National Institute for Health and Care Excellence

Draft for consultation

Intrapartum care for healthy women and babies

[H] Pushing techniques

NICE guideline CG190 (update)

Evidence review underpinning recommendations 1.9.7, 1.9.9, 1.9.10 in the NICE guideline

April 2023

Draft

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Pushing techniques

Review question

What are the benefits and risks of the different pushing techniques (immediate, spontaneous, delayed, directed) in the second stage of labour in women with and without regional analgesia?

Introduction

A range of different pushing techniques may be used in the second stage of labour to assist with the birth of the baby.

Spontaneous pushing is when women have an instinctive and irresistible urge to push, and may push several times during one contraction. Directed pushing is when women are encouraged to take a deep breath in at the beginning of the contraction and push throughout the duration of each contraction. Women can push with an open glottis (on exhalation) or closed glottis (Valsalva manouevre).

Pushing may either commence as soon as the cervix is fully dilated (immediate pushing), or be delayed from the time of complete cervical dilation to allow a period of passive descent where the uterine contractions alone may propel the baby through the birth canal. In women with regional analgesia (an epidural) in place the urge and ability to push may be reduced, and so a delay may ensure that the baby has descended further into the birth canal before directed pushing is commenced, which may help to shorten the active second stage.

There is uncertainty as to whether one pushing technique is more beneficial than another, and whether pushing should be delayed or begin immediately at the time of diagnosis of full dilatation of the cervix.

The aim of this review is to identify the benefits and risks of different pushing techniques and identify the optimal pushing technique for birth outcomes and birth experience for women with and without an epidural.

Summary of the protocol

See Table 1 for a summary of the Population, Intervention, Comparison and Outcome (PICO) characteristics of this review.

Table 1: Summary of the protocol (PICO table)

Population	• Women in the second stage of labour with or without regional analgesia who are pregnant with a single baby who has not been identified before labour to be at high risk of adverse outcomes; who go into labour at term (37 to 42 weeks of pregnancy) and who do not have any pre-existing medical conditions or antenatal conditions that predispose to a higher risk birth • Singleton babies born at term (37 to 42 weeks of pregnancy) with no previously identified problems (for example congenital malformations, genetic anomalies, intrauterine growth restriction, placental problems)
Intervention	Any kind of breathing or pushing technique in the second stage of labour. Interventions will be categorised as follows: • Timing of pushing techniques: ○ Immediate/active pushing: this refers to pushing techniques which begin as soon as the woman is fully dilated ○ Passive descent or delayed pushing: this refers to pushing techniques which allow for spontaneous descent • Type of pushing techniques: ○ Directed pushing or Valsalva manoeuvre: this refers to pushing techniques which encourage women to take a deep breath at the beginning of a contraction, then hold it and bear down throughout the contraction ○ Spontaneous, physiological or mother-led pushing: this refers to pushing techniques which follow the woman's natural urge to push
Comparison	• Different timing of pushing techniques compared against each other (for example, immediate versus delayed pushing) • Different type of pushing techniques compared against each other (for example, directed versus spontaneous pushing) • Different timing of pushing techniques compared against different type of pushing techniques (for example, immediate versus directed)
Outcome	**Critical:** • Mode of birth (spontaneous vaginal, instrumental vaginal, caesarean birth) • Third/fourth degree tears • Apgar score <7 at 5 minutes **Important:** • Duration of active second stage (minutes)/duration of pushing (minutes) • Duration of passive second stage (minutes) • Women's experience of labour and birth • Neonatal admission

For further details see the review protocol in appendix A.

Methods and process

This evidence review was developed using the methods and process described in Developing NICE guidelines: the manual. Methods specific to this review question are described in the review protocol in appendix A and the methods document (Supplement 1).

Declarations of interest were recorded according to NICE's conflicts of interest policy.

Effectiveness evidence

Included studies

Nine studies were included for this review. Eight were randomised controlled trials (RCTs) (Ahmadi 2017, Araujo 2021, Barasinski 2020, Barnett 1982, Koyucu 2017, Parnell 1983, Walker 2012, Yuksel 2017) and 1 was a systematic review (Lemos 2017). The systematic review had 16 RCTs included (Buxton 1988, Fitzpatrick 2002, Fraser 2000, Goodfellow 1979, Hansen 2002, Jahdi 2011, Kelly 2010, Lam 2010, Low 2013, Mayberry 1999, Plunkett 2003, Schaffer 2005, Thomson 1993, Vause 1998, Vaziri 2016, Yildirim 2008).

Three studies (Ahmadi 2017, Barasinski 2020, Barnett 1982) compared directed pushing with open glottis breathing technique to directed pushing with closed glottis or Valsalva manoeuvre breathing technique. Eleven studies (Araujo 2021, Jahdi 2011, Koyucu 2017, Lam 2010, Low 2013, Parnell 1993, Schaffer 2005, Thomson 1993, Vzairi 2016, Yildirim 2008, Yuksel 2017) compared spontaneous pushing to directed pushing using closed glottis. Ten studies (Buxton 1988, Fitzpatrick 2002; Fraser 2000; Goodfellow 1979; Hansen 2002; Kelly 2010; Mayberry 1999; Plunkett 2003; Vause 1998, Walker 2012) compared immediate to delayed pushing.

The studies were from Brazil, Canada, Denmark, France, Hong Kong, Iran, Ireland, Spain, Turkey, United Kingdom and the United States.

The included studies are summarised in Table 2.

See the literature search strategy in appendix B and study selection flow chart in appendix C.

Excluded studies

Studies not included in this review are listed, and reasons for their exclusion are provided in appendix J.

Summary of included studies

Summaries of the studies that were included in this review are presented in Table 2.

Table 2: Summary of included studies.

Study	Population	Intervention	Comparison	Outcomes
Ahmadi 2017 Randomised controlled trial Iran	N=172 women Primiparous No epidural	Directed breathing with open glottis	Directed breathing holding the breath	• Third/fourth degree tears

Araujo 2021
 	
Randomised controlled trial
 	
Brazil
	N=210 women
	
	Mixed parity
	
	No epidural
		Spontaneous pushing	Directed pushing using closed glottis	• Mode of birth:
				  ○ Spontaneous vaginal birth
				  ○ Instrumental birth
				  ○ Caesarean birth
				• Apgar score <7 at 5 minutes
				• Duration of active second stage
				• Duration of second stage

Study	Population	Intervention	Comparison	Outcomes
				• Women's experience of labour and birth • Neonatal admission
Barasinski 2020 Randomised controlled trial France	N=250 women Mixed parity With epidural	Directed breathing with open glottis	Directed breathing with closed glottis	• Mode of birth: ○ Spontaneous vaginal birth ○ Instrumental vaginal birth ○ Caesarean birth • Third/fourth degree tears • Duration of active second stage • Duration of passive second stage • Neonatal admission
Barnett 1982 Randomised controlled trial United States	N=10 women Multiparous No epidural	Directed breathing with open glottis	Directed breathing with Valsalva manoeuvre (closed glottis)	• Duration of active second stage • Duration of second stage
Koyucu 2017 Randomised controlled trial Turkey	N=80 women Nulliparous No epidural	Spontaneous	Directed closed glottis	• Mode of birth ○ Spontaneous vaginal birth • Third/fourth degree tears • Duration of second stage • Neonatal admission
Lemos 2017 Cochrane systematic review Canada, Hong Kong, Iran, Ireland, Turkey, United Kingdom, United States	K=16 (Buxton 1988, Fitzpatrick 2002, Fraser 2000, Goodfellow 1979, Hansen 2002, Jahdi 2011, Kelly 2010, Lam 2010, Low 2013, Mayberry 1999, Plunkett 2003, Schaffer 2005, Thomson 1993, Vause 1998, Vaziri 2016, Yildirim 2008) N=3911 women	Immediate (Buxton 1988, Fitzpatrick 2002, Fraser 2000, Goodfellow 1979, Hansen 2002, Kelly 2010, Mayberry 1999, Plunkett 2003, Vause 1998)	Delayed	• Mode of birth ○ Spontaneous vaginal birth ○ Instrumental birth ○ Caesarean birth • Third/fourth degree tears • Apgar score <7 at 5 minutes • Duration of active second stage • Duration of passive second stage • Duration of second stage • Women's experience of labour and birth • Neonatal admission
		Spontaneous (Jahdi 2011, Lam 2010, Low 2013, Schaffer 2005, Thomson 1993, Vaziri 2016, Yildirim 2008)	Directed closed glottis/Valsalva manoeuvre	

Study	Population	Intervention	Comparison	Outcomes
	With and without epidural			
Parnell 1983 Randomised controlled trial Denmark	N=306 women Primiparous, or multiparous after a caesarean birth No epidural	Spontaneous	Directed using Valsalva manoeuvre	• Duration of active second stage • Duration of second stage

Walker 2012
 	
Randomised controlled trial
 	
Spain
	N=199 women
	
	Mixed parity
	
	With epidural
		Immediate	Delayed	• Mode of birth
				  ○ Spontaneous vaginal birth
				  ○ Instrumental birth
				• Duration of active second stage
				• Apgar score <7 at 5 minutes

Yuksel 2017 Randomised controlled trial Turkey	N=250 women Nulliparous No epidural	Spontaneous	Directed closed glottis	• Duration of second stage

See the full evidence tables in appendix D and the forest plots in appendix E.

