Systematic Review

Fetal Movement Counting and Perinatal Mortality

A Systematic Review and Meta-analysis

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OBJECTIVE: To assess the association of fetal movement counting with perinatal mortality.

DATA SOURCES: Electronic databases (ie, MEDLINE, ClinicalTrials.gov, ScienceDirect, the Cochrane Library at the CENTRAL Register of Controlled Trials) were searched from inception until May 2019. Search terms used were: "fetal movement," "fetal movement counting," "fetal kick counting," "stillbirth," "fetal demise," "fetal mortality," and "perinatal death."

METHODS OF STUDY SELECTION: We included all randomized controlled trials comparing perinatal mortality in those women randomized to receive instructions for fetal movement counting compared with a control group of women without such instruction.

TABULATION, INTEGRATION AND RESULTS: The primary outcome was perinatal mortality. Five of 1,290 identified articles were included, with 468,601 fetuses. Definitions of decreased fetal movement varied. In four of five studies, women in the intervention group were asked to contact their health care providers if they perceived decreased fetal movement; the fifth study did not provide details. Reported reduction in fetal movement usually resulted in electronic fetal monitoring and ultrasound assessment of fetal well-being. There was no difference in the incidence of perinatal outcome between groups. The incidence of perinatal death was 0.54% (1,252/229,943) in the fetal movement counting group and 0.59% (944/159,755) in the control group (relative risk [RR] 0.92, 95% CI 0.85–1.00). There were no statistical differences for other perinatal outcomes as stillbirths, neonatal deaths, birth weight less than 10th percentile, reported decreased fetal movement, 5-minute Apgar score less than 7, neonatal intensive care unit admission or perinatal morbidity. There were weak but significant increases in preterm delivery (7.6% vs 7.1%; RR 1.07, 95% CI 1.05–1.10), induction of labor (36.6% vs 31.6%; RR 1.15, 95% CI 1.09–1.22), and cesarean delivery (28.2% vs 25.3%; RR 1.11, 95% CI 1.10–1.12).

CONCLUSION: Instructing pregnant women on fetal movement counting compared with no instruction is not associated with a clear improvement in pregnancy outcomes. There are weak associations with some secondary outcomes such as preterm delivery, induction of labor, and cesarean delivery.

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Maternal regular perception of fetal movements is considered a sign of fetal well-being, and concerns for decreased perception of fetal movements is a common cause of presentation to the emergency department or labor and delivery. Many definitions of decreased fetal movement have been proposed, both quantitative and qualitative, and none of them has been universally accepted.[1–3] Among these, one of the most frequently adopted is "less than 10 movements within 2 hours"; other authors consider reduced fetal movement in case of total absence of

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fetal movement for a whole day. Currently, we have no evidence that a formal count of fetal movement using one of the alternative methods of fetal activity monitoring is beneficial compared with maternal subjective perception of decreased fetal movement.[1,3]

Reduction of fetal movement is associated with various adverse pregnancy outcomes, including stillbirth, growth restriction, placental insufficiency, fetomaternal hemorrhage, congenital anomalies, and neonatal mortality.[4–8] Moreover, compared with normal pregnancies, those characterized by reduced fetal movements have a significantly higher uterine artery pulsatility index at mid-trimester ultrasound examination[9] and many of the adverse perinatal outcomes previously described are strongly associated with abnormal uterine artery Doppler.[10,11] However, there is an ongoing debate in the literature regarding the usefulness of maternal fetal movement counting for the prevention of poor pregnancy outcomes.

Recent studies have raised doubts about the efficacy of this practice because it can be associated with increased medical interventions without measurable benefits.[12–14] These contradictory results may be a result of the low incidence of stillbirth and neonatal mortality; therefore, to demonstrate whether fetal movement counting has an effect in these outcomes, a very large number of patients is required. The aim of this systematic review and meta-analysis was to assess the efficacy of fetal movement counting for prevention of perinatal mortality.

