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REVIEW

One step versus two step approach for gestational diabetes screening: systematic review and meta-analysis of the randomized trials

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ABSTRACT

Introduction: To compare both the prevalence of gestational diabetes mellitus (GDM) as well as maternal and neonatal outcomes by either the one-step or the two-step approaches.

Material and methods: Electronic databases were searched from their inception until June 2017. We included all randomized controlled trials (RCTs) comparing the one-step with the two-step approaches for the screening and diagnosis of GDM. The primary outcome was the incidence of GDM.

Results: Three RCTs ($n = 2333$ participants) were included in the meta-analysis. 910 were randomized to the one step approach (75 g, 2 hrs), and 1423 to the two step approach. No significant difference in the incidence of GDM was found comparing the one step versus the two step approaches (8.4 versus 4.3%; relative risk (RR) 1.64, 95%CI 0.77–3.48). Women screened with the one step approach had a significantly lower risk of preterm birth (PTB) (3.7 versus 7.6%; RR 0.49, 95%CI 0.27–0.88), cesarean delivery (16.3 versus 22.0%; RR 0.74, 95%CI 0.56–0.99), macrosomia (2.9 versus 6.9%; RR 0.43, 95%CI 0.22–0.82), neonatal hypoglycemia (1.7 versus 4.5%; RR 0.38, 95%CI 0.16–0.90), and admission to neonatal intensive care unit (NICU) (4.4 versus 9.0%; RR 0.49, 95%CI 0.29–0.84), compared to those randomized to screening with the two step approach.

Conclusions: The one and the two step approaches were not associated with a significant difference in the incidence of GDM. However, the one step approach was associated with better maternal and perinatal outcomes.

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Diabetes; insulin; gestational diabetes mellitus; obesity

Introduction

Carbohydrates disorders, including gestational diabetes mellitus (GDM) and pregestational diabetes mellitus (DM), are common morbidities in pregnancy, with short- and long-term consequences to mothers, fetuses, and newborns. It has been estimated that about 6–18% of all pregnancies are complicated by DM in pregnancy [1–6]. The last report from the International Diabetes Federation (IDF) estimate that worldwide, approximately 1 in 7 births in 2015 were complicated by some form of hyperglycemia during pregnancy [7].

Management for women with GDM includes diet, physical activity, oral hypoglycemic agents and/or insulin as needed [6,8]. The management of women with GDM is aimed at achieving best possible glycemic control, with normal or near normal glucose values, while avoiding hypoglycemia [4–6]. This management is effective in reducing maternal and neonatal morbidity and mortality [6,7]. Nevertheless, worldwide controversy exists regarding the best approach and criteria for GDM screening and diagnosis (Table 1) [6,7,15–25]. Several randomized controlled trials (RCTs), comparing the one step versus the two step approaches for GDM screening and diagnosis, have been published so far [22–24].

The aim of this systematic review and meta-analysis of RCTs was to compare the incidence of GDM, as well as the maternal and neonatal outcomes, by the one step versus the two step approaches.

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Table 1. Criteria for gestational diabetes mellitus screening by selected societies.

	Test	Number of abnormal values required for diagnosis	Fasting glucose (mg/dL)	1 hour after loading (mg/dL)	2 hours after loading (mg/dL)	3 hours after loading (mg/dL)
ACOG, 2013 C&C [6]	2 step 3 h 100 g	≥2	95	180	155	140
ACOG, 2013 NDDG [6]	2 step 3 h 100 g	≥2	105	190	165	145
ADA, 2017 75g [9]	1 step 2 h 75 g	≥2	95	180	155	Not required
ADA, 2017 100g [9]	2 step 3 h 100 g	≥2	95	180	155	140
CDA, 2013 [10]	2 step 2 h 75 g	≥2	95	191	160	Not required
FIGO, 2013 [11]	1 step 2 h 75 g	≥1	92	180	153	Not required
IADPSG, 2015 [7]	1 step 2 h 75 g	≥1	92	180	153	Not required
NICE/RCOG, 2015 [12]	1 step 2 h 75 g	≥1	101	Not required	140	Not required
WHO, 1999 [13]	1 step 2 h 75 g	≥1	126	Not required	200	Not required
WHO, 2013 [14]	1 step 2 h 75 g	≥1	92	180	153	Not required

ACOG: American College of Obstetricians and Gynecologists; ADA: American Diabetes Association; CDA: Canadian Diabetes Association; C&C: Carpenter and Coustan; IADPSG: International Association of Diabetes Pregnancy Study Group; NICE: National Institute for Health and Care Excellence; RCOG: Royal College of Obstetricians and Gynaecologists; NDDG: National Diabetes Data Group; WHO: World Health Organization.