Summary of the evidence

Across all comparisons there were generally no important differences between groups, or no evidence of a difference between groups in terms of mode of birth, third/fourth degree tears, Apgar scores <7 at 5 minutes, women's experience of labour and birth and neonatal admission, with a few exceptions. There were differences between groups in terms of the duration of the active second stage of labour across all comparisons, and some differences for duration of the second stage of labour.

Direct with open glottis versus directed with closed glottis

Directed pushing using an open glottis breathing technique was compared to directed pushing using closed glottis or Valsalva manoeuvre technique. There were no important differences, or no evidence of an important difference between groups in terms of mode of birth, for women of mixed parity who had an epidural. There was no evidence of an important difference between groups for nulliparous or mixed parity women, with or without an epidural, in terms of third/fourth degree tears.

In terms of the duration of active and passive second stage, there was no important difference between groups for mixed parity women with an epidural. However, for multiparous women without an epidural, directed pushing with open glottis led to a reduction in the duration of the active second stage compared to directed pushing with a closed glottis.

For multiparous women without an epidural there was no important difference between groups on the duration of the passive second stage.

The evidence ranged from very low to moderate quality, with the main concerns around imprecision. There were some concerns around risk of bias, and indirectness due to not enough information given as to whether women had been induced.

Spontaneous versus directed

Spontaneous pushing was compared to directed pushing. Valsalva manoeuvre or closed glottis was used in both groups. For nulliparous and mixed parity women without an epidural, the evidence showed no important differences or no evidence of an important difference between groups in terms of mode of birth. The exception was a possible increase in the number of caesarean births for spontaneous pushing over directed pushing for nulliparous women with epidural.

There were no important differences, or no evidence of an important difference for third/fourth degree tears, or Apgar score <7 at 5 minutes for nulliparous women or women of mixed parity without epidural.

In terms of duration of the active second stage, the evidence for nulliparous women without an epidural showed no differences between groups, however for mixed parity without an epidural, spontaneous pushing led to a decrease in the duration compared to directed pushing. For nulliparous and mixed parity women, with or without an epidural, there was no important difference on the duration of the second stage of labour.

There were no differences between the groups on maternal satisfaction in nulliparous women without an epidural, or neonatal admission in mixed parity and nulliparous women without an epidural.

All the evidence for spontaneous versus directed was rated as very low quality with concerns around risk of bias, heterogeneity, indirectness and imprecision. The exception was spontaneous vaginal births in nulliparous women which was rated moderate quality with concerns around risk of bias only.

Immediate versus delayed

Immediate pushing was compared to delayed pushing. All the evidence was in women with an epidural. The evidence showed no important differences in terms of spontaneous vaginal birth for nulliparous and multiparous women. There was no important difference for instrumental vaginal births for nulliparous women, or mixed parity, but some evidence on multiparous women showed a possible important increase in the number of instrumental vaginal births for immediate pushing. There was no important difference or no evidence of an important difference on caesarean births for nulliparous or mixed parity women.

There was no important difference on third/fourth degree tears in nulliparous women, or Apgar score <7 at 5 minutes for nulliparous or mixed parity women.

There was an important increase in the duration of the active second stage of labour, with immediate pushing for both nulliparous and multiparous women, but evidence for mixed parity showed no important difference between groups.

Evidence on the passive stage of second stage, and the total second stage showed an important decrease in the duration for immediate pushing, in nulliparous, multiparous and mixed parity. This is expected as the women in the immediate group would have moved to the active/pushing stage of labour sooner than the delayed group.

There were no important differences between groups for neonatal admissions for nulliparous women.

The evidence was rated as mainly very low quality, with concerns around risk of bias, heterogeneity, indirectness and imprecision. Some of the evidence was of low and moderate quality.

Economic evidence

Included studies

A systematic review of the economic literature was conducted but no economic studies were identified which were applicable to this review question.

Excluded studies

Economic studies not included in this review are listed, and reasons for their exclusion are provided in appendix J.

Economic model

No economic modelling was undertaken for this review because the committee agreed that other topics were higher priorities for economic evaluation.

The committee's discussion and interpretation of the evidence

The outcomes that matter most

The committee agreed that mode of birth was a critical outcome for this review as it would provide women and healthcare professionals with information on whether different pushing techniques were more or less likely to lead to a spontaneous vaginal birth, or whether they would have an impact on the rate of birth with forceps or ventouse, or a caesarean birth, and this in turn would have an impact on women's experience of labour and birth. The committee also agreed that third/fourth degree tears was a critical outcome for this review, as the quality of life for women following this outcome can be greatly reduced. They also prioritised Apgar score <7 at 5 minutes as a critical outcome for the baby, as this outcome is an indicator for the survival and health outcomes for the neonate.

The committee also chose important outcomes for this review. They agreed that the duration of the active and the passive second stage of labour were important outcomes as different pushing techniques may lead to longer durations of labour, and information regarding this would be beneficial to women when deciding which approach is best. In addition they agreed that a prolonged active second stage of labour may lead to pelvic floor damage. The committee also wanted to explore women's experience during labour and whether any pushing techniques had an impact on this, and so included this as an important outcome. The committee recognised the great importance of women's experience, in particular with this topic, but they were aware that data on this outcome was likely to be sparse and unlikely to inform decision-making in a meaningful way, so they prioritised this outcome as important, rather than critical. The committee also recognised that neonatal admission was an important outcome for this review and would provide an indication of the health of the neonate.

The quality of the evidence

The quality of the evidence for outcomes was assessed with GRADE and was rated as moderate to very low.

Some of the evidence was downgraded due to risk of bias. For subjective outcomes this was due to not being able to blind for interventions. Other concerns around bias were some concerns around the randomisation of participants, incomplete data for some of the evidence

and some concerns around selective reporting due to pre-specified protocols not being available.

There was heterogeneity in some of the evidence that could not be explained by subgroup analysis. Some of the evidence was downgraded for indirectness, this was mainly due to women who had their labour induced, or there were high risk groups included in the population and not enough information regarding the proportion of these women in the total sample.

Most of the evidence was also downgraded for imprecision around the estimate of effect.

Benefits and harms

The committee discussed the evidence and agreed to make recommendations specific to the parity of women (where possible) and whether they had an epidural in situ.

The committee discussed the evidence for directed and spontaneous pushing (directed with open glottis versus directed with Valsava/closed glottis and spontaneous versus directed, both with Valsava/closed glottis) and noted that most of the evidence showed no difference or no evidence of an important difference between the different types of pushing techniques. However, they noted that for both comparisons there was a reduction in the duration of active second stage in women without an epidural and this was seen in a group of mixed parity and in a group of multiparous women. The evidence showed that spontaneous pushing reduced the duration of the active stage of labour compared to directed pushing, and directed pushing with an open glottis (exhaling while bearing down and pushing) was also beneficial in terms of this outcome for multiparous women without an epidural. However, the committee also noted that there was a possible increase in caesarean births for spontaneous pushing over directed pushing for nulliparous women with an epidural.

As overall there was no evidence suggesting a clear benefit of one pushing technique over another, the committee agreed that they would not recommend a specific pushing technique and that women's preferences should be the main factor to consider. They therefore agreed to make a recommendation advising women without an epidural in situ of the potential benefits of spontaneous pushing and pushing while exhaling on the duration of the second stage of labour, and that there may be an increase in the rate of caesarean birth for nulliparous women with an epidural, and so made recommendations advising women of this.

The committee discussed the evidence for the timing of pushing (immediate compared to delayed) and noted that all the evidence was in women with an epidural in situ, but that it had been able to break it down into nulliparous and multiparous women. They discussed that the evidence showed an important increase in the duration of the active second stage for immediate pushing in both nulliparous and multiparous women, meaning that the active second stage was shorter with delayed pushing. The committee noted that, as expected, the duration of the passive second stage was reduced with immediate pushing, but that despite the increase in the duration of the active stage with immediate pushing, the total duration of the second stage was reduced with immediate pushing. The committee agreed that although there may be some damage to the pelvic floor in the passive second stage, due to the presenting part pushing on the pelvic floor, it was a prolonged active second stage which led to more pelvic floor damage, and so they agreed they would make recommendations advising women with epidurals of the benefits of delayed pushing. For multiparous women with an epidural in situ there was evidence immediate pushing increased the rate of birth with forceps or ventouse, and so this evidence reinforced the recommendation that these women should be advised to delay pushing.