SOURCES

This review was performed according to a protocol designed a priori for systematic review. Electronic databases (ie, MEDLINE, ClinicalTrials.gov, ScienceDirect, the Cochrane Library at the CENTRAL Register of Controlled Trials) were searched from their inception until May 2019. Search terms used were the following text words: "fetal movement," "fetal movement counting," "fetal kick counting," "stillbirth," "fetal demise," "fetal mortality," "perinatal death," of which fetal movement, stillbirth, fetal mortality, and perinatal mortality were MeSH terms.

No restrictions for language or geographic location were applied. In addition, the reference lists of all identified articles were examined to identify studies not captured by electronic searches. The gray literature was not searched. The electronic search and the eligibility of the studies were independently assessed by two authors (F.B., G.P.). Disagreement between reviewers were discussed and resolved with a third reviewer (V.B.) through discussion.

STUDY SELECTION

We included all randomized controlled trials (RCT) comparing patients randomized to receive instructions for fetal movement counting compared with women who received standard prenatal care, without specific information about fetal movement perception. The intervention group included women instructed to monitor fetal movement in some fashion during pregnancy. The control group included women who received standard prenatal care without any specific instruction regarding fetal movement monitoring. Data extraction was completed by two independent authors (F.B., G.P.). We resolved discrepancies through discussion and by consensus with a third reviewer (V.B.).

The risk of bias in each included study was assessed by using the criteria outlined in the *Cochrane Handbook for Systematic Reviews of Interventions.*[15] Seven domains related to risk of bias were assessed in each included trial, because there is evidence that these issues are associated with biased estimates of treatment effect: 1) random sequence generation, 2)

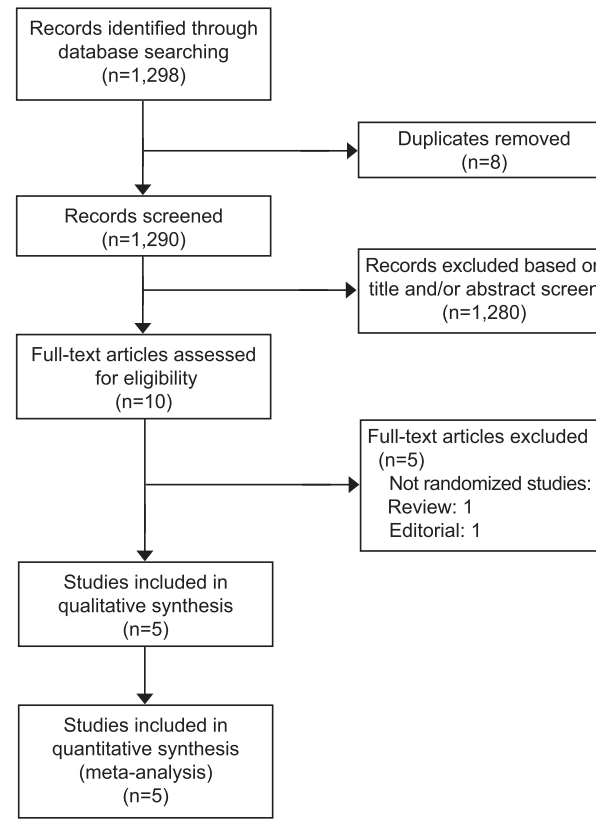

Fig. 1. Flow diagram of studies identified in the systematic review.

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Table 1. Characteristics of the Included Studies

Characteristic	Neldam[17]	Grant et al[20]	Saastad et al[18]	Delaram and Jafarzadeh[19]	Norman et al[12]
Location	Denmark	United Kingdom, Belgium, Sweden, Ireland, United States	Norway	Iran	United Kingdom, Ireland
Type of study	Single-center RCT	Multicenter RCT with "cluster" allocation	Multicenter RCT	Single-center RCT	Stepped wedge multicenter cluster RCT
Sample size (no. of fetuses in intervention vs control group)	1,562 vs 1,549	31,993 vs 36,661	544 vs 532	100 vs 108	227,860 vs 157,692
Inclusion criteria	Singletons, estimated fetal weight 1,500 g or more	Singletons and twins	Singletons	Singletons	Singletons and twins
Exclusion criteria	Fetal abnormalities	Fetal abnormalities	Fetal abnormalities	Oligohydramnios, fetal abnormalities, smoking	Women delivering at home
Gestational age at randomization (wk)	32	28–32	17–19	17–18	Not reported
Primary study outcome	Effect of fetal movement counting on pregnancy outcomes	Stillbirth	Composite*	Effect of fetal movement counting on pregnancy outcomes	Stillbirth
Definition of stillbirth	Not reported	At 28 wk of gestation or greater	Not reported	Not reported	At 24 wk of gestation or greater
Definition of neonatal death	Not reported	Neonatal deaths not investigated	Not reported	Neonatal deaths not investigated	Death in the first 7 d after birth

RCT, randomized controlled trial.
* Composite perinatal outcome, defined as at least one of the following: fetal growth restriction less than the 2.5th centile, emergency cesarean delivery for fetal indication, oligohydramnios, abnormal umbilical artery Doppler, maternal perception of absent fetal movements for more than 24 hours before admission to hospital, perinatal death.

allocation concealment, 3) blinding of participants and personnel, 4) blinding of outcome assessment, 5) incomplete outcome data, 6) selective reporting, and 7) other bias.

Review authors' judgments were categorized as "low risk," "high risk," or "unclear risk" of bias. Two authors (F.B., V.B.) independently assessed inclusion criteria, risk of bias, and data extraction. Disagreements were resolved by discussion. All analyses were done using an intention-to-treat approach, evaluating the outcomes according to the treatment group to which they were randomly allocated in the original trials. Primary and secondary outcomes were defined before data extraction.

The primary outcome measure was the incidence perinatal mortality, defined as stillbirths (defined by the study) and neonatal deaths (as defined the study). Secondary perinatal outcomes were stillbirth, neonatal death, small for gestational age (birth weight less than the 10th percentile), 5-minute Apgar score less than 7, and admission to the neonatal intensive care unit. Secondary obstetric outcomes include report of decreased fetal movement, admission to hospital for reduced fetal movement, elective or emergent delivery (cesarean or induction of labor) after decreased fetal movement, preterm birth, induction of labor, and cesarean delivery.

Data from each eligible study were extracted without modification of original data onto custom-made data collection forms. A two-by-two table was assessed for relative risk (RR). The data analysis was completed independently by two authors (G.S., V.D.V.) using Review Manager 5.3. The completed analyses were then compared, and any difference was resolved by discussion. The summary measures were

Table 2. Characteristics of the Intervention and Control Groups

Study Characteristic	Neldam[17]	Grant et al[20]	Saastad et al[18]	Delaram and Jafarzadeh[19]	Norman et al[12]
Type of intervention	Fetal movement counting	Fetal movement counting	Fetal movement counting	Fetal movement counting	Fetal movement counting
Control group	Normal antenatal care	Normal antenatal care	Normal antenatal care	Normal antenatal care	Normal antenatal care
Type of instruction given to intervention group	Written information about fetal movement counting; Lying down for 1 h after the principal meal once/wk until 32 wk of gestation, 3 times/wk after 32 wk of gestation; fetal movement count recorded on a chart	Fetal movement counting routinely every day, starting as early in the day as possible, to record the time taken to feel 10 movements on a modified Cardiff "Count-to-Ten" chart	Fetal movement counting daily from 28 wk of gestation using modified "Count-to-Ten" method: mothers are asked to note the time it takes to feel 10 movements after they have felt 1 movement; Women were phoned 2 wk after starting to count to discuss problems with the technique	Fetal movement counting from 28 to 37 wk of gestation performed lying down in left lateral position after breakfast every morning for half an hour, counting and recording fetal movements on a chart to be shown at each antenatal appointment	A leaflet with information on fetal movement counting was provided to every woman; During every antenatal appointment, women were asked whether they felt decreased fetal movement, and information about perception of fetal movements was provided; E-learning education package for all clinical staff
Type of instruction given to control group	No specific information on fetal movement counting; Women were asked whether they felt decreased fetal movement at each antenatal appointment	No instructions to monitor movements routinely; Women could be asked about fetal movements at antenatal appointments; Obstetricians could give charts to selected women when needed	No instructions to monitor movements routinely	No instructions to monitor movements routinely	No instructions to monitor movements routinely
Definition of decreased fetal movement	Not reported	No movements on a single day or fewer than 10 movements in 10 h on 2 successive days (except in Belgium, where fewer than 10 movements on a single day was deemed sufficient)	Maternal perception of decreased fetal movement (subjective assessment of fetal movements)	Not reported	Maternal perception of decreased fetal movement (subjective change in frequency of fetal movements)

(*continued*)

Table 2. Characteristics of the Intervention and Control Groups (*continued*)

Study Characteristic	Neldam[17]	Grant et al[20]	Saastad et al[18]	Delaram and Jafarzadeh[19]	Norman et al[12]
Management of decreased fetal movement	Contact the hospital immediately when registered "less movement" after 32 wk of gestation	Contact the hospital immediately in case of reduced fetal movement	Contact maternity unit in case of reduced fetal movement or concern about fetal movement	Not reported	Contact maternity unity in case of concern about decreased fetal movement
Interventions in case of reported decreased fetal movement	Ultrasound scan to count fetal movements, EFM, serum E3, and HPL; In cases of suspected asphyxia (motionless for 30 min, anomalous EFM): cesarean delivery; Fetal activity less than 50% of normal for that fetus: admission to the hospital for 24 h; if biophysical profile and hormone values were abnormal: induction of labor; Fetal activity greater than 50% of normal: discharge; The same management was adopted for both groups	Not reported	No standardized management; In most of cases (95.7 vs 90%), EFM was performed, and, in most cases (78.3 vs 78.2%), ultrasound scan for evaluation of fetal growth, AF, or fetal activity was performed as well; in almost half of cases (43.9 vs 52.8%), uterine artery Doppler was evaluated	Not reported	Delivery was recommended for women who were at 37 wk of gestation or later with any of: estimated fetal weight less than the 10th centile, abdominal circumference less than the 10th centile, a deepest pocket less than 2 cm, abnormal EFM, or recurrent decreased fetal movement; Women at less than 37 wk of gestation were referred to a senior obstetrician; In case of 1st episode of decreased fetal movement: management depended on the gestational age and varied from anomaly scan to growth scan or fetal well-being assessment

EFM, electronic fetal monitoring; E3, estriol; HPL, human placental lactogen; AF, amniotic fluid. Numbers in parenthesis denote percentages in the intervention group compared with the control group.

reported as RR with 95% CI using the random effects model of DerSimonian and Laird. I-squared (Higgins I^2) was used to identify heterogeneity.

Before data extraction, the review was registered with the PROSPERO International Prospective Register of Systematic Reviews (registration no. CRD42019123264). The review was reported according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement.[16]

RESULTS

The original search identified 1,290 nonduplicate articles. Of these, five RCTs met inclusion criteria and 468,601 fetuses were included in the systematic review (Fig. 1). Three trials enrolled only singleton gestations,[17–19] and Grant et al[20] and Norman et al[12] also included twin pregnancies (Table 1). One study[12] accounted for 82% of our population. The vast majority were singleton gestations without fetal anomalies

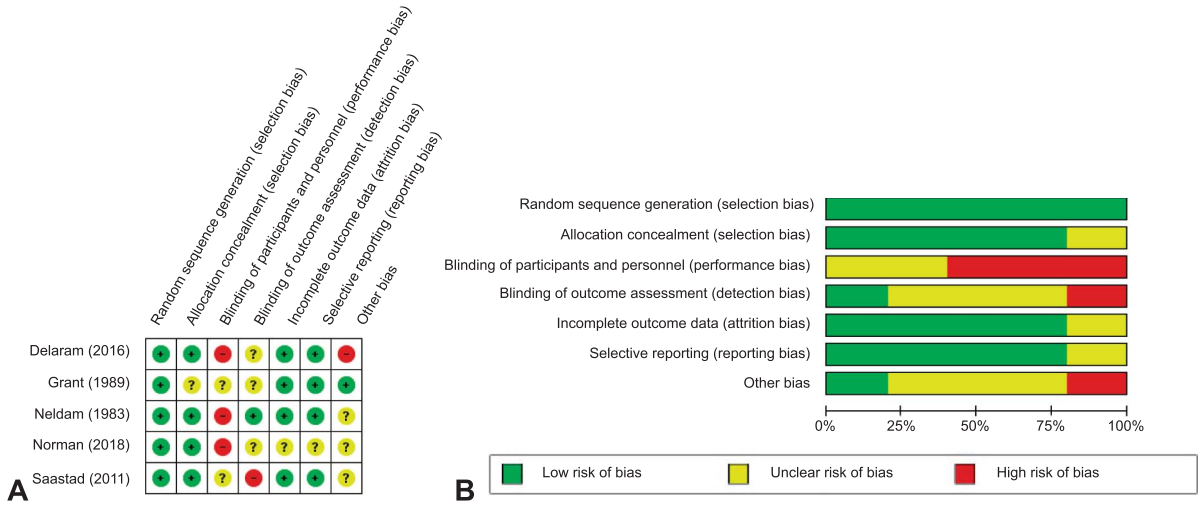

Fig. 2. Assessment of risk of bias. **A**. Summary of risk of bias for each trial. *Plus sign* indicates low risk of bias; *minus sign* indicates high risk of bias; *question mark* indicates unclear risk of bias. **B**. Risk of bias graph about each risk of bias item, presented as percentages across all included studies.

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randomized at 17 weeks of gestation or later. All RCTs that mentioned it seemed to include both low-risk and high-risk pregnancies, without providing a subgroup analysis; see exclusion criteria in Table 1. Instructions for fetal movement counting in the intervention group varied (Table 2). Definitions of decreased fetal movement varied among the trials, being sometimes qualitative and sometimes quantitative. In three of five studies, women in the intervention group were asked to contact their health care providers in case of reduced fetal movement. Interventions in cases of reported decreased fetal movement varied among the studies included, but usually included electronic fetal monitoring and ultrasound assessment of fetal well-being alone or in combination (Table 2). In the control group, no specific instructions to monitor fetal movements were given. A summary of the methodologic quality for each individual study is presented in Figure 2A, and a summary of methodologic quality across all trials in Figure 2B. Random sequence generation was assessed as "low risk of bias" in all the included trials. Given the nature of the interventions, it was not possible to blind the intervention for the outcome assessor. It was also impossible to blind the participants to the allocated group and therefore all trials were assessed to be at high risk of performance bias. The statistical heterogeneity between the trials ranged from low to moderate, with no inconsistency ($I^2=0\%$) for the primary outcome.

The incidence of perinatal death was 0.54% (1,252/229,943) in the intervention group and 0.59% (944/159,755) in the control group (RR 0.92, 95% CI 0.85–1.00; Table 3 and Fig. 3). There was no significant between-group difference in the incidence of secondary perinatal outcomes, including stillbirth (Fig. 4), neonatal death (Fig. 5), birth weight less than the 10th percentile, 5-minute Apgar score less than 7, and neonatal intensive care unit admission (Table 3). In terms of obstetric outcomes, there were small but statistically significant increases in preterm birth (7.6% vs 7.1%; RR 1.07, 95% CI 1.05–1.10), induction of labor (36.6% vs 31.6%; RR 1.15, 95% CI 1.09–1.22), and cesarean delivery (28.2% vs 25.3%; RR 1.1, 95% CI 1.10–1.12) (Table 4).

DISCUSSION

Fetal well-being through fetal movement counting remains a nearly ubiquitous component of prenatal care and as such, the evaluation of its potential benefits and harms may affect the care of most pregnant women. In this systematic review and meta-analysis, women instructed on fetal movement counting had no difference in perinatal mortality compared with those who did not receive instructions (Table 3). The only significant findings were marginally increased rates in preterm birth, induction of labor, and cesarean delivery, all within the zone of potential bias and of questionable clinical significance.

The Cochrane Review[3] published in 2015, including 71,458 women, is the only prior meta-analysis of RCT on fetal movement counting: our meta-analysis includes three studies[12,17,19] not included in that one. They also found no differences in the incidence of

Table 3. Perinatal Outcomes

Outcome	Neldam[17]	Grant et al[20]	Saastad et al[18]	Delaram and Jafarzadeh[19]	Norman et al[12]	Total	I^2 (%)	RR or MD (95% CI)
Perinatal death	14/1,583 (0.88) vs 21/1,569 (1.34)	Not reported	0/544 (0) vs 0/532 (0)	Not reported	1,238/227,816 (0.54) vs 923/157,654 (0.58)	1,252/229,943 (0.54) vs 944/159,755 (0.59)	0	0.92 (0.85–1.00)
Stillbirth	4/1,583 (0.25) vs 12/1,569 (0.76)	99/31,648 (0.31) vs 100/36,231 (0.28)*	0/544 vs 0/532	0/100 vs 0/108	921/227,816 (0.4) vs 691/157,654 (0.43)	1,024/261,691 (0.39) vs 803/196,094 (0.41)	61	0.94 (0.71 to 1.25)
Neonatal death	10/1,573 (0.64) vs 9/1,560 (0.58)	Not reported	0/544 vs 0/532	Not reported	317/227,816 (0.14) vs 232/157,654 (0.14)	327/229,933 (0.14) vs 241/159,746 (0.15)	0	0.95 (0.80–1.12)
SGA (birth weight less than the 10th percentile)	120/1,583 (7.6) vs 110/1,569 (7)	Not reported	46/543 (8.5) vs 46/530 (8.7)	Not reported	10,853/227,860 (4.7) vs 8,444/157,692 (5.4)	11,019/229,986 (4.8) vs 8,600/159,791 (5.4)	21	0.92 (0.83–1.02)
5-min Apgar score less than 7	Not reported	Not reported	Not reported	Not reported	3,613/227,860 (1.6) vs 2,361/157,692 (1.5)	3,613/227,860 (1.6) vs 2,361/157,692 (1.5)	NA	1.06 (1.01–1.11)
NICU admission	317/1,583 (20) vs 323/1,569 (20.6)	Not reported	33/544 (6.1) vs 30/532 (5.6)	NA	19,237/227,860 (8.4) vs 13,029/157,692 (8.3)	19,587/229,987 (8.5) vs 13,382/159,793 (8.4)	0	1.02 (1.00–1.04)

RR, relative risk; MD, mean difference; SGA, small for gestational age; NA, not applicable NICU, neonatal intensive care unit.
Data are n/N (%) for the intervention group vs the control group unless otherwise specified.
* Antepartum late fetal death among normally formed singleton fetuses.

stillbirth or perinatal mortality between the groups.[3] The study selection was different from ours–we compared women who were given instructions on fetal movement counting with women without any instructions, whereas the Cochrane meta-analysis also included comparison of different fetal movement counting techniques.

Current research demonstrates no definite evidence that fetal movement counting is associated

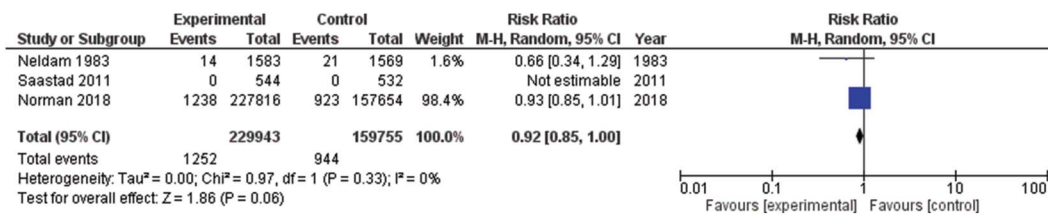

Fig. 3. Forest plot for the risk of perinatal death. M-H, Mantel-Haenszel.
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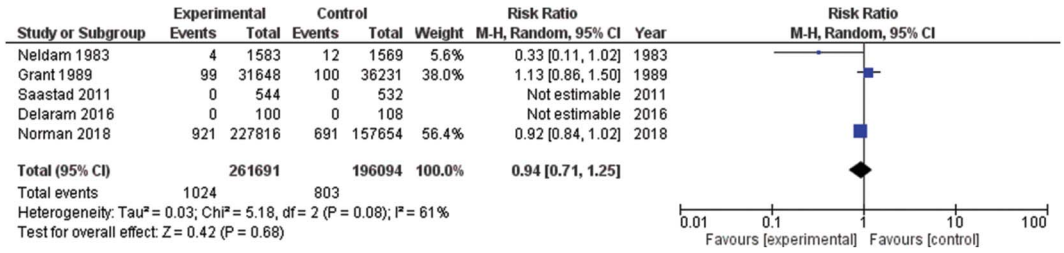

Fig. 4. Forest plot for the risk of stillbirth. M-H, Mantel-Haenszel.
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with prevention of perinatal mortality. The AFFIRM trial, which contributed 82% of patients in this review, was well-designed and performed. They reported a nonsignificant decrease in the stillbirth rate from 4.40 per 1,000 births in the control group to 4.06 per 1,000 births in the fetal movement counting intervention group (a 7.7% decrease),[21] similar to the 8% decrease found in this meta-analysis. This is unsurprising given the weight in this meta-analysis from the AFFIRM study. Furthermore, the authors concluded that, although more than 400,000 patients were enrolled for the purpose of the AFFIRM trial, the sample size might not have been large enough to demonstrate a significant reduction in the incidence of stillbirth.[12]

The only statistically significant results in this meta-analysis are small increased rates of preterm birth, induction of labor and cesarean delivery, of marginal clinical significance. It is not possible to know whether the clinical interventions prevented a stillbirth, neonatal death, or neonatal morbidity or whether the outcomes would have been the same without the interventions. To answer that question, a randomized trial of intervention compared with nonintervention in women who report decreased fetal movement would be needed, however such a study is unlikely to be performed.

This systematic review and meta-analysis has several limitations. The biggest is that one study[12] contributed to 82% of the total population; therefore the other smaller studies have little contribution in addition to this large RCT. In fact, some have argued that results from large RCTs may be more reliable than those from meta-analyses.[22] Larger RCTs similar to the largest study[12] we included are needed.

Most of the RCT included in this meta-analysis were performed in high-income countries, where perinatal death is a rare outcome. Because of this, results may not be generalizable to low-income countries with higher rates of perinatal death. As well, despite the large sample size of our study (468,601 fetuses included), it may not have been large enough to detect a small risk reduction in a rare event. Fetal movement counting is commonly used in obstetrics and women may on their own volition choose to incorporate this technique, which could have contaminated the control group. A Hawthorne effect in the included RCTs may be likely. Other relevant limitations were variability in the definition of fetal movement counting, the instructions given to patients to count fetal movements, the management of decreased fetal movement and the definition of stillbirth. Moreover, several outcomes of interest such as type of preterm birth (spontaneous vs iatrogenic) and important neonatal and long-term outcomes were not available. Differences among studies, in particular regarding instructions on how to monitor fetal movements in the intervention group, also present in the previous Cochrane Review and meta-analysis,[3] make it difficult to generalize the results of the studies on this topic. Although most studies included only singleton gestations, two included both singletons and

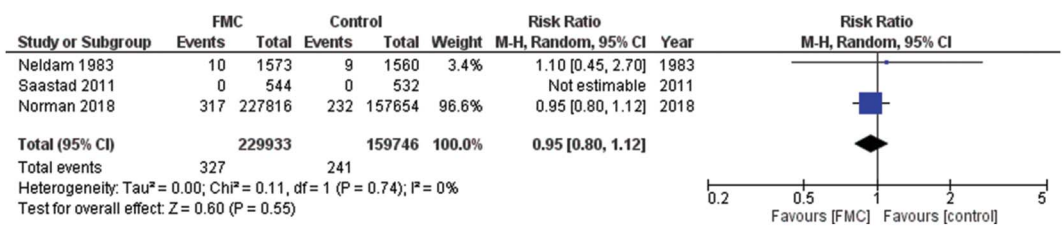

Fig. 5. Forest plot for the risk of neonatal death. FMC, fetal movement counting; M-H, Mantel-Haenszel.
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Table 4. Obstetrics Outcomes

Outcome	Neldam[17]	Grant et al[20]	Saastad et al[18]	Delaram and Jafarzadeh[19]	Norman et al[12]	Totals	I^2 (%)	RR or MD (95% CI)
Reported DFM	Not reported	Not reported	71/544 (13.1) vs 56/532 (10.5)	Not reported	Not reported	71/544 (13.1) vs 56/532 (10.5)	NA	1.24 (0.89–1.72)
Admission to hospital for DFM	Not reported	Not reported	19/67 (28.4) vs 8/56 (14.3)	Not reported	Not reported	19/67 (28.4) vs 8/56 (14.3)	NA	1.99 (0.94–4.19)
Elective or emergent delivery after DFM	Not reported	Not reported	24/71 (33.8) vs 19/56 (33.9)	Not reported	Not reported	24/71 (33.8) vs 19/56 (33.9)	NA	1.00 (0.61–1.63)
Preterm birth	48/1,562 (3.1) vs 41/1,549 (2.7)	Not reported	20/544 (3.7) vs 24/532 (4.5)	0/100 vs 0/108	17,376/227,860 (7.6) vs 11,228/,157,692 (7.1)	17,444/230,066 (7.6) vs 11,293/159,881 (7.1)	0	**1.07 (1.05-1.10)**
Induction of labor	Not reported	Not reported	77/544 (14.2) vs 76/532 (14.3)	Not reported	83,499/227,860 (36.6) vs 49,952/157,692 (31.7)	83,576/228,404 (36.6) vs 50,028/158,224 (31.6)	6	**1.15 (1.09-1.22)**
Cesarean delivery	206/1,583 (13) vs 175/1,569 (11.2)	Not reported	36/544 (6.6) vs 38/532 (7.1)	53/100 (53) vs 58/108 (53.7)	64,572/227,860 (28.3) vs 40,231/157,692 (25.5)	64,867/230,087 (28.2) vs 40,502/159,901 (25.3)	0	**1.11 (1.10-1.12)**

RR, relative risk; MD, mean difference; DFM, decreased fetal movement; NA, not applicable.
Data are n/N (%) for the intervention group vs the control group unless otherwise specified.
Bold indicates statistically significant results.

twins; percentages of each population in these studies were not available, even on request to the authors. All RCTs that mentioned it seemed to include both low-risk and high-risk pregnancies, without providing any subgroup analysis.

Clearly, more well-designed and larger trials are needed. Two RCTs are ongoing on this topic, including the "My Baby's Movements Trial" in Australia and New Zealand and the "Mindfetalness study"[23] in Sweden. The possible benefit of decreasing perinatal mortality has not yet been realized and the current analysis raises concerns about the possible risk of harm related to iatrogenic delivery. A technique used ubiquitously warrants rigorous study. The results of these two studies and their possible inclusion in future meta-analyses may contribute important information.

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