 (Bangladesh)	Clusters were the same as in Azad et al[14] An open cohort of women residing in three rural districts of Bangladesh, who were permanent residents of the union in which their delivery was identified from January, 2009, to June, 2011; temporary residents were excluded	Nine cluster (9106 births) In addition to the 162 women's groups already set up previously (Azad et al[14]), 648 new groups were formed by newly recruited facilitators to increase population coverage; from January, 2009, the new groups followed a participatory learning and action cycle with monthly meetings about maternal and newborn health Health service strengthening was as in the control group	Nine clusters (8834 births) Health service strengthening: provision of basic medical equipment to local facilities; training of traditional birth attendants in essential newborn care; and refresher training in essential newborn care for physicians	Primary: neonatal mortality rate Secondary: stillbirth, perinatal mortality rate, pregnancy-related mortality, institutional delivery, home-care practices, and health-care seeking

[*] 2×2 factorial, cluster-randomised controlled trial of volunteer peer counselling support for breastfeeding and infant care.

[†] 2×2 factorial, cluster-randomised controlled trial of quality improvement of health facilities.

Table 2

Behavioural mechanisms for the effect of the interventions on pregnancy and birth outcomes

	Manandhar et al,[12] 2004 (Nepal)	Tripathy et al,[13] 2010 (India)	Azad et al,[14] 2010 (Bangladesh)	More et al,[24] 2012 (India)	Lewycka et al,[25] 2013 (Malawi)	Colbourn et al,[26] 2013 (Malawi)	Fottrell et al,[27] 2013 (Bangladesh)
Increased uptake of any antenatal care	*	†	†	†	*	Not reported	†,‡
Increased care-seeking for a problem in pregnancy	*	†	Not reported	†,§	Not reported	Not reported	Not reported
Increased institutional deliveries	*	†	†	†	†	†	†
Increased handwashing by attendant before home deliveries	*	*	†	Not reported	†	Not reported	*
Increased use of clean delivery kits for home births	*	*	†	Not reported	Not reported	Not reported	*
Increased appropriate cord care for home births (nothing or use of antiseptic)	*	†	†	Not reported	Not reported	Not reported	*
Increased appropriate thermal care for the newborn infant	†	†	†	Not reported	†	Not reported	1 of 3¶
Increased care-seeking for the newborn in case of a health problem	*	†	†	†,	Not reported	Not reported	†,**
Early initiation of breastfeeding (within 1 h of birth)	†	†	Not reported	†	†	Not reported	*
Exclusive breastfeeding for the first 6 weeks of life	Not reported	*	†	†,††	*,‡‡	Not reported	*
Increased care-seeking for the mother in case of a post-partum problem	Not reported	†	Not reported	*,§§	Not reported	Not reported	†,¶¶

Not reported indicates that the secondary outcome was not measured or not reported by the investigators.

*
Significant difference (p<0·05) between intervention and control groups in published data; we used analyses adjusted for clustering and variables that differed at baseline.

†
Secondary outcome was measured but not significant.

‡
Four or more antenatal-care visits.

§
Sentinel antepartum symptom (leaking of waters, vaginal bleeding, baby not moving, convulsion, or loss of consciousness).

¶
Infant not bathed in the first 24 h of life.

Sought clinical care for specified newborn illness within 24 h.

**
In Fottrell and colleagues,[27] this is infant check-up within 6 weeks, so not necessarily in the event of a problem.

††
Exclusively breastfed for at least 28 days.

‡‡
First 6 months.

§§
Postpartum check.

¶¶
In Fottrell and colleagues,[27] this is postpartum check-up within 6 weeks so not necessarily in the event of a problem.

Table 3

Cost-effectiveness ratios for the participatory women's group intervention (in 2011 international dollars)

	Cost of women's group intervention per neonatal death averted	Cost of women's group intervention per neonatal year of life lost averted[*]	Gross domestic product per person (2011)
Manandhar et al,[12] 2004 (Nepal) [*]	22 961	753	1252
Tripathy et al,[13] 2010 (India)	2770	91	3629
Lewycka et al,[25] 2013 (Malawi)	17 604	577	893
Fottrell et al,[27] 2013 (Bangladesh)	19 810	650	1777

To standardise calculations of the years of life lost averted, we recalculated cost per year of life lost averted for Manandhar[12] and Tripathy[13] and their colleagues' studies by dividing the reported cost per death averted by 30·5—ie, years of life lost associated with an infant death assuming standard life expectancy and no age weights. Lewycka[25] and Fottrell[27] and their colleagues included all start-up costs, whereas Manandhar[12] and Tripathy[13] and their colleagues included a proportion of the start-up cost because it was annualised over 10 years.

[*] Reported in Borghi and colleagues.[32]