The committee discussed that the exact timing of the delay would be useful to include in the recommendations and looked at the evidence for further detail on the timings. The committee discussed the evidence for multiparous women, which favoured a 1 hour delay over immediate pushing in terms of duration of the active second stage, as well as a possible

reduction in instrumental births. They agreed that this was also in line with current practice and therefore included this in their recommendation.

The committee discussed the evidence for nulliparous women, and discussed the variation in practice with regard to the length of delay of pushing for this group of women. They noted that the studies used a range of timings for delay from up to 1 hour and up to 3 hours. The committee considered the effect estimates for the different timings separately based on the data provided in the forest plots. The evidence showed that the benefit was specific to the evidence that used a delay of up to 2 and up to 3 hours. The committee considered the benefits alongside the harms of recommendation for up to 3 hours delay. Although the evidence for a 3 hour delay did not show a difference between interventions in the mode of birth outcomes, or neonatal admission, the committee were aware of the risks of post-partum haemorrhage, pelvic floor damage and incontinence related issues with very long second stages. They therefore agreed that a 3 hour delay may offer the same benefits as a 2 hour delay but may also increase the likelihood of these adverse consequences and so agreed to recommend a 2 hour delay as for the appropriate time for delayed pushing in nulliparous women.

Cost effectiveness and resource use

The committee noted that there were no costs associated with the different pushing techniques themselves but any difference in outcomes could result in a difference in resource use between alternative approaches. However, as the review did not find consistent evidence of a difference in outcomes such as mode of birth, neonatal admission, and duration of the active second stage of labour, the committee concluded that evidence on cost-effectiveness was inconclusive and that it was reasonable for the recommendations on pushing technique to be based on the clinical evidence and the woman's choice.

Again, the committee reasoned that any differences in outcomes were likely to be the principal driver of costs associated with the length of delay in pushing and that any delay thought to produce a clinical benefit was likely to be cost-effective. The recommendations made by the committee reflected current practice and are not expected to have a significant resource impact on the NHS.

Other factors the committee took into account

The committee were aware that defining delay in the second stage of labour needed to take into account the periods of delayed pushing, and so cross-checked these recommendations with the section of the guideline on defining delay, to ensure consistency.

Recommendations supported by this evidence review

This evidence review supports recommendations 1.9.7, 1.9.9 and 1.9.10.

References – included studies

Effectiveness

Ahmadi 2017

Ahmadi, Zohre, Torkzahrani, Shahnaz, Roosta, Firouze et al. (2017) Effect of Breathing Technique of Blowing on the Extent of Damage to the Perineum at the Moment of Delivery: A Randomized Clinical Trial. Iranian journal of nursing and midwifery research 22(1): 62-66

Araujo 2021

Araujo, Ana Eulina, Delgado, Alexandre, Maia, Juliana Netto et al. (2021) Efficacy of spontaneous pushing with pursed lips breathing compared with directed pushing in maternal and neonatal outcomes. Journal of obstetrics and gynaecology : the journal of the Institute of Obstetrics and Gynaecology: 1-7

Barasinski 2020

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Barnett 1982

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Buxton 1988

Buxton, E. J.; Redman, C. W. E.; Obhrai, M. (1988) Delayed pushing with lumbar epidural in labour - Does it increase the incidence of spontaneous delivery?. Journal of Obstetrics and Gynaecology 8(3): 258-261

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Fitzpatrick 2002

Fitzpatrick, Myra, Harkin, Rosemary, McQuillan, Katherine et al. (2002) A randomised clinical trial comparing the effects of delayed versus immediate pushing with epidural analgesia on mode of delivery and faecal continence. BJOG : an international journal of obstetrics and gynaecology 109(12): 1359-65

Fraser 2000

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Goodfellow

Goodfellow CF and Studd C (1979) The reduction of forceps in primigravidae with epidural analgesia--a controlled trial. The British journal of clinical practice 33(10): 287-288

Hansen 2002

Hansen, Susan L.; Clark, Steven L.; Foster, Joyce C. (2002) Active pushing versus passive fetal descent in the second stage of labor: a randomized controlled trial. Obstetrics and gynecology 99(1): 29-34

Jahdi 2011

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Kelly 2010

Kelly, Mary, Johnson, Eileen, Lee, Vickie et al. (2010) Delayed versus immediate pushing in second stage of labor. MCN. The American journal of maternal child nursing 35(2): 81-8

Koyucu 2017

Koyucu, Refika Genc and Demirci, Nurdan (2017) Effects of pushing techniques during the second stage of labor: A randomized controlled trial. Taiwanese journal of obstetrics & gynecology 56(5): 606-612

Lemos 2017

Lemos, A., Amorim, M. M., Dornelas de Andrade, A. et al. (2017) Pushing/bearing down methods for the second stage of labour. Cochrane Database of Systematic Reviews 2017(3): cd009124

Low 2013

Low, Lisa Kane, Miller, Janis M., Guo, Ying et al. (2013) Spontaneous pushing to prevent postpartum urinary incontinence: a randomized, controlled trial. International urogynecology journal 24(3): 453-60

Mayberry 1999

Mayberry, L. J., Hammer, R., Kelly, C. et al. (1999) Use of delayed pushing with epidural anesthesia: findings from a randomized, controlled trial. Journal of perinatology : official journal of the California Perinatal Association 19(1): 26-30

Parnell 1993

Parnell, C., Langhoff-Roos, J., Iversen, R. et al. (1993) Pushing method in the expulsive phase of labor. A randomized trial. Acta obstetricia et gynecologica Scandinavica 72(1): 31-5

Plunkett 2003

Plunkett BA, Lin A, Wong CA et al. (2003) Management of the second stage of labor in nulliparas with continuous epidural analgesia. Obstetrics and gynecology 102(1): 109-114

Schaffer 2005

Schaffer, J. I., Bloom, S. L., Casey, B. M. et al. (2005) A randomized trial of the effects of coached vs uncoached maternal pushing during second stage of labor on postpartum pelvic floor structure and function. American journal of obstetrics and gynecology 192: 1692-1696

Thomson 1993

Thomson, A. M. (1993) Pushing techniques in the second stage of labour. Journal of advanced nursing 18(2): 171-7

Vause 1998

Vause, S.; Congdon, H. M.; Thornton, J. G. (1998) Immediate and delayed pushing in the second stage of labour for nulliparous women with epidural analgesia: a randomised controlled trial. British journal of obstetrics and gynaecology 105(2): 186-8

Vaziri 2016

Vaziri, Farideh, Arzhe, Amene, Asadi, Nasrin et al. (2016) Spontaneous Pushing in Lateral Position versus Valsalva Maneuver During Second Stage of Labor on Maternal and Fetal Outcomes: A Randomized Clinical Trial. Iranian Red Crescent medical journal 18(10): e29279

Walker 2012

Walker, Carolina, Rodriguez, Tania, Herranz, Ana et al. (2012) Alternative model of birth to reduce the risk of assisted vaginal delivery and perineal trauma. International urogynecology journal 23(9): 1249-56

Yildirim 2008

Yildirim, Gulay and Beji, Nezihe Kizilkaya (2008) Effects of pushing techniques in birth on mother and fetus: a randomized study. Birth (Berkeley, Calif.) 35(1): 25-30

Yuksel 2017

Yuksel, Hilal, Cayir, Yasemin, Kosan, Zahide et al. (2017) Effectiveness of breathing exercises during the second stage of labor on labor pain and duration: a randomized controlled trial. Journal of integrative medicine 15(6): 456-461

Appendices

Appendix A Review protocols

Review protocol for review question: What are the benefits and risks of the different pushing techniques (immediate, spontaneous, delayed, directed) in the second stage of labour in women with and without regional analgesia?