Materials and methods

This review was performed according to a protocol designed *a priori* and recommended for systematic review [26]. Electronic databases (i.e. Medline, Scopus, ClinicalTrials.gov, EMBASE, ScienceDirect, the Cochrane Library at the CENTRAL Register of Controlled Trials, SCIelo) were searched from their inception until January 2017. Search terms used were the following text words: "diabetes", "trial", "screening", "diagnosis", "one-step", "two-step", "guidelines", "review", "randomized", and "clinical trial". 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 electronic search and the eligibility of the studies were independently assessed by two authors (GS, CC). Differences were discussed with a third reviewer (VB).

We included all RCTs comparing the one step versus the two step approaches for screening and diagnosis of GDM. Quasi RCTs (i.e. trials in which allocation was done on the basis of a pseudorandom sequence, e.g. odd/even hospital number or date of birth, alternation) were excluded.

The risk of bias in each included study was assessed by using the criteria outlined in the *Cochrane Handbook for Systematic Reviews of Interventions*. Seven domains related to risk of bias were assessed in each included trial since there is evidence that these issues are associated with biased estimates of treatment effect: (1) random sequence generation; (2) 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' judgements were categorized as "low risk", "high risk" or "unclear risk" of bias [26].

Two authors (GS, CC) independently assessed inclusion criteria, risk of bias and data extraction. Disagreements were resolved by discussion with a third reviewer (VB). All analyses were done using an intention-to-treat approach, evaluating women according to the screening group to which they were randomly allocated in the original trials. Primary and secondary outcomes were defined before data extraction. All authors of the original trials were contacted for missing data.

The primary outcome was the incidence of GDM. Secondary outcomes were gestational weight gain (GWG) from randomization to delivery (in grams), gestational hypertension and preeclampsia (as defined by the original trial), preterm birth (PTB) <37 weeks, induction of labor, shoulder dystocia (as defined by the original trial), cesarean delivery, and perinatal outcomes including birth weight, stillbirth (i.e. fetal death >23 weeks), macrosomia (i.e. birth weight 4000 grams), large for gestational age (LGA) (i.e. birthweight >90th percentile), small for gestational age (SGA) (i.e. birthweight <10th percentile), neonatal hypoglycemia (i.e. glucose <40 mg/dL), neonatal hyperbilirubinemia (i.e. total serum bilirubin >5 mg/dL), admission to neonatal intensive care unit (NICU), and neonatal death (i.e. death of a liveborn baby within the first 28 days of life). We also planned to assess cost-analysis comparing the two screening methods.

The data analysis was completed independently by two authors (GS, CC) using Review Manager v. 5.3 (The Nordic Cochrane Centre, Cochrane Collaboration, 2014, Copenhagen, Denmark). The completed analyses were then compared, and any difference was resolved by discussion with a third reviewer (VB).

Data from each eligible study were extracted without modification of original data onto custom-made data collection forms. For continuous outcomes

means ± standard deviation was extracted and imported into Review Manager v. 5.3.

Meta-analysis was performed using the random effects model of DerSimonian and Laird, to produce summary treatment effects in terms of mean difference (MD) or relative risk (RR) with 95% confidence interval (CI). Heterogeneity was measured using I-squared (Higgins I^2). A subgroup analysis for the primary and the secondary outcomes was performed comparing the one step with 75 g 2 hours test using the International Association of Diabetes and Pregnancy Study Group (IADPSG) criteria, versus the two step with 50 g 1 hour followed for abnormals by the 3 h 100 g test using the Carpenter and Coustan (C&C) criteria.

Potential publication biases were assessed statistically by using Begg's and Egger's tests. The meta-analysis was reported following the Preferred Reporting Item for Systematic Reviews and Meta-analyses (PRISMA) statement [26]. Before data extraction was completed, the review was registered with the PROSPERO International Prospective Register of Systematic Reviews (CRD42017060752).

Results

Three RCTs [22–24] ($n = 2333$ participants) were identified as relevant and included in the meta-analysis (Figure 1, Table 2). Publication bias, assessed statistically by using Begg's and Egger's tests, showed no significant bias ($p = .37$ and $p = .31$, respectively). All authors kindly provided additional unpublished data from their trial. The entire database from one trial was also obtained [23].

The overall risk of bias was low. All studies had low risk of bias in "random sequence generation", and used opaque randomized envelopes. The randomization sequence was computer-generated by a statistician. Adequate methods for allocation of women were used in all the trials. Given the intervention, no trial was double-blind (Figure 2). The statistical heterogeneity within the study ranged from low to moderate with $I^2 = 65\%$ for the primary outcome, and $I^2 = 0\%$ for most of the secondary outcomes.

Out of the 2333 women included in the review, 910 were randomized to the one step approach (2 hrs, 75 g),

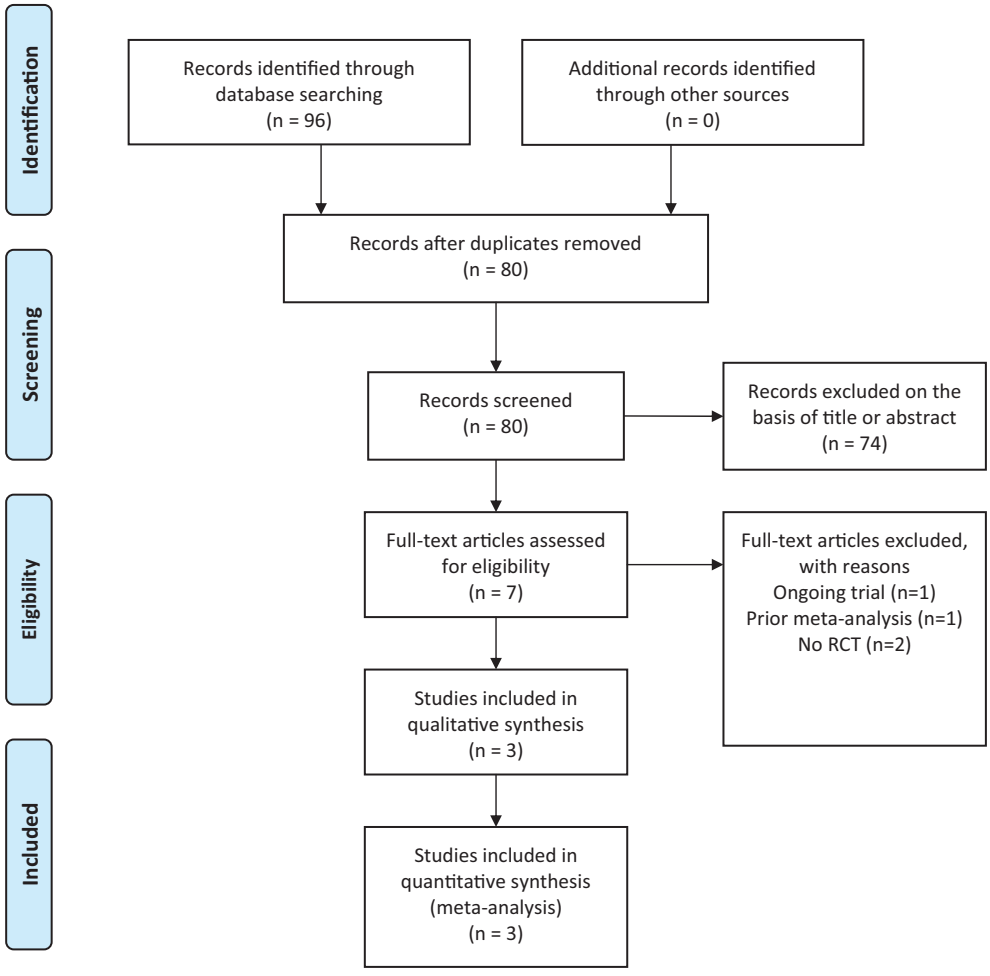

Figure 1. Flow diagram of studies identified in the systematic review. (Prisma template [Preferred Reporting Item for Systematic Reviews and Meta-analyses]).

Table 2. Characteristics of the included trials.

	Location	Population screened	Timing of screening	Risk factors for early screening	Fasting or not fasting state at screening	Sample size[a]
Meltzer, 2010 [22]	Canada	All pregnant women without pregestational DM	24–28 weeks	Presence of multiple risk factors[b]	Fasting	1500 (500 versus 1000)
Sevket, 2014 [23]	Turkey	Singleton gestations without pregestational DM	24–28 weeks	Not stated	Fasting	786 (386 versus 400)
Scifres, 2015 [24]	USA	Spontaneous-conceived, singleton gestations without pregestational DM	18–24 weeks	Not stated	Fasting	47 (24 versus 23)

[a]Number in the one step versus number in the two step group.
[b]According to the Canadian Diabetes Association 21.
DM: diabetes mellitus.

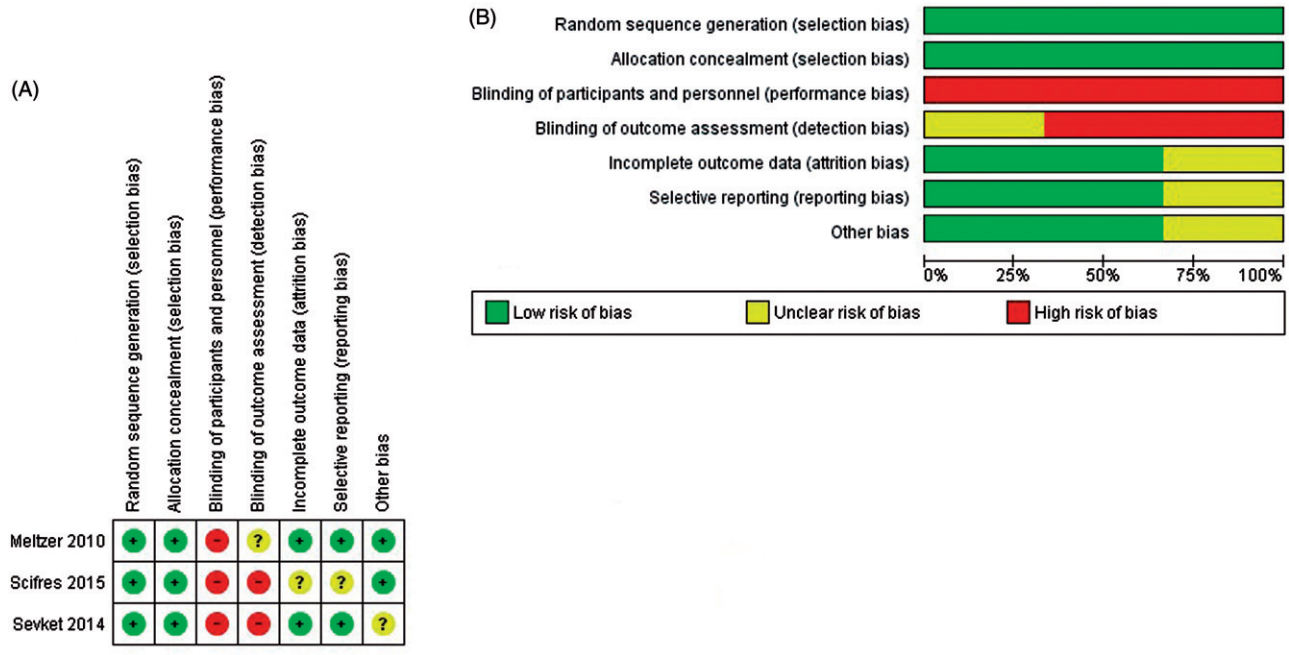

Figure 2. Assessment of risk of bias. (A) Summary of risk of bias for each trial; Plus sign: low risk of bias; minus sign: high risk of bias; question mark: unclear risk of bias. (B) Risk of bias graph about each risk of bias item presented as percentages across all included studies.

and 1423 to the two step approach (Table 1). Regarding the two step approach, one trial used 50 g 1 hr followed by 100 g 3 hrs [23]; in one trial all women had 50 g 1 hr test before randomization and were excluded if glucose ≥200 mg/dL and then women in the control group received 100 g 3 hrs [24]; finally, Meltzer et al. [22] was a three arms trial with two control groups: two step 50 g 1 hour followed by 100 g 3 hrs, and two step 50 g 1 hour followed by 75 g 2 hours. For this review, both control groups of this trial [22] were considered as control group (Table 3).

Data about diabetes management were available for two RCTs. Both studies used four blood glucose measurements per day, fasting and 1 hour after main meals; glucose cutoff values were 95 mg/dL fasting and 140 mg/dL 1 hour after meals. Management differed on cutoffs for change from diet to pharmacologic therapy, type of initial therapy, criteria for dose adjustment and criteria for modify therapy. Meltzer [22] gave precise indications on management, while Scifres [24] preferred changes based on clinician judgement (Table 4).

Tables 5 and 6 show the primary and the secondary outcomes. No significant difference in the incidence of GDM was found comparing the one step versus the two step approach (8.4 versus 4.3%; RR 1.64, 95%CI 0.77–3.48; Figure 3). Women screened with the one step approach had a significantly lower risk of PTB, cesarean delivery, macrosomia, LGA, NICU admission, and neonatal hypoglycemia, compared to those randomized to the screening with the two step approach (Tables 5 and 6). Moreover, women in the

Table 3. Study design of the included trials.

	Study group	Study group cutoffs	Control group (1)	Control group cutoffs	Control group (2)
Meltzer, 2010 [22]	One step (2 hrs, 75 g)	CDA: fasting 95 mg/dL; 1 h 190 mg/dL; 2 h 160 mg/dL	Two step (50 g 1 hr; 100 g 3 hrs)	NDDG: fasting 105 mg/dL; 1 h 190 mg/dL; 2 h 165 mg/dL; 3 h 145 mg/dL	Two step (50 g 1 hr; 75 g 2 hrs)
Sevket, 2014 [23]	One step (2 hrs, 75 g)	IADPSG: fasting 92 mg/dL; 1 h 180 mg/dL; 2 h 153 mg/dL	Two step (50 g 1 hr; 100 g 3 hrs)	C&C: fasting 95 mg/dL; 1 h 180 mg/dL; 2 h 155 mg/dL; 3 h 140 mg/dL	–
Scifres, 2015 [24][a]	One step (2 hrs, 75 g)	IADPSG: fasting 92 mg/dL; 1 h 180 mg/dL; 2 h 153 mg/dL	Two step (50 g 1 h; 100 g 3 h)	C&C: fasting 95 mg/dL; 1 h 180 mg/dL; 2 h 155 mg/dL; 3 h 140 mg/dL	–

[a]All women in this study first had a 50 g 1 hr test before randomization and were excluded if glucose ≥200 mg/dl.
CDA: Canadian Diabetes Association; NDDG: National Diabetes Data Group; IADPSG: International Association of Diabetes and Pregnancy Study Group; C&C: Carpenter and Coustan.

Table 4. Diabetes management and primary outcome.

		Meltzer, 2010 [22]	Sevket, 2014 [23]	Scifres, 2015 [24]
Management	Frequency of glucose testing	Prebreakfast and 1 h after meals (QID)[a]	Not stated	4x/day; fasting and 1 hr pp[a]
	Glucose target values	Fasting 75–95 1h PC meal ≤140[a]	Not stated	Fasting <95 mg/dL; 1 hr pp <140 mg/dL[a]
	Cutoffs for change from diet to therapy	As above for 3 days in a row or 4/7 days[a]	Not stated	Per clinician judgement[a]
	Type of initial therapy	Lifestyle followed by insulin PRN[a]	Not stated	Glyburide or insulin[a]
	Dose and frequency of initial therapy	NPH HS 4–10 units or premeal 2–4 units to start[a]	Not stated	Per clinician judgement[a]
	Criteria for pharmacologic therapy dose adjustment	Patients given adjustment algorithm for q2d changes if not at target[a]	Not stated	Per clinician judgement[a]
	Criteria for adding or switching pharmacologic therapy	Only switch was lifestyle to insulin if not at targets[a]	Not stated	Per clinician judgement[a]
Primary outcome		Costs of screening and maternal and neonatal outcomes for overall study	Maternal and neonatal outcomes	Maternal and neonatal outcomes

[a]Additional unpublished data kindly obtained by the original authors.

one step group had also a lower birth weight of about 135 grams (Table 6). Given that only one trial [22] compared the two screening approaches in terms of costs, pooled data for this outcome were not available.

Subgroup analysis was performed for primary and secondary outcomes excluding Meltzer et al. [22], which was slightly different from the other two RCTs in terms of inclusion criteria (i.e. inclusion of also multiple gestations) and in terms of GDM screening criteria (Table 2). The subgroup analysis for the primary outcome revealed that the one step approach with 75 g 2 hours test using the IADPSG criteria was associated with a significant increase in the incidence of GDM compared to the two step approach with 50 g 1 hour followed for abnormals by the 3 h 100 g test using the C&C criteria (13.9 versus 5.7%; RR 2.43, 95%CI 1.54–3.82; Figure 4). This Meltzer trial [22] did not contribute data to quantitative meta-analysis for the secondary outcomes. Therefore, like in the main analysis, the one step approach with 75 g 2 hours test using the IADPSG criteria was associated with significantly lower risks of PTB, cesarean delivery, macrosomia, LGA, NICU admission, and neonatal hypoglycemia, as well as significantly lower birth weight compared to the two step approach with 50 g 1 hour followed for abnormals by the 3 h 100 g test using the C&C criteria (Tables 5 and 6) [23,24].

Discussion

This meta-analysis from three RCTs showed that screening women with the one step approach was associated with a nonsignificant difference in the incidence of GDM, compared to the two step approach. However, our study provides evidence that the one step approach is associated with better maternal and perinatal outcomes, including significantly lower risks of PTB, cesarean delivery, macrosomia, LGA, neonatal hypoglycemia, admission to NICU, and lower mean birth weight. Moreover, even if not statistically significant, in many other secondary outcomes, which were probably underpowered as uncommon, we found a nonsignificant trend for benefit in the one step group (Tables 5 and 6). When comparing the one step with 75 g 2 hours test using the IADPSG criteria (as recommended currently by IADPSG [7], FIGO [11], and WHO [13]), versus the two step with 50 g 1 hour followed for abnormals by the 3 h 100 g test using C&C criteria

Table 5. Maternal outcomes.

	GDM	GWG (grams)	Gestational hypertension	PE	PTB	Shoulder dystocia	Induction	Cesarean delivery
Meltzer, 2010 [22]	18/486 (3.6%) versus 36/982 (3.7%)	Not stated	Not stated	Not stated	Not stated	Not stated	Not stated	Not stated
Sevket, 2014 [23]	56/386 (14.5%) versus 24/400 (6.0%)	Not stated	57/386 (14.8%) versus 60/400 (15.0%)[a]	5/386 (1.3%) versus 25/400 (6.3%)[a]	15/386 (3.9%) 32/400 (8.0%)[a]	Not stated	Not stated	65/386 (17.6%) 91/400 (22.8%)[a]
Scifres, 2015 [24]	1/24 (4.3%) versus 0/23	13,244 ± 8391 versus 14,514 ± 8210	0/24 versus 0/23[a]	1/24 (4.3%) versus 0/23	0/24 versus 0/23[a]	1/24 (4.3%) versus 0/23	4/24 (18.2%) versus 6/23 (26.1%)	2/24 (8.7%) versus 2/23 (8.7%)
Total	75/896 (8.4%) versus 60/1405 (4.3%)	13,244 versus 14,514	57/410 (13.9%) versus 60/423 (14.2%)	6/410 (1.5%) versus 25/423 (5.9%)	15/410 (3.7%) versus 32/423 (7.6%)	1/24 (4.3%) versus 0/23	4/24 (18.2%) versus 6/23 (26.1%)	67/410 (16.3%) versus 93/423 (22.0%)
RR or MD (95% CI)	1.64 (0.77–3.48)	−1270 grams (−6016 to 3476)	0.98 (0.70–1.38)	0.49 (0.04–5.60)	**0.49 (0.27–0.88)**	2.88 (0.12–67.29)	0.64 (0.21–1.97)	**0.74 (0.56–0.99)**
I^2	65%	Not applicable	Not applicable	59%	Not applicable	Not applicable	Not applicable	0%

GMD: gestational diabetes mellitus; GWG: gestational weight gain; PE: preeclampsia; PTB: preterm birth; RR: relative risk; MD: mean difference; CI: confidence interval.
Data are presented as number (percentage) or as mean difference ± standard deviation.
Boldface data: statistically significant.
[a]Additional unpublished data kindly obtained by the original authors.

Table 6. Perinatal outcomes.

	BW (grams)	Stillbirth	Macrosomia	LGA	SGA	Neonatal hypoglycemia	Neonatal hyperbilirubinemia	NICU admission	Neonatal death
Meltzer, 2010 [22]	Not stated	Not stated	Not stated	Not stated	Not stated	Not stated	Not stated	Not stated	Not stated
Sevket, 2014 [23]	3,209 ± 613 versus 3,344 ± 522[a]	Not stated	11/386 (2.8%) versus 26/400 (6.5%)[a]	11/386 (2.8%) versus 26/400 (6.5%)[a]	11/386 (2.8%) versus 18/400 (4.5%)[a]	7/386 (1.8%) versus 19/400 (4.8%)[a]	24/386 (6.2%) versus 31/400 (7.8%)[a]	18/386 (4.7%) versus 38/400 (9.5)[a]	1/386 (0.3%) 4/400 (1.0%)[a]
Scifres, 2015 [24]	Not stated	0/24 versus 0/23	1/24 (4.3%) versus 3/23 (13.0%)	1/24 (4.2%) versus 3/23 (13.0)[a]	3/24 (12.5%) versus 3/23 (13.0%)[a]	0/24 versus 0/23[a]	Not stated	0/24 versus 0/23[a]	0/24 versus 0/23[a]
Total	Not stated	0/24 versus 0/23	12/410 (2.9%) versus 29/423 (6.9%)	12/410 (2.9%) versus 29/423 (6.9%)	14/410 (2.9%) versus 21/423 (5.0%)	7/410 (1.7%) versus 19/423 (4.5%)	24/386 (6.2%) versus 31/400 (7.8%)	18/410 (4.4%) versus 38/423 (9.0%)	1/410 (0.2%) versus 4/423 (0.9%)
RR or MD (95% CI)	**−135 grams (−214.73 to −55.27)**	Not applicable	**0.43 (0.22–0.82)**	**0.43 (0.22–0.82)**	0.69 (0.35–1.33)	**0.38 (0.16–0.90)**	0.80 (0.48–1.34)	**0.49 (0.29–0.84)**	0.26 (0.03–2.31)
I^2	Not applicable	Not applicable	0%	0%	0%	Not applicable	Not applicable	Not applicable	Not applicable

RR: relative risk; MD: mean difference; CI: confidence interval; BW: birth weight; LGA: large for gestational age; SGA: small for gestational age; NICU: neonatal intensive care unit.
Data are presented as number (percentage, number in the one step versus number in the two step groups).
Boldface data: statistically significant.
[a]Additional unpublished data kindly obtained by the original authors.

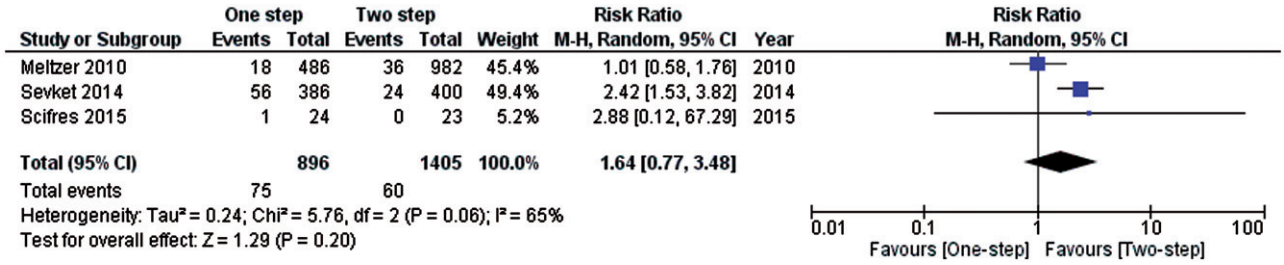

Figure 3. Forest plot for the incidence of gestational diabetes mellitus. CI: confidence interval.

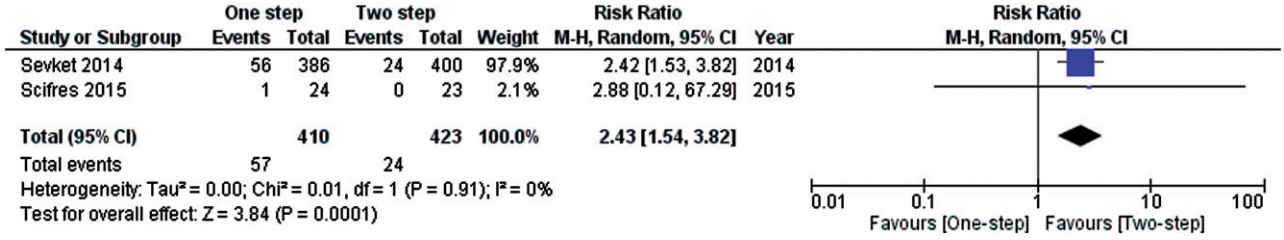

Figure 4. Forest plot for the incidence of gestational diabetes mellitus in subgroup analysis comparing the one step with 75 g 2 hours test using the International Association of Diabetes and Pregnancy Study Group (IADPSG) criteria, versus the two step with 50 g 1 hour followed for abnormals by the 3 h 100 g test using the Carpenter and Coustan (C&C) criteria. CI: confidence interval.

(as recommended currently by ACOG [6] and ADA [9]), the one step with IADPSG criteria was associated with significantly higher incidence of GDM (13.9 versus 5.7%), and significantly lower risk of PTB, cesarean delivery, macrosomia, LGA, neonatal hypoglycemia, admission to NICU, and lower mean birth weight (Tables 5 and 6).

This may be the first meta-analysis of RCTs comparing the one with the two step approach for screening of GDM. A prior Cochrane review by Farrar et al. aimed to evaluate and compare different testing strategies for diagnosis of GDM to improve maternal and infant health while assessing their impact on healthcare service costs [27]. Six small RCTs, including 694 women, were analyzed. However, none of these included studies compared one versus two step approach and therefore this analysis was not carried out [27].

Only three RCTs were included in our meta-analysis. The largest one [22], did not report data on maternal and perinatal outcomes and therefore the second largest trial [23], drives the statistics in terms of maternal and benefits for the one step approach. This is the major shortcoming of our meta-analysis. Meltzer et al. [22] was slightly different from the other two in terms of inclusion criteria (i.e. inclusion of also multiple gestations) and in terms of GDM screening criteria, and also had two different control groups (Table 3). Only one trial [22], compared the two screening methods in terms of costs. Meltzer et al. concluded that the two step approach was less expensive with equivalent diagnostic power compared to the one step approach [22]. Another limitation of our study may be that lowering the diagnostic criteria in any way that increases the incidence of the disease will increase the false positive rate and include more patients who are on the normal side of the spectrum in the "diseased" category. And that will improve outcomes in the "diseased" group, because those patients aren't really all "diseased".

Different approaches and criteria for screening and diagnosis of GDM have been proposed in the literature (Table 1) [6,7,9–14]. The most common approaches are the one step and the two step ones. Recent controversy [6,7] has focused on the fact that IADPSG [7], FIGO [11], and WHO [13], as well as other societies, recommend the 75-gram 2 hours test using the IADPSG criteria, while ACOG [6] and ADA [9] recommend the two step with 50 g 1 hour followed for abnormals by the 3 h 100 g test using C&C criteria. The argument against the one step approach has been that it increases the incidence of GDM significantly, without proven improvement in maternal and/or perinatal outcomes [6]. Our meta-analysis of RCTs revealed that indeed, compared to the two step with 50 g 1 hour followed for abnormals by the 3 h 100 g test using C&C criteria, the 75-gram 2 hours test using the IADPSG criteria is associated with significantly higher incidence of GDM (13.9 versus 5.7%), but also with significantly lower risk of PTB (3.7 versus 7.6%), cesarean delivery (16.3 versus 22.0%), macrosomia (2.9 versus 6.9%), neonatal hypoglycemia (1.7 versus 4.5%), admission to NICU (4.4 versus 9.0%), and lower mean birth

weight by 135 grams (Tables 5 and 6). Clinically, these are important outcomes, which would advise towards recommending more globally the 75-gram 2 hours test using the IADPSG criteria, especially if confirmed by more level 1 data, and by cost-effectiveness analyses based on data from this meta-analysis. Data from our meta-analysis may also explain, perhaps in small part, the higher risks of some of these outcomes (e.g. PTB, cesarean delivery, macrosomia) in the USA, where the two step with 50 g 1 hour followed for abnormals by the 3 h 100 g test using C&C criteria is commonly used [6], compared to most European countries, where in general the 75-gram 2 hours test using the IADPSG criteria is more commonly used. The 75-gram 2 hours test using the IADPSG criteria has the added benefit of being only one step, and so giving potentially results for GDM diagnosis sooner, but the downside of requiring fasting for all women being screened for GDM.

In summary, the one and the two step approach screening were associated with nonsignificant difference in the incidence of GDM. However, the one step approach was associated with better maternal and perinatal outcomes, including lower risk of PTB, cesarean delivery, macrosomia, LGA, neonatal hypoglycemia, admission to NICU, and lower mean birth weight.

Disclosure statement

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