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Systematic review

# Effect of spontaneous pushing versus Valsalva pushing in the second stage of labour on mother and fetus: a systematic review of randomised trials

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**Background** Valsalva pushing is frequently used in the second stage of labour, but the evidence for this pushing technique is not clear.

**Objectives** To critically evaluate any benefit or harm for the mother and her baby of Valsalva pushing versus spontaneous pushing in the second stage of labour.

**Search strategy** Electronic databases from MEDLINE, EMBASE, CINAHL, and the Cochrane Central Register of Controlled Trials were systematically searched (last search May 2010). The reference lists of retrieved studies were searched by hand and an internet hand search of master theses and dissertations was performed. No date or language restriction was used.

**Selection criteria** Randomised controlled trials that compared instructed pushing with spontaneous pushing in the second stage of labour were considered. Studies were evaluated independently for methodological quality and appropriateness for inclusion by two authors (MP and JB).

**Data collection and analysis** The primary outcome was instrumental/operative delivery. Other outcomes were length of labour, any perineal repair, bladder function, maternal satisfaction. Infant outcomes included low Apgar score <7 after 5 minutes, umbilical arterial pH <7.2, admission to neonatal intensive care unit and serious neonatal morbidity or perinatal death.

**Main results** Three randomised controlled studies covering 425 primiparous women met the inclusion criteria. Women who used epidural analgesia were excluded in all three studies. No statistical difference was identified in the number of instrumental/operative deliveries (three studies; 425 women; relative risk 0.70; 95% CI 0.34–1.43), perineal repair, postpartum haemorrhage. Length of labour was significantly shorter in women who used the Valsalva pushing technique (three studies; 425 women; mean difference 18.59 minutes; 95% CI 0.46–36.73 minutes). Neonatal outcomes did not differ significantly. Urodynamic factors measured 3 months postpartum were negatively affected by Valsalva pushing. Measures of first urge to void and bladder capacity were decreased (one study; 128 women; mean difference respectively 41.50 ml, 95% CI 8.40–74.60, and 54.60 ml, 95% CI 13.31–95.89).

**Authors' conclusion** The evidence from our review does not support the routine use of Valsalva pushing in the second stage of labour. The Valsalva pushing method has a negative effect on urodynamic factors according to one study. The duration of the second stage of labour is shorter with Valsalva pushing but the clinical significance of this finding is uncertain. The primary studies are sparse, diverse and some flawed. Further research seems warranted. In the mean time supporting spontaneous pushing and encouraging women to choose their own method of pushing should be accepted as best clinical practice.

**Keywords** Pushing method, second stage of labour, systematic review, Valsalva.

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## Introduction

The Valsalva pushing technique during the second stage of labour is widely advocated.[1] When this technique is used, a woman is instructed to take a deep breath at the beginning of the contraction, to hold her breath and push as long and hard as she can in synchrony with her contractions. A woman who uses a spontaneous pushing approach is

self-directed in her bearing-down techniques. She may push with an open glottis and vocalisation or use an intermittent exhalation technique.[2] Using these self-directed pushing efforts the woman pushes in response to an involuntary urge. She starts pushing from a resting respiratory volume, without first taking a deep breath.[3] She will typically push three to five times for 3–5 seconds followed by a breath and release of air.[4] These spontaneous pushing efforts, also referred to as 'physiological pushing', vary in intensity and frequency.[5,6]

Maternal bearing-down efforts and their effect on the mother and the fetus have been studied and debated for decades[1,5–9]. Concerns have been raised about the potential adverse effect of Valsalva pushing on the fetal heart rate and oxygenation.[10] It is postulated that closed glottis pushing has maternal haemodynamic effects and increases intrathoracic pressure. This produces a drop in venous return to the heart, a drop in cardiac output, drop in maternal arterial pressure, drop in blood perfusion of the placenta, drop in oxygen supply to the fetus illustrated in lower pH and $Po_2$ of the umbilical arterial blood.[11] When bearing down by exhalation and open glottis, air escapes and the thoracic pressure is not maintained.

Measurements of intrauterine pressure have shown that the Valsalva pushing method performed during a contraction increased the intrauterine pressure by 62% compared with the baseline pressure of the contracted uterus.[12] Maternal pushing during the second stage is presumably a significant contributor to the expulsive forces and consequently influences the length of the second stage.[13]

It is also suggested that vigorous pushing might be one of the aetiological factors of perineal trauma[7,8,14,15] and of stress incontinence because of the increased downward stress resulting in potential damage to the anterior vaginal wall and to the supports of the bladder.[7]

Furthermore the Valsalva pushing style is associated with a more directive communication style of the midwife[16,17] or obstetrician, which could affect the woman's feelings of satisfaction and accomplishment about her delivery.

In September 2007 the British Royal College of Obstetricians and Gynaecologists stated in its clinical guideline on intrapartum care, that there is no high-level evidence that either directed pushing or spontaneous pushing affects outcomes.[18]

We conducted a systematic review and meta-analysis of randomised controlled trials to evaluate the benefits and harms associated with spontaneous, physiological pushing and Valsalva pushing in the second stage of labour among women with uncomplicated pregnancies. We hypothesised that if Valsalva pushing had an adverse effect on fetal well-being we would see an increase in the rate of operative/instrumental deliveries (caesarean section or forceps or vacuum extraction) for nonreassuring fetal heart rate.

## Methods

We compared the outcomes of women who were randomised to push according to the Valsalva manoeuvre or to push spontaneously.

The primary prespecified outcome was operative/instrumental delivery. Other outcomes related to the mother included: length of labour, caesarean section, episiotomy, perineal/vaginal/anal sphincter laceration, postpartum haemorrhage >1000 ml, bladder function, and maternal satisfaction. Infant outcomes included low Apgar score <7 after 5 minutes, umbilical arterial pH <7.2, need for intubation, admission to neonatal intensive care unit, serious neonatal morbidity or perinatal death not related to major congenital abnormalities.

### Inclusion and exclusion criteria

We included published and unpublished randomised controlled trials that compared instructed pushing with spontaneous pushing in the second stage of labour and in which at least one of our outcomes of interest was reported. We had no language restriction.

### Search strategy

We used four methods to identify the relevant studies comparing spontaneous pushing with the Valsalva pushing method. We performed a literature search in the Cochrane library, MEDLINE (1950 to May 2010), EMBASE (1980 to May 2010) and CINAHL (1982 to May 2010). We searched the registers of ongoing clinical trials: www.thecochrane library.com and www.controlled-trials.com, and performed an internet hand search to find relevant master's theses and dissertations on www.proquest.com. We cross-checked the reference lists of all relevant papers.

The search terms included Mesh headings and key words linked with Booleans OR, AND: ('Second stage of labour' or 'parturition' or 'expulsive phase' or 'childbirth' or 'deliver') and ('push*' or 'Valsalva' or 'bearing down') and ('pregnancy outcome' or 'infant' or 'neon*' or 'maternal' or 'mother').

### Quality assessment and data extraction

Quality was assessed for randomisation (sequence, blinding), loss to follow up, number of participants, description of intervention treatment and control treatment, outcome variables, blinding of outcome measurements, intention-to-treat analysis and blinding of analysis. Two reviewers independently assessed the eligibility of the randomised controlled trials for inclusion; any disagreement of assessment was discussed and resolved by consensus. The quality assessment data sheet is available on request. Data were extracted independently by two reviewers and recorded on a purpose-designed data sheet.

### Analysis

Statistical analysis was carried out using Review Manager software (RevMan, version 5.0, Copenhagen, Denmark: The Nordic Cochrane Centre, The Cochrane Collaboration, 2008).

Data were entered independently by two reviewers and cross-checked. For continuous data we pooled the mean outcome and the standard deviation to calculate the weighted mean difference and 95% confidence intervals. Dichotomous variables were presented as relative risks and 95% confidence intervals.

The assumption of homogeneity was tested using the $I^2$ test. Overall estimates of effect were calculated with the Mantel–Haenszel fixed-effect model. If the $I^2$ statistic was >50%, we used random-effect models. To evaluate the robustness of the results a sensitivity analysis was carried out by consecutively removing the high-quality studies and rerunning the analysis. Publication bias was assessed by inspection of the funnel plots.

## Results

The initial search yielded 584 citations; most titles were excluded ($n = 471$) because of lack of relevance to the topic of this review or duplication.

A total of 113 papers were left for review of the abstract or full text. Finally, 11 randomised controlled trials were retrieved for full-text review. One of these was an unpublished study and was found by hand search. We did not find any ongoing trials (Figure 1).

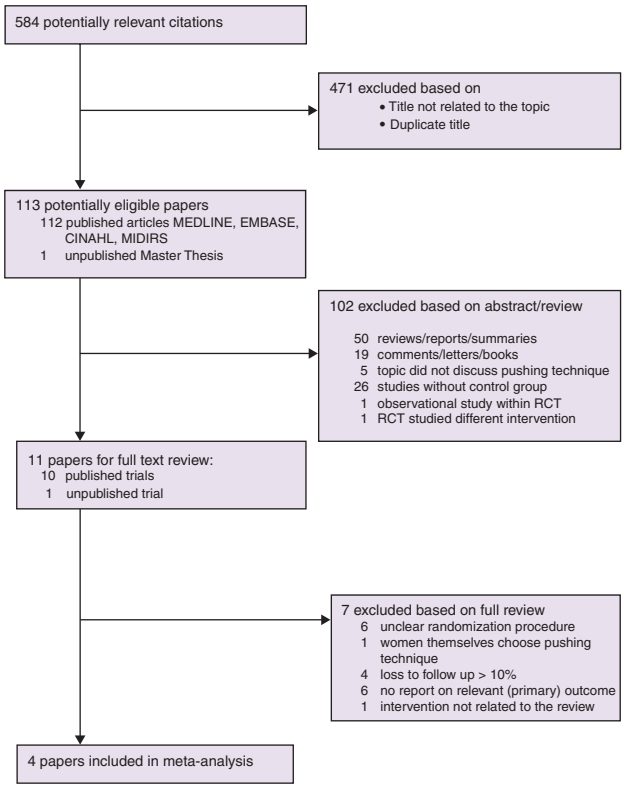


**Figure 1.** Results of literature review.

### Description of the studies

A total of 425 primiparous women from four papers[3,19–21] were included in the review: one study[19] was an unpublished master's thesis; two publications reported different outcomes based on the same trial data of 325 women[20,21] so we counted these women only once. The studies were conducted in the UK,[3] USA[20,21] and Hong Kong.[19] All trials only included low-risk, healthy, nulliparous women with an uncomplicated pregnancy and a gestational age of at least 36 weeks. Epidural analgesia was an exclusion criterion in all studies. The primary outcome of this review, instrumental delivery, was reported in all studies. Detailed information on the characteristics of the included studies is provided in Table 1. Reasons for exclusion are described in the Supporting Information (see Table S1). Seven studies were excluded.[4,22–27]

### Outcomes

*Maternal outcomes*

All studies reported on the primary outcome: operative/instrumental delivery. To determine the rate of caesarean section and instrumental delivery we subtracted spontaneous vaginal deliveries from the denominator, taking into account the loss to follow up. There was no significant difference in instrumental/operative deliveries between the spontaneous pushing group and the groups who pushed according to the Valsalva method (three studies; 425 women; overall fixed effect estimate of the risk ratio [RR] 0.90; 95% CI 0.34–1.43) (Figure 2).

The duration of the second stage was significantly shorter in the Valsalva pushing group (three studies; 425 women; mean difference in minutes 18.59; 95% CI 0.46–36.73) (Figure 3).

Because the $I^2$ was 78% a sensitivity analysis was carried out by consecutively removing the studies and rerunning the analysis.

The study by Thomson[3] is small and the outcomes of the mean duration of the second stage of labour differ extremely. Women in the spontaneous pushing group had a mean duration of the second stage of 121.4 minutes but in the women in the Valsalva group this was 57 minutes. This huge difference was not present in the studies by Bloom et al.[20] and Lam[19]. By excluding the study of Thomson the mean difference was 9.75 minutes; 95% CI 2.43–17.06 (Figure 3).

Bloom et al.[20] and Thomson[3] reported on perineal laceration. Episiotomy was measured by Bloom et al.[20] but they

**Table 1.** Characteristics of the studies included comparing spontaneous pushing in the second stage of labour with the Valsalva pushing technique

| Author, Study period, Country, Population | Criteria for inclusion/exclusion | Primary outcomes instrumental/ operative delivery | | Other outcomes | Comments |
|---|---|---|---|---|---|
| | | Intervention Spontaneous pushing | Control Valsalva pushing | | |
| Thomson[3]<br>1993<br>UK<br>*n* = 32 | Inclusion<br>primiparous women aged over 18<br>singleton pregnancy >37 weeks<br>cephalic presentation<br>absence of maternal or fetal condition that would affect the management of the second stage of labour<br>Exclusion<br>conception achieved *in vitro*<br>baby was to be adopted<br>use of epidural analgesia | 12/15 normal delivery | 15/17 normal delivery | No significant difference in<br>perineal trauma rate<br>estimated maternal blood loss<br>umbilical venous blood gas levels<br>fetal acid–base status<br>Significantly<br>longer second stage in the spontaneous pushing group. | Randomisation using a table with random numbers, women at least 6 cm dilated. Researcher who was present at the time of randomisation.<br>Pushing started as soon as the second stage of labour was diagnosed.<br>After 90 minutes of pushing the midwife could adopt whatever clinical management she thought would fit. Mean duration of second stage in spontaneous group was 121.4 minutes.<br>Outcome data all complete.<br>Intention-to-treat analysis. |
| Schaffer[21]*<br>2005<br>USA<br>*n* = 128<br>Hispanic women | Inclusion<br>nulliparous women<br>singleton pregnancy 36–41 weeks<br>cephalic presentation<br>uncomplicated pregnancy<br>cervical dilatation at least 4 cm<br>Exclusion<br>use of oxytocin<br>use of epidural analgesia<br>history of urinary/anal incontinence<br>history of pelvic organ prolapse<br>estimated fetal weight >4000 g<br>any known complication of pregnancy | | | No significant difference in<br>maximum urethral closure<br>functional urethral length<br>positive Valsalva leak point pressure<br>maximum flow rate ml/sec<br>detrusor pressure at peak flow<br>detrusor overactivity<br>urodynamic stress incontinence<br>Significant difference<br>decreased bladder capacity in Valsalva group<br>decreased first urge to void in Valsalva group | Allocation to study group adequate, see Bloom's study. Three months postpartum women were invited to undergo urodynamic tests. 61 from the intervention and 67 from the control group participated<br>Urogynaecology nurse practitioners measured outcomes and were blinded to obstetric management |

**Table 1.** (*Continued*)

| Author, Study period, Country, Population | Criteria for inclusion/exclusion | Primary outcomes instrumental/ operative delivery | | Other outcomes | Comments |
|---|---|---|---|---|---|
| | | Intervention Spontaneous pushing | Control Valsalva pushing | | |
| Bloom[20]*<br>2006<br>USA<br>*n* = 325<br>Hispanic women | Inclusion<br>nulliparous women<br>singleton pregnancy 36–41 weeks<br>cephalic presentation<br>uncomplicated pregnancy<br>cervical dilatation at least 4 cm<br>regular uterine contractions<br>Exclusion<br>use of oxytocin<br>use of epidural analgesia<br>estimated fetal weight >4000 g<br>known complication of pregnancy<br>history of urinary/anal incontinence<br>history of pelvic organ prolapse | 7/157 instrumental<br>1/157 caesarean section | 6/163 instrumental<br>5/163 caesarean section | No significant difference in<br>umbilical arterial pH<br>Apgar score <7<br>Admission to neonatal intensive care unit<br>perineal lacerations<br>Significantly<br>longer second stage in the spontaneous pushing group | Computer generated randomisation in blocks of ten women at the onset of the second stage<br>Pushing started as soon as the second stage of labour was diagnosed.<br>Data outcome 320/325 complete<br>Intention-to-treat analysis |
| Lam[19]<br>2006<br>Hong Kong<br>*n* = 78,<br>Chinese women | Inclusion<br>woman between 18 and 40 years<br>experienced their first birth<br>healthy singleton fetus ≥37 weeks<br>cephalic presentation<br>uncomplicated pregnancy<br>Exclusion<br>medical or obstetric complication which would affect the management of the second stage of labour<br>use epidural analgesia | 0/35 instrumental (0/35 caesarean section) | 4/38 instrumental (0/38 caesarean section) | No significant difference in<br>length of the second stage of labour<br>umbilical arterial pH<br>Apgar score <7<br>admission to neonatal intensive care unit<br>perineal lacerations<br>Significantly<br>more instrumental deliveries in the Valsalva group | Block randomisation on balanced blocks of ten at the onset of the second stage<br>After 60 minutes of pushing the woman was changed over to the clinical management policy of the unit<br>Pushing started when the fetal head was at +1 level of the ischial spines<br>Control group 3/41 incomplete forms. In the experimental group 2/37 incomplete forms<br>Intention-to-treat analysis |

*Bloom and Schaffer used the same data from the trial with 325 women but presented different variables. In the table and meta-analysis we counted these women once.

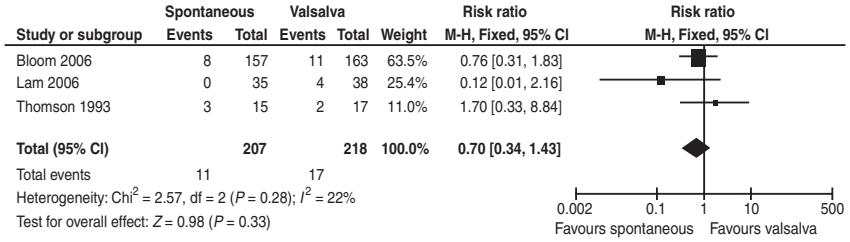


**Figure 2.** Meta-analysis results: instrumental/operative delivery.

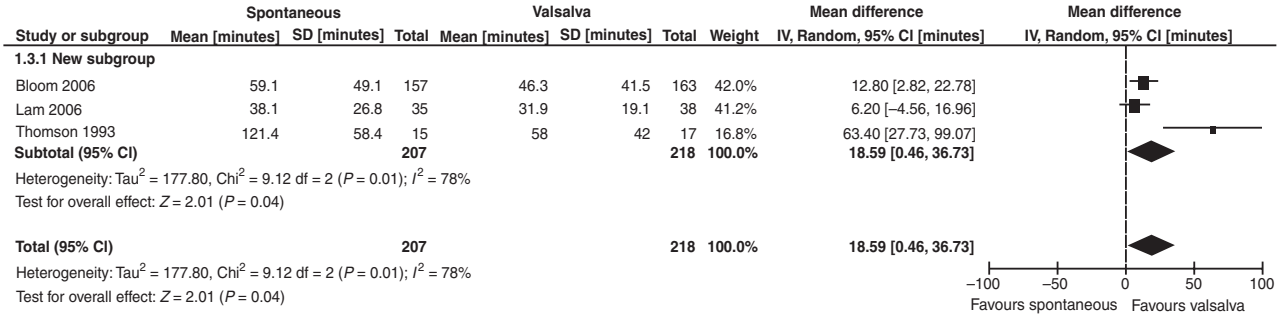


**Figure 3.** Meta-analysis results: duration of second-stage of labour.

showed no difference between the spontaneous and Valsalva groups (one study; 320 women; RR 0.79; 95% CI 0.53–1.19) (Table 2). Overall, perineal repair showed no significant difference (two studies; 352 women; RR 0.95; 95% CI 0.64–1.40) (Table 2).

Because the $I^2$ was 57% we performed a sensitivity analysis by excluding the studies one by one. A nonsignificant trend towards fewer lacerations in the spontaneous pushing group became clear after excluding the small study of Thomson (one study; 320 women; RR 0.82, 95% CI 0.67–1.00). Excluding the trial which contributed 65.5% of the weight showed again no difference (one study; 320 women; RR 1.25, 95% CI 0.76–2.06).

Only Schaffer et al.[21] reported urodynamic parameters. Bladder capacity and a first urge to void during testing (measured by filling the bladder using cystometry at a rate of 100 ml/minutes) were significantly decreased (one study; 128 women; mean difference of first urge to void 41.50 ml; 95% CI 8.40–74.60) and mean difference of bladder capacity 54.60 ml; 95% CI 13.31–95.89). No other significant differences regarding bladder function were found. (Table 2).

One study ($n = 32$) reported on maternal satisfaction.[3] Thomson used five questions and assessed women's views on the pushing part of the second stage of labour using a 10-cm visual analogue scale. The outcomes did not differ significantly.

*Infant outcomes*

There were no significant differences following spontaneous or Valsalva pushing in Apgar scores <7 after 5 minutes, mean Apgar scores after 5 minutes, mean umbilical artery pH, mean umbilical vein pH, umbilical artery pH <7.20. (Table 2). Also the need for resuscitation did not differ, though in the small study by Thomson the need for resuscitation in both groups was high. One-third of the neonates needed resuscitation. Admission to neonatal intensive care unit did not differ between the groups (Table 2).

## Discussion

This meta-analysis of randomised controlled trials compared spontaneous pushing with the Valsalva technique in 425 women and showed no difference in operative/instrumental deliveries. A significant reduction of 18.59 minutes in duration of the second stage of labour was found in women who used the Valsalva pushing technique.

One study[21] showed that Valsalva pushing resulted in a significant decrease of first urge to void and in a decreased bladder capacity 3 months postpartum, suggesting that this technique may have harmful effects on pelvic-floor function. All other neonatal or maternal outcomes showed no significant difference.

We are uncertain of the clinical relevance of a shorter second stage of labour because no significant difference was found in operative/instrumental deliveries or in fetal condition.

Our study, which discusses a topic that affects all labouring women, has some strengths. All 425 participants were nulliparous, low-risk women. Potential confounders such as complicated pregnancies and use of epidural analgesia were

**Table 2.** Summary of the meta-analysis of maternal and fetal outcomes

| Outcome or subgroup | Studies | Participants | Statistical method* | Effect estimate | *P* value | Heterogeneity $I^2$ (%) |
|---|---|---|---|---|---|---|
| Operative or instrumental delivery | 3 | 425 | Risk Ratio (M-H, Fixed, 95% CI) | 0.70 (0.34–1.43) | 0.33 | 27 |
| Duration of second stage defined from full dilatation (minutes) | 3 | 425 | Mean difference (IV, Random, 95% CI [minutes]) | 18.59 (0.46–36.73) | 0.04 | 78 |
| Episiotomy | 1 | 320 | Risk ratio (M-H, Fixed, 95% CI) | 0.79 (0.53–1.19) | 0.26 | |
| pH arterial <7.20 mmol/l | 1 | 320 | Risk ratio (M-H, Fixed, 95% CI) | 0.65 (0.22–1.94) | 0.44 | |
| Mean venous pH | 1 | 32 | Mean difference (IV, Fixed, 95% CI) | –0.05 (–0.12 to 0.02) | Not applicable | |
| Mean arterial pH | 1 | 320 | Mean difference (IV, Fixed, 95% CI) | 0.00 (–0.22 to 0.22) | 1.00 | |
| Mean Apgar score after 5 minutes | 1 | 73 | Mean difference (IV, Fixed, 95% CI) | 0.00 (–0.23 to 0.23) | 1.00 | |
| Apgar score <7 after 5 minutes | 2 | 393 | Risk ratio (M-H, Fixed, 95% CI) | 0.35 (0.01–8.43) | 0.51 | Not applicable |
| Any perineal repair | 2 | 352 | Risk ratio (M-H, Random, 95% CI) | 0.95 (0.64–1.40) | 0.79 | 57 |
| Third- or fourth-degree tear | 1 | 320 | Risk ratio (M-H, Fixed, 95% CI) | 0.87 (0.45–1.66) | 0.66 | |
| Need for resuscitation | 2 | 352 | Risk ratio (M-H, Fixed, 95% CI) | 0.83 (0.40–1.75) | 0.63 | 0 |
| Admission to neonatal intensive care unit | 2 | 393 | Risk ratio (M-H, Fixed, 95% CI) | 1.08 (0.30–3.79) | 0.91 | 0 |
| Mean estimated blood loss | 2 | 105 | Mean difference (IV, Fixed, 95% CI) | 9.72 (–37.84 to 57.29) | 0.69 | 0 |
| First urge to void | 1 | 128 | Mean difference (IV, Fixed, 95% CI) | 41.50 (8.40–74.60) | 0.01 | |
| Bladder capacity | 1 | 128 | Mean difference (IV, Fixed, 95% CI) | 54.60 (13.31–95.89) | 0.010 | |

*IV, inverse variance; M-H, Mantel–Haenszel.

excluded in all three studies. This is demonstrated by the low incidence of caesarean section and instrumental deliveries, reduced Apgar score and reduced umbilical cord pH.

We also think the meta-analysis has some limitations which affects the external validity of the study. First, the population in the review consisted mainly of Hispanic and Chinese women and the included studies were small. Seven out of ten studies did not meet our quality criteria.

Second, blinding of the intervention was not possible and there is a chance of measurement bias for some of the subjective outcome variables like Apgar score, duration of the second stage of labour and mean estimated blood loss. Third, it is plausible that a variation in pushing instructions and a variation in compliance to the assigned pushing method existed.[22,28]

In addition to this, the onset of the second stage of labour was defined differently between the studies. One study excluded women who used oxytocin.[20] The two smaller studies made no reference to the use of oxytocin. Only one study reported the birthing position and birthing position has been shown to effect maternal and fetal outcomes.[29]

Furthermore, it was impossible to compare the neonatal and maternal outcomes because all studies used different parameters to measure the condition of the neonate and maternal outcomes. Therefore pooling was not possible. Finally, the sample size of this review ($n = 425$) was too small to study adverse neonatal outcomes in a low-risk population.

## Conclusion

The sparse evidence from our review does not support the routine use of Valsalva pushing in the second stage of labour for women who deliver without epidural analgesia, but the studies were too small to report on the important outcomes.

Given the wide prevalence of the use of the Valsalva pushing technique, further rigorous research needs to be undertaken before it can be recommended. A randomised controlled trial large enough to answer the questions of the (long-term) maternal effects and neonatal morbidity is suggested. The trial should include a sample of low-risk primiparous women preferably of diverse ethnic origin. Measurement of compliance to the protocol, and of confounders like birthing position, fetal station, use of oxytocin and other medication, is required. Attention must be paid to independent measurement of the outcome variables. Use of validated questionnaires or additional qualitative research is recommended to gain more insight into maternal satisfaction and satisfaction of the caregiver.

Until more evidence is available we think spontaneous pushing should be accepted as good practice and women preferably should be encouraged to choose their own pushing technique. They should be supported in following the feelings of their bodies and use their own bearing down efforts and urges to push. The caregiver can provide more explicit direction, guidance and assistance with bearing down on the woman's request or whenever it seems reasonable, e.g. when the second stage of labour needs to be hastened.

### Disclosure of interest
There were no conflicts of interests.

### Contribution to authorship
MP wrote the protocol and performed the literature search. MP and JB selected the studies and assessed the studies for risk of bias. CL and EH contributed to the development of the protocol, methodological issues, conduct of the review and meta-analysis. All authors participated in reviewing and editing the manuscript. MP has final responsibility for the decision to submit for publication.

### Details of ethics approval
No ethics approval was required.

### Funding
We received no funding.

## Supporting information

The following Supporting Information are available for this article:

**Table S1.** Characteristics of the excluded randomised controlled studies.

Additional Supporting Information may be found in the online version of this article.

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