Table 3: Review protocol

Field	Content
PROSPERO registration number	CRD42022307177
Review title	Benefits and risks of different pushing techniques in the second stage of labour
Review question	What are the benefits and risks of the different pushing techniques (immediate, spontaneous, delayed, directed) in the second stage of labour in women with and without regional analgesia?
Objective	To update the recommendations in CG190 (2014) for the benefits and risks of the different pushing techniques in the second stage of labour in women with and without regional analgesia. Surveillance has identified that immediate pushing may be associated with lower rates of postpartum haemorrhage and shorter duration of the second stage and that delayed pushing may be associated with significantly increased incidence of low umbilical cord blood pH.
Searches	The following databases will be searched: • Cochrane Central Register of Controlled Trials (CENTRAL) • Cochrane Database of Systematic Reviews (CDSR) • Embase • MEDLINE & MEDLINE In-Process • International Health Technology Assessment (IHTA) database Searches will be restricted by: • No date limitations • English language studies

Field	Content
	• Human studies Other searches: • Inclusion lists of systematic reviews The full search strategies for the MEDLINE database will be published in the final review. For each search, the principal database search strategy is quality assured by a second information scientist using an adaptation of the PRESS 2015 Guideline Evidence-Based Checklist.
Condition or domain being studied	Labour and birth
Population	• Women in the second stage of labour with or without regional analgesia who are pregnant with a single baby who has not been identified before labour to be at high risk of adverse outcomes; who go into labour at term (37 to 42 weeks of pregnancy) and who do not have any pre-existing medical conditions or antenatal conditions that predispose to a higher risk birth • Singleton babies born at term (37 to 42 weeks of pregnancy) with no previously identified problems (for example congenital malformations, genetic anomalies, intrauterine growth restriction, placental problems)
Intervention	Any kind of breathing or pushing technique in the second stage of labour. Interventions will be categorised as follows: • Timing of pushing techniques: • Immediate/active pushing: this refers to pushing techniques which begin as soon as the woman is fully dilated • Passive descent or delayed pushing: this refers to pushing techniques which allow for spontaneous descent • Type of pushing techniques: • Directed pushing or Valsalva manoeuvre: this refers to pushing techniques which encourage women to take a deep breath at the beginning of a contraction, then hold it and bear down throughout the contraction • Spontaneous, physiological or mother-led pushing: this refers to pushing techniques which follow the woman's natural urge to push

Field	Content
Comparator	• Different timing of pushing techniques compared against each other (for example, immediate versus delayed pushing) • Different type of pushing techniques compared against each other (for example, directed versus spontaneous pushing) • Different timing of pushing techniques compared against different type of pushing techniques (for example, immediate versus directed) Studies will be included if the intervention being evaluated include a combination of any of the above (for example, a timing of pushing technique in combination with a type of pushing technique versus a type of pushing technique)
Types of study to be included	Include published full-text papers: • Systematic reviews of RCTs • Parallel RCTs • If RCTs do not report data on all critical and important outcomes: cohort studies (prospective and retrospective) Conference abstracts will not be included because these do not typically have sufficient information to allow full critical appraisal.
Other exclusion criteria	Population: • Women in labour who are identified before labour to be at high risk, or whose baby is at high risk, of complications or adverse outcomes • Women with non-cephalic presentation • Women in preterm labour • Women with an intrauterine fetal death • Women pregnant with multi-fetal pregnancies • Women who are having their labour induced (until active labour is established) • Women who have had a previous caesarean birth or who are having a planned caesarean birth Intervention: • Fundal pressure If any study or systematic review includes <1/3 of women with the above characteristics, it will be considered for inclusion but, if included, the evidence will be downgraded for indirectness.

Field	Content
Context	This guideline will partly update the following: Intrapartum care for healthy women and babies (CG190)
Primary outcomes (critical outcomes)	• Mode of birth (spontaneous vaginal, instrumental vaginal, caesarean birth) • Third/fourth degree tears • Apgar score <7 at 5 minutes
Secondary outcomes (important outcomes)	• Duration of active second stage (minutes)/duration of pushing (minutes) • Duration of passive second stage (minutes) • Women's experience of labour and birth • Neonatal admission (includes neonatal intensive care unit [NICU] and special care baby unit [SCBU])
Data extraction (selection and coding)	All references identified by the searches and from other sources will be uploaded into EPPI and de-duplicated. Titles and abstracts of the retrieved citations will be screened to identify studies that potentially meet the inclusion criteria outlined in the review protocol. Dual sifting will be performed on at least 10% of records; 90% agreement is required. Disagreements will be resolved via discussion between the two reviewers, and consultation with senior staff if necessary. Full versions of the selected studies will be obtained for assessment. Studies that fail to meet the inclusion criteria once the full version has been checked will be excluded at this stage. Each study excluded after checking the full version will be listed, along with the reason for its exclusion. A standardised form will be used to extract data from studies. The following data will be extracted: study details (reference, country where study was carried out, type and dates), participant characteristics, inclusion and exclusion criteria, details of the interventions if relevant, setting and follow-up, relevant outcome data and source of funding. One reviewer will extract relevant data into a standardised form, and this will be quality assessed by a senior reviewer.
Risk of bias (quality) assessment	Quality assessment of individual studies will be performed using the following checklists: • ROBIS tool for systematic reviews • Cochrane RoB tool v.2 for RCTs • Cochrane RoB tool v.2 for cluster randomised trials

Field	Content
	• Cochrane ROBINS-I tool for non-randomised (clinical) controlled trials and cohort studies The quality assessment will be performed by one reviewer and this will be quality assessed by a senior reviewer.
Strategy for data synthesis	Quantitative findings will be formally summarised in the review. Where multiple studies report on the same outcome for the same comparison, meta-analyses will be conducted using Cochrane Review Manager software. A fixed effect meta-analysis will be conducted and data will be presented as risk ratios if possible or odds ratios when required (for example, if only available in this form in included studies) for dichotomous outcomes, and mean differences or standardised mean differences for continuous outcomes. Heterogeneity in the effect estimates of the individual studies will be assessed using the I2 statistic. Alongside visual inspection of the point estimates and confidence intervals, I2 values of greater than 50% and 80% will be considered as significant and very significant heterogeneity, respectively. Heterogeneity will be explored as appropriate using sensitivity analyses and pre-specified subgroup analyses. If heterogeneity cannot be explained through subgroup analysis then a random effects model will be used for meta-analysis, or the data will not be pooled. The confidence in the findings across all available evidence will be evaluated for each outcome using an adaptation of the 'Grading of Recommendations Assessment, Development and Evaluation (GRADE) toolbox' developed by the international GRADE working group: http://www.gradeworkinggroup.org/ Minimally important differences: • Validated scales/continuous outcomes: published MIDs where available • All other outcomes & where published MIDs are not available: 0.8 and 1.25 for all relative dichotomous outcomes ; +/- 0.5x control group SD for continuous outcomes

Analysis of subgroups	Evidence will be stratified by:
	• Women with regional analgesia versus women without regional analgesia
	• Parity (nulliparous/primiparous versus multiparous)
	• Position (upright versus recumbent)
	• BMI thresholds on booking:
	  ○ Underweight range: <18.5 kg/m2
	  ○ Healthy weight range: 18.5 to 24.9 kg/m2
	  ○ Overweight range: 25 to 29.99 kg/m2

Field	Content	
	○ Obesity range 1: 30 to 34.99 kg/m2 ○ Obesity range 2: 35 to 39.99 kg/m2 Stratifications will be dealt with in a hierarchy (this is, where possible, stratify first by analgesia, then by parity, then by position, and then by BMI thresholds on booking). Evidence will be subgrouped by the following only in the event that there is significant heterogeneity in outcomes: • Age of woman (<35 vs >/= 35) • Ethnicity ○ White ○ Asian/Asian British ○ Black/African/Caribbean/Black British ○ Mixed/Multiple ethnic groups ○ Other ethnic group • Women with disability vs not • Deprived socioeconomic group vs not • Country where the study was conducted: high income countries versus low and middle income countries (as defined by the OECD) Where evidence is stratified or subgrouped the committee will consider on a case by case basis if separate recommendations should be made for distinct groups. Separate recommendations may be made where there is evidence of a differential effect of interventions in distinct groups. If there is a lack of evidence in one group, the committee will consider, based on their experience, whether it is reasonable to extrapolate and assume the interventions will have similar effects in that group compared with others.	
Type and method of review	☒	Intervention
	☐	Diagnostic
	☐	Prognostic
	☐	Qualitative
	☐	Epidemiologic
	☐	Service Delivery

Field	Content	
	☐	Other (please specify)
Language	English	
Country	England	
Anticipated or actual start date	10/01/2022	
Anticipated completion date	22/03/2023	
Named contact	5a. Named contact Guideline Development Team National Guideline Alliance (NGA) 5b. Named contact e-mail IPCupdate@nice.org.uk 5c. Organisational affiliation of the review Guideline Development Team NGA, Centre for Guidelines, National Institute for Health and Care Excellence (NICE).	
Review team members	From the Guideline Development Team NGA: • Senior Systematic Reviewer • Systematic Reviewer	
Funding sources/sponsor	This systematic review is being completed by the Guideline Development Team NGA. Centre for Guidelines, which is part of the National Institute for Health and Care Excellence NICE.	
Conflicts of interest	All guideline committee members and anyone who has direct input into NICE guidelines (including the evidence review team and expert witnesses) must declare any potential conflicts of interest in line with NICE's code of practice for declaring and dealing with conflicts of interest. Any relevant interests, or changes to interests, will also be declared publicly at the start of each guideline committee meeting. Before each meeting, any potential conflicts of interest will be considered by the guideline committee Chair and a senior member of the development team. Any decisions to exclude a person from all or part of a meeting will be documented. Any	

Field	Content
	changes to a member's declaration of interests will be recorded in the minutes of the meeting. Declarations of interests will be published with the final guideline.
Collaborators	Development of this systematic review will be overseen by an advisory committee who will use the review to inform the development of evidence-based recommendations in line with section 3 of Developing NICE guidelines: the manual. Members of the guideline committee are available on the NICE website: https://www.nice.org.uk/guidance/cg190
Other registration details	None
URL for published protocol	https://www.crd.york.ac.uk/PROSPERO/display_record.php?RecordID=307177
Dissemination plans	NICE may use a range of different methods to raise awareness of the guideline. These include standard approaches such as: notifying registered stakeholders of publication publicising the guideline through NICE's newsletter and alerts issuing a press release or briefing as appropriate, posting news articles on the NICE website, using social media channels, and publicising the guideline within NICE.
Keywords	Pushing techniques; directed pushing; spontaneous pushing; immediate pushing; delayed pushing
Details of existing review of same topic by same authors	Not applicable
Additional information	None
Details of final publication	www.nice.org.uk

CDSR: Cochrane Database of Systematic Reviews; CENTRAL: Cochrane Central Register of Controlled Trials; GRADE: Grading of Recommendations Assessment, Development and Evaluation; IHTA: International Health Technology Assessment; MID: minimally important difference; NGA: National Guideline Alliance; NICE: National Institute for Health and Care Excellence; NICU: neonatal intensive care unit; OECD: organisation for economic co-operation and development; PRESS: peer review of electronic search strategies; RCT: randomised controlled trial; RoB(IS): risk of bias (in systematic reviews); ROBINS-I: risk of bias in non-randomized studies of interventions; SCBU: special care baby unit; SD: standard deviation

Appendix B Literature search strategies

Literature search strategies for review question: What are the benefits and risks of the different pushing techniques (immediate, spontaneous, delayed, directed) in the second stage of labour in women with and without regional analgesia?

Database: Medline – OVID interface

Date of last search: 07/12/2022

#	Searches
1	LABOR STAGE, SECOND/
2	(second adj3 stage?).ti,ab.
3	or/1-2
4	PHYSICAL EXERTION/
5	RESPIRATION/
6	BREATH HOLDING/
7	VALSALVA MANEUVER/
8	BREATHING EXERCISES/
9	push*.ti,ab.
10	((passive* or spontaneous*) adj3 descen*).ti,ab.
11	breath*.ti,ab.
12	bear* down.ti,ab.
13	valsalva.ti,ab.
14	or/4-13
15	3 and 14
16	limit 15 to english language
17	LETTER/
18	EDITORIAL/
19	NEWS/
20	exp HISTORICAL ARTICLE/
21	ANECDOTES AS TOPIC/
22	COMMENT/
23	CASE REPORT/
24	(letter or comment*).ti.
25	or/17-24
26	RANDOMIZED CONTROLLED TRIAL/ or random*.ti,ab.
27	25 not 26
28	ANIMALS/ not HUMANS/
29	exp ANIMALS, LABORATORY/
30	exp ANIMAL EXPERIMENTATION/
31	exp MODELS, ANIMAL/
32	exp RODENTIA/
33	(rat or rats or mouse or mice).ti.
34	or/27-33
35	16 not 34
36	META-ANALYSIS/
37	META-ANALYSIS AS TOPIC/
38	(meta analy* or metanaly* or metaanaly*).ti,ab.
39	((systematic* or evidence*) adj2 (review* or overview*)).ti,ab.
40	(reference list* or bibliograph* or hand search* or manual search* or relevant journals).ab.
41	(search strategy or search criteria or systematic search or study selection or data extraction).ab.
42	(search* adj4 literature).ab.
43	(medline or pubmed or cochrane or embase or psychlit or psyclit or psychinfo or psycinfo or cinahl or science citation index or bids or cancerlit).ab.
44	cochrane.jw.
45	or/36-44
46	randomized controlled trial.pt.
47	controlled clinical trial.pt.
48	pragmatic clinical trial.pt.
49	randomi#ed.ab.
50	placebo.ab.
51	randomly.ab.
52	CLINICAL TRIALS AS TOPIC/

#	Searches
53	trial.ti.
54	or/46-53
55	35 and 45
56	35 and 54
57	or/55-56

Database: Embase – OVID interface

Date of last search: 07/12/2022

#	Searches
1	LABOR STAGE 2/
2	(second adj3 stage?).ti,ab.
3	or/1-2
4	*EXERCISE/
5	*BREATHING/
6	BREATH HOLDING/
7	VALSALVA MANEUVER/
8	BREATHING EXERCISE/
9	push*.ti,ab.
10	((passive* or spontaneous*) adj3 descen*).ti,ab.
11	breath*.ti,ab.
12	bear* down.ti,ab.
13	valsalva.ti,ab.
14	or/4-13
15	3 and 14
16	limit 15 to english language
17	letter.pt. or LETTER/
18	note.pt.
19	editorial.pt.
20	CASE REPORT/ or CASE STUDY/
21	(letter or comment*).ti.
22	or/17-21
23	RANDOMIZED CONTROLLED TRIAL/ or random*.ti,ab.
24	22 not 23
25	ANIMAL/ not HUMAN/
26	NONHUMAN/
27	exp ANIMAL EXPERIMENT/
28	exp EXPERIMENTAL ANIMAL/
29	ANIMAL MODEL/
30	exp RODENT/
31	(rat or rats or mouse or mice).ti.
32	or/24-31
33	16 not 32
34	SYSTEMATIC REVIEW/
35	META-ANALYSIS/
36	(meta analy* or metanaly* or metaanaly*).ti,ab.
37	((systematic or evidence) adj2 (review* or overview*)).ti,ab.
38	(reference list* or bibliograph* or hand search* or manual search* or relevant journals).ab.
39	(search strategy or search criteria or systematic search or study selection or data extraction).ab.
40	(search* adj4 literature).ab.
41	(medline or pubmed or cochrane or embase or psychlit or psyclit or psychinfo or psycinfo or cinahl or science citation index or bids or cancerlit).ab.
42	((pool* or combined) adj2 (data or trials or studies or results)).ab.
43	cochrane.jw.
44	or/34-43
45	random*.ti,ab.
46	factorial*.ti,ab.
47	(crossover* or cross over*).ti,ab.
48	((doubl* or singl*) adj blind*).ti,ab.
49	(assign* or allocat* or volunteer* or placebo*).ti,ab.
50	CROSSOVER PROCEDURE/
51	SINGLE BLIND PROCEDURE/
52	RANDOMIZED CONTROLLED TRIAL/
53	DOUBLE BLIND PROCEDURE/
54	or/45-53
55	33 and 44

#	Searches
56	33 and 54
57	or/55-56

Databases: Cochrane Central Register of Controlled Trials; Cochrane Database of Systematic Reviews – Wiley interface

Date of last search: 07/12/2022

#	Searches
#1	MeSH descriptor: [Labor Stage, Second] this term only
#2	(second near/3 stage*):ti,ab
#3	#1 or #2
#4	MeSH descriptor: [Physical Exertion] this term only
#5	MeSH descriptor: [Respiration] this term only
#6	MeSH descriptor: [Breath Holding] this term only
#7	MeSH descriptor: [Valsalva Maneuver] this term only
#8	MeSH descriptor: [Breathing Exercises] this term only
#9	push*:ti,ab
#10	((passive* or spontaneous*) near/3 descen*):ti,ab
#11	breath*:ti,ab
#12	"bear* down":ti,ab
#13	valsalva:ti,ab
#14	#4 or #5 or #6 or #7 or #8 or #9 or #10 or #11 or #12 or #13
#15	#3 and #14

Database: INAHTA

Date of last search: 07/12/2022

#	Searches
	All: "second stage" or "stage 2"
	AND All: push or pushes or pushing or breath or breaths or breathing or "bear down" or "bearing down" or valsalva

Health Economics Search Strategies

Database: Medline – OVID interface

Date of last search: 07/12/2022

#	Searches
1	LABOR STAGE, SECOND/
2	(second adj3 stage?).ti,ab.
3	or/1-2
4	PHYSICAL EXERTION/
5	RESPIRATION/
6	BREATH HOLDING/
7	VALSALVA MANEUVER/
8	BREATHING EXERCISES/
9	push*.ti,ab.
10	((passive* or spontaneous*) adj3 descen*).ti,ab.
11	breath*.ti,ab.
12	bear* down.ti,ab.
13	valsalva.ti,ab.
14	or/4-13
15	3 and 14
16	limit 15 to english language
17	LETTER/
18	EDITORIAL/
19	NEWS/
20	exp HISTORICAL ARTICLE/

#	Searches
21	ANECDOTES AS TOPIC/
22	COMMENT/
23	CASE REPORT/
24	(letter or comment*).ti.
25	or/17-24
26	RANDOMIZED CONTROLLED TRIAL/ or random*.ti,ab.
27	25 not 26
28	ANIMALS/ not HUMANS/
29	exp ANIMALS, LABORATORY/
30	exp ANIMAL EXPERIMENTATION/
31	exp MODELS, ANIMAL/
32	exp RODENTIA/
33	(rat or rats or mouse or mice).ti.
34	or/27-33
35	16 not 34
36	ECONOMICS/
37	VALUE OF LIFE/
38	exp "COSTS AND COST ANALYSIS"/
39	exp ECONOMICS, HOSPITAL/
40	exp ECONOMICS, MEDICAL/
41	exp RESOURCE ALLOCATION/
42	ECONOMICS, NURSING/
43	ECONOMICS, PHARMACEUTICAL/
44	exp "FEES AND CHARGES"/
45	exp BUDGETS/
46	budget*.ti,ab.
47	cost*.ti,ab.
48	(economic* or pharmaco?economic*).ti,ab.
49	(price* or pricing*).ti,ab.
50	(financ* or fee or fees or expenditure* or saving*).ti,ab.
51	(value adj2 (money or monetary)).ti,ab.
52	resourc* allocat*.ti,ab.
53	(fund or funds or funding* or funded).ti,ab.
54	(ration or rations or rationing* or rationed).ti,ab.
55	ec.fs.
56	or/36-55
57	35 and 56

Database: Embase – OVID interface

Date of last search: 07/12/2022

#	Searches
1	LABOR STAGE 2/
2	(second adj3 stage?).ti,ab.
3	or/1-2
4	*EXERCISE/
5	*BREATHING/
6	BREATH HOLDING/
7	VALSALVA MANEUVER/
8	BREATHING EXERCISE/
9	push*.ti,ab.
10	((passive* or spontaneous*) adj3 descen*).ti,ab.
11	breath*.ti,ab.
12	bear* down.ti,ab.
13	valsalva.ti,ab.
14	or/4-13
15	3 and 14
16	limit 15 to english language
17	letter.pt. or LETTER/
18	note.pt.
19	editorial.pt.
20	CASE REPORT/ or CASE STUDY/
21	(letter or comment*).ti.
22	or/17-21
23	RANDOMIZED CONTROLLED TRIAL/ or random*.ti,ab.
24	22 not 23

#	Searches
25	ANIMAL/ not HUMAN/
26	NONHUMAN/
27	exp ANIMAL EXPERIMENT/
28	exp EXPERIMENTAL ANIMAL/
29	ANIMAL MODEL/
30	exp RODENT/
31	(rat or rats or mouse or mice).ti.
32	or/24-31
33	16 not 32
34	HEALTH ECONOMICS/
35	exp ECONOMIC EVALUATION/
36	exp HEALTH CARE COST/
37	exp FEE/
38	BUDGET/
39	FUNDING/
40	RESOURCE ALLOCATION/
41	budget*.ti,ab.
42	cost*.ti,ab.
43	(economic* or pharmaco?economic*).ti,ab.
44	(price* or pricing*).ti,ab.
45	(financ* or fee or fees or expenditure* or saving*).ti,ab.
46	(value adj2 (money or monetary)).ti,ab.
47	resourc* allocat*.ti,ab.
48	(fund or funds or funding* or funded).ti,ab.
49	(ration or rations or rationing* or rationed).ti,ab.
50	or/34-49
51	33 and 50

Database: Cochrane Central Register of Controlled Trials – Wiley interface

Date of last search: 07/12/2022

#	Searches
#1	MeSH descriptor: [Labor Stage, Second] this term only
#2	(second near/3 stage*):ti,ab
#3	#1 or #2
#4	MeSH descriptor: [Physical Exertion] this term only
#5	MeSH descriptor: [Respiration] this term only
#6	MeSH descriptor: [Breath Holding] this term only
#7	MeSH descriptor: [Valsalva Maneuver] this term only
#8	MeSH descriptor: [Breathing Exercises] this term only
#9	push*:ti,ab
#10	((passive* or spontaneous*) near/3 descen*):ti,ab
#11	breath*:ti,ab
#12	"bear* down":ti,ab
#13	valsalva:ti,ab
#14	#4 or #5 or #6 or #7 or #8 or #9 or #10 or #11 or #12 or #13
#15	#3 and #14
#16	MeSH descriptor: [Economics] this term only
#17	MeSH descriptor: [Value of Life] this term only
#18	MeSH descriptor: [Costs and Cost Analysis] explode all trees
#19	MeSH descriptor: [Economics, Hospital] explode all trees
#20	MeSH descriptor: [Economics, Medical] explode all trees
#21	MeSH descriptor: [Resource Allocation] explode all trees
#22	MeSH descriptor: [Economics, Nursing] this term only
#23	MeSH descriptor: [Economics, Pharmaceutical] this term only
#24	MeSH descriptor: [Fees and Charges] explode all trees
#25	MeSH descriptor: [Budgets] explode all trees
#26	budget*:ti,ab
#27	cost*:ti,ab
#28	(economic* or pharmaco?economic*):ti,ab
#29	(price* or pricing*):ti,ab
#30	(financ* or fee or fees or expenditure* or saving*):ti,ab
#31	(value near/2 (money or monetary)):ti,ab
#32	resourc* allocat*:ti,ab
#33	(fund or funds or funding* or funded):ti,ab
#34	(ration or rations or rationing* or rationed):ti,ab

#	Searches
#35	#16 or #17 or #18 or #19 or #20 or #21 or #22 or #23 or #24 or #25 or #26 or #27 or #28 or #29 or #30 or #31 or #32 or #33 or #34
#36	#15 and #35

Database: International Health Technology Assessment

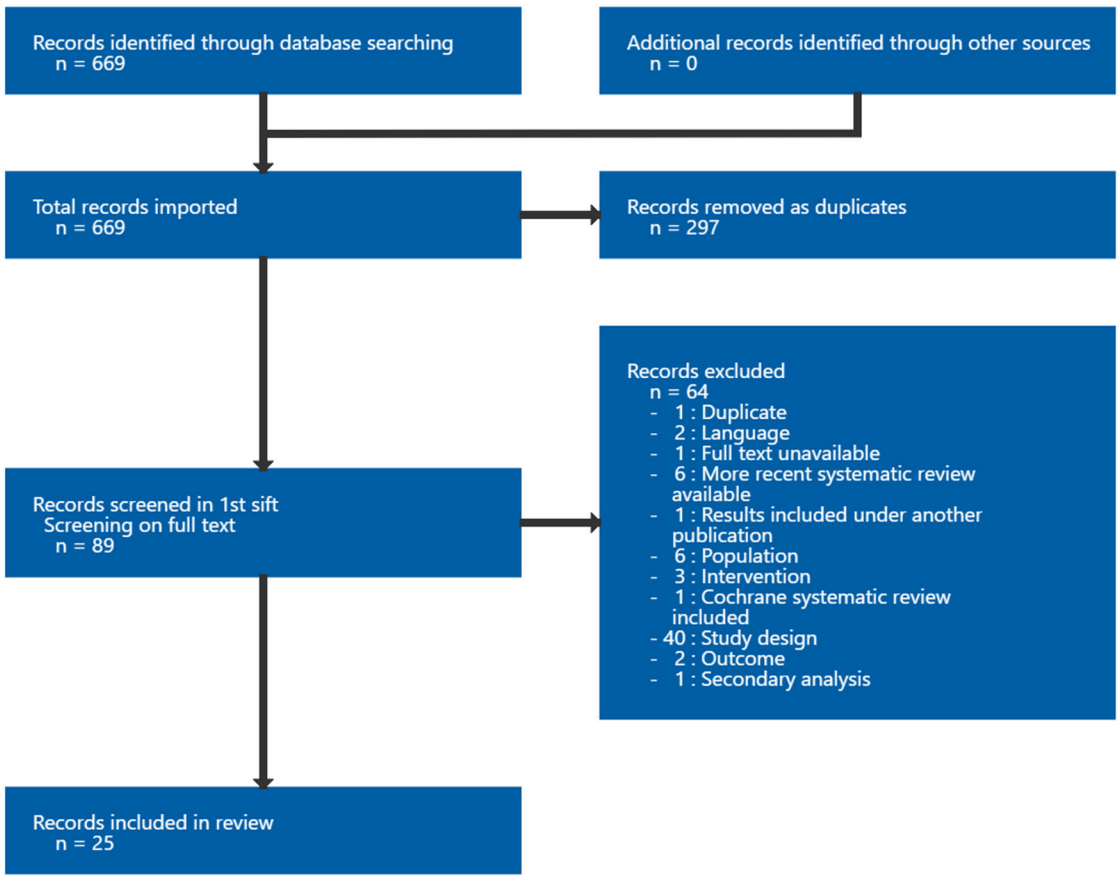
Date of last search: 07/12/2022

#	Searches
	All: "second stage" or "stage 2"
	AND All: push or pushes or pushing or breath or breaths or breathing or "bear down" or "bearing down" or valsalva

Appendix C Effectiveness evidence study selection

Study selection for: What are the benefits and risks of the different pushing techniques (immediate, spontaneous, delayed, directed) in the second stage of labour in women with and without regional analgesia?

Figure 1: Study selection flow chart [a]



[a] 25 studies were included in this review. However, as 1 of the studies is a systematic review with 16 additional studies, these individual studies appear in the included records section of the PRISMA diagram.

Appendix D Evidence tables

Evidence tables for review question: What are the benefits and risks of the different pushing techniques (immediate, spontaneous, delayed, directed) in the second stage of labour in women with and without regional analgesia?

Ahmadi, 2017

Bibliographic Reference	Ahmadi, Zohre; Torkzahrani, Shahnaz; Roosta, Firouze; Shakeri, Nezhat; Mhmoodi, Zohre; Effect of Breathing Technique of Blowing on the Extent of Damage to the Perineum at the Moment of Delivery: A Randomized Clinical Trial; Iranian journal of nursing and midwifery research; 2017; vol. 22 (no. 1); 62-66

Study details

Country/ies where study was carried out	Iran
Study type	Randomised controlled trial (RCT)
Study dates	October 2013 to January 2014
Inclusion criteria	• Iranian women aged between 18 and 35 years • primiparous • singleton pregnancy • cephalic presentation • candidate for vaginal birth • 3-5 cm dilated • normal BMI • not attending regular counselling to prepare for childbirth • not exercising regularly • not massaging perineum during pregnancy • perineal length larger than 3cm.
Exclusion criteria	• Unwillingness to continue with study • not co-operating with researcher • premature rupture of membranes • emergency caesarean birth

	• occiput posterior position • vulvovaginitis at time of hospitalisation • smoking in pregnancy • underlying chronic condition such as asthma, or urinary incontinence • shoulder dystocia • birthweight <2500g or >3999g • head circumference <32cm and >38cm • Use of pharmacological pain reduction methods • carrying out exercises such as body building and horse riding.
Patient characteristics	Maternal age, years - mean (SD): Intervention: 22.57 (3.32) Control: 23.40 (3.96) BMI, kg/m2 - mean (SD): Intervention: 22.7 (1.68) Control: 23.14 (1.67) Gestational age, weeks - mean (SD): Intervention: 38.79 (1.08) Control: 39.16 (0.94) Use of oxytocin to induce labour - % Intervention: 30.1 Control: 27.7
Intervention(s)/control	Intervention - using breathing techniques • Women were taught deep abdominal breathing • Pushing technique with open glottis, as well as blowing technique were taught. • When there was full dilation the women were asked to push. They were told to take 2 deep abdominal breaths during pain, and then another deep breath and push for 4-5 seconds with an open mouth while exhaling. Control - Valsalva maneuver

	• Women were asked to push at full dilation, by holding the breath.
Sources of funding	Not reported
Sample size	N=172 randomised Intervention, n=87 Control, n=85

Outcomes

Outcome	**Intervention , N = 83**	**Control, N = 83**
Third degree tears Posterior laceration No of events	n = 0	n = 3

Critical appraisal

Section	**Question**	**Answer**
Domain 1: Bias arising from the randomisation process	Risk of bias judgement for the randomisation process	Some concerns *(No information regarding concealment, but no baseline imbalances.)*
Domain 2a: Risk of bias due to deviations from the intended interventions (effect of assignment to intervention)	Risk of bias for deviations from the intended interventions (effect of assignment to intervention)	Low *(There were no deviations therefore women were analysed according to group assigned.)*
Domain 3. Bias due to missing outcome data	Risk-of-bias judgement for missing outcome data	Low *(Data available for almost all participants.)*

Section	Question	Answer
Domain 4. Bias in measurement of the outcome	Risk-of-bias judgement for measurement of the outcome	Low *(Outcomes not subjective, therefore low risk of bias.)*
Domain 5. Bias in selection of the reported result	Risk-of-bias judgement for selection of the reported result	Some concerns *(No pre-specified protocol available.)*
Overall bias and Directness	Risk of bias judgement	Some concerns
Overall bias and Directness	Overall Directness	Directly applicable
Overall bias and Directness	Risk of bias variation across outcomes	No variation across outcomes

Araujo, 2021

Bibliographic Reference	Araujo, Ana Eulina; Delgado, Alexandre; Maia, Juliana Netto; Lima Campos, Shirley; Wanderley Souto Ferreira, Caroline; Lemos, Andrea; Efficacy of spontaneous pushing with pursed lips breathing compared with directed pushing in maternal and neonatal outcomes; Journal of obstetrics and gynaecology : the journal of the Institute of Obstetrics and Gynaecology; 2021; 1-7

Study details

Country/ies where study was carried out	Brazil
Study type	Quasi- randomised controlled trial
Study dates	July 2018 to January 2019
Inclusion criteria	• Low and high risk pregnant women in second stage of labour • between 19-45 years old

	• 37-42 weeks gestation.
Exclusion criteria	• Multiparous women • dead fetus • history of analgesia • induced delivery • use of psychoactive drugs • breathing problems • smokers.
Patient characteristics	**Maternal age, years (median, IQR)** Spontaneous pushing: 23 (21 to 28) Directed pushing: 23 (19 to 30) **Gestational age, weeks (median, IQR)** Spontaneous pushing: 39 (38 to 40) Direction pushing: 39 (38 to 40) **BMI kg/m2 (median, IQR)** Spontaneous pushing: 26.6 (24.5 to 30.3) Directed pushing: 26.4 (24.8 to 28.7) **Parity - multiparous, n(%)** Spontaneous pushing: 24 (78) Directed pushing: 21 (68)
Intervention(s)/control	Intervention - spontaneous pushing • After diagnosis by the hospital of 10 cm dilation of the cervix, the intervention group received guidance on spontaneous pushing.

	• This involved breathing with pursed lips and an open glottis, also abdominal muscle efforts and perineal relaxation 'relax as if you were going to pee'. • Women were told to push when they felt the desire to, and not only during contractions. • Women were given positive feedback such as 'you're doing great', and 'the baby is coming'. <u>Control - directed pushing</u> • Women were guided to push regardless of desire, right after a contraction. • Women were guided to perform a deep inspiration, and then start pushing with a closed glottis and maintaining for 10 seconds or more. • The women were told to 'make a long force downwards', or 'make poop force'.
Sources of funding	not reported
Sample size	N=210 randomised Spontaneous pushing: 111 randomised (31 analysed) Directed pushing: 99 randomised (31 analysed)

Outcomes

Outcome	**Spontaneous pushing, N = 31**	**Directed pushing, N = 31**
Spontaneous vaginal birth No of events	n = 31	n = 30
Instrumental birth already included in spontaneous vaginal birth outcome No of events	n = 0	n = 3

Outcome	Spontaneous pushing, N = 31	Directed pushing, N = 31
Caesarean birth No of events	n = 0	n = 1
Apgar score <7 in 5 minutes No of events	n = 0	n = 0
Duration of pushing (Minutes) Mean (SD)	3.2 (3.5)	6.5 (3.8)
Duration of second stage (Minutes) Mean (SD)	28.1 (26.3)	40.9 (29.2)
High maternal satisfaction No of events	n = 27	n = 27
Neonatal admission to intensive care No of events	n = 0	n = 0

Critical appraisal

Section	Question	Answer
Domain 1: Bias arising from the randomisation process	Risk of bias judgement for the randomisation process	Low *(Allocation was random and concealed.)*
Domain 2a: Risk of bias due to deviations from the intended	Risk of bias for deviations from the intended interventions	Some concerns *(Not enough information regarding deviations from intended intervention, and no information on intention to treat analysis.)*

Section	Question	Answer
interventions (effect of assignment to intervention)	(effect of assignment to intervention)	
Domain 3. Bias due to missing outcome data	Risk-of-bias judgement for missing outcome data	Some concerns *(Outcome data was not available due to induction of labour being excluded. Although part of the exclusion criteria, this could have an impact on satisfaction outcome, if women relate the induction to the intervention as it was not balanced between groups. Low risk for other outcomes.)*
Domain 4. Bias in measurement of the outcome	Risk-of-bias judgement for measurement of the outcome	Some concerns *(Assessment of satisfaction could have been influenced by the outcome assessor, but there is not enough information to appropriately assess this. Low concerns for other outcomes.)*
Domain 5. Bias in selection of the reported result	Risk-of-bias judgement for selection of the reported result	Some concerns *(Unable to access pre-specified protocol.)*
Overall bias and Directness	Risk of bias judgement	Some concerns
Overall bias and Directness	Overall Directness	Indirectly applicable
Overall bias and Directness	Risk of bias variation across outcomes	High concerns for satisfaction outcome due to loss of follow up unbalanced between arms Some concerns for other outcomes.

Barasinski, 2020

Bibliographic Reference	Barasinski, C.; Debost-Legrand, A.; Vendittelli, F.; Is directed open-glottis pushing more effective than directed closed-glottis pushing during the second stage of labor? A pragmatic randomized trial - the EOLE study; Midwifery; 2020; vol. 91; 102843

Study details

Country/ies where study was carried out	France
Study type	Randomised controlled trial (RCT)
Study dates	July 2015 to June 2017
Inclusion criteria	• Women of any parity • singleton pregnancy • cephalic presentation • between 37 to 42 weeks gestational age • planned vaginal birth • spontaneous or induced labour • taken an antenatal class that included the specific training developed for the study in the types of pushing.
Exclusion criteria	• Women younger than 18 • previous caesarean birth, or other uterine surgery • disease contraindicating pushing • disease that might required emergency delivery (such as haemolysis elevated liver enzyme low platelet syndrome, abruptio placentae etc) • severe genital haemorrhage • major fetal malformation • polyhydramnios • oligohydramnios, intrauterine growth restriction diagnosed in utero • fetal heart rate anomaly • in utero fetal death.
Patient characteristics	Maternal age, years - mean (SD) Intervention: 30.1 (4) Comparator: 30.5 (3.7)

	BMI, kg/m2 - mean (SD) Intervention: 22.5 (3.4) Comparator: 22.9 (4.2) Nulliparous - n (%) Intervention: 87 (69.6) Comparator: 85 (68) Gestational age at birth, weeks - mean (SD): Intervention: 40.1 (1) Comparator: 40.1 (1) Spontaneous labour: Intervention: 101 (80.8) Comparator: 106 (84.8) Labour induced, n (%) *(not reported by the study but calculated from data on spontaneous labour)* Intervention: 24 (19.2) Comparator: 19 (15.2)
Intervention(s)/control	All participating staff including the staff teaching antenatal classes, and the midwives-investigators who recruited, randomised, and managed the birth, were trained in both pushing techniques. They watched a video specifically developed for the study to standardise the information they provided to women. Both groups had antenatal training which is available free to all women. During weeks 29 to 37 of pregnancy women received information about the study and instruction about the types of pushing. Women also watched a video demonstrating both the pushing types. Women received a card to show they had completed this session and it was brought to labour ward. Intervention - directed open-glottis

	• Women were instructed to: 'after inhaling deeply, exhale while pulling in your stomach so that you can use the contraction of your abdominal muscles to help the fetus descend through the birth canal. You should push as long as possible'. <u>Comparator - directed closed-glottis</u> • Women were instructed to: 'after inhaling deeply, you should push very hard downwards to the perineum, while holding the inhaled breath in your lungs. You should push as hard and as long as possible'. Women in both groups were directed to push 3 times per contraction.
Sources of funding	Not industry funded
Sample size	N=250 Intervention: n=125 Comparator: n=125
Other information	Women with induced labour were included in this study. Less than 33% of women were induced.

Outcomes

Outcome	**Intervention - open glottis, N = 125**	**Comparator - closed glottis, N = 125**
Spontaneous vaginal birth No of events	n = 89	n = 98
Instrumental vaginal birth No of events	n = 30	n = 25
Caesarean birth No of events	n = 6	n = 2

Outcome	Intervention - open glottis, N = 125	Comparator - closed glottis, N = 125
3rd degree tears there were no 4th degree tears (n=84 vs 89) No of events	n = 5	n = 1
Duration of expulsion phase (Minutes) Mean (SD)	24.4 (17.4)	18 (15)
Duration of passive second stage (Minutes) time from full dilation until start of pushing. Only women vaginal birth (n=122 vs 123) Mean (SD)	113.3 (74.4)	94.3 (72.2)
Neonatal admission No of events	n = 2	n = 1

Critical appraisal

Section	Question	Answer
Domain 1: Bias arising from the randomisation process	Risk of bias judgement for the randomisation process	Low *(Allocation random and concealed.)*
Domain 2a: Risk of bias due to deviations from the intended interventions (effect of assignment to intervention)	Risk of bias for deviations from the intended interventions (effect of assignment to intervention)	Low *(No deviations from intended intervention and analysis by intention to treat.)*
Domain 3. Bias due to missing outcome data	Risk-of-bias judgement for missing outcome data	Low *(Outcome data available for nearly all participants.)*

Section	Question	Answer
Domain 4. Bias in measurement of the outcome	Risk-of-bias judgement for measurement of the outcome	Low *(Outcome assessors were not aware of the allocation interventions.)*
Domain 5. Bias in selection of the reported result	Risk-of-bias judgement for selection of the reported result	Low *(Outcomes reported as in the pre-specified protocol.)*
Overall bias and Directness	Risk of bias judgement	Low
Overall bias and Directness	Overall Directness	Directly applicable
Overall bias and Directness	Risk of bias variation across outcomes	No variation

Barnett, 1982

Bibliographic Reference	Barnett, M. M.; Humenick, S. S.; Infant outcome in relation to second stage labor pushing method; Birth (Berkeley, Calif.); 1982; vol. 9; 221-228

Study details

Country/ies where study was carried out	United States
Study type	Randomised controlled trial (RCT)
Study dates	Not reported
Inclusion criteria	• 16-30 years old • 38-42 weeks gestation • Multiparous

	• Fetal weight estimated at 2500-4000 grams
Exclusion criteria	• If women had regional anaesthesia • If there was any abnormality of fetal condition before the onset of expulsion.
Patient characteristics	<u>Maternal age (mean):</u> Control: 22.8 years Experimental: 23 years All women laboured in a sitting, semi-recumbent, or side-lying position. All women were encouraged not to push until complete dilation of cervix. Women pushed while semi-recumbent.
Intervention(s)/control	<u>Intervention - open glottis pushing</u> • Women were given instructions for pushing by the principal investigator. • They were instructed to: 1. Push when they felt the urge. 2. Take a deep breath and push as long as they felt the need. 3. When they push, let some air out your mouth and make a sound. • The investigator demonstrated the short push and groan. • The woman was instructed not to push longer than she felt the need, and discouraged from pushing longer than 6 seconds. <u>Control - Valsalva pushing</u> • Women were given instructions for pushing by the principal investigator.

	• They were instructed to: 1. Make long Valsalva pushes: Take a deep breath as contraction begins, hold their breath, make no noise and bear down as hard and as long as they can. • Women were encouraged to push for at least 10 seconds. • Women were not encouraged to push past 10 seconds, nor discouraged. • At the end of the push, women were told to release their breath and repeat if the contraction continued. • Women were discouraged from groaning or crying out, or letting air out their nose or mouth. The investigator gave instructions for pushing to each women until the head crowned, and then stopped instructions. The nurse-midwife then managed delivery.
Sources of funding	Not reported
Sample size	N=10 Intervention: n=5 Control: n=5
Other information	No information on whether women were induced.

Outcomes

Outcome	**Intervention - open glottis, N = 5**	**Control - Valsalva, N = 5**
Length of pushing effort (seconds) Mean (SD)	3.01 (1)	8.56 (2.7)
Length of second stage (Minutes) Mean (SD)	43.6 (27.6)	24.6 (11.2)

Critical appraisal

Section	Question	Answer
Domain 1: Bias arising from the randomisation process	Risk of bias judgement for the randomisation process	High *(Random is only mentioned in the abstract, no other mention of randomisation or allocation concealment.)*
Domain 2a: Risk of bias due to deviations from the intended interventions (effect of assignment to intervention)	Risk of bias for deviations from the intended interventions (effect of assignment to intervention)	High *(Not enough information regarding deviations from intended interventions or analysis.)*
Domain 3. Bias due to missing outcome data	Risk-of-bias judgement for missing outcome data	Some concerns *(Unclear regarding missing outcome data, but assume no loss to follow up.)*
Domain 4. Bias in measurement of the outcome	Risk-of-bias judgement for measurement of the outcome	Some concerns *(Not enough information, however knowledge of intervention unlikely to affect outcome assessment.)*
Domain 5. Bias in selection of the reported result	Risk-of-bias judgement for selection of the reported result	Some concerns *(No pre-specified protocol available.)*
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Indirectly applicable
Overall bias and Directness	Risk of bias variation across outcomes	No variation.

Koyucu, 2017

Bibliographic Reference	Koyucu, Refika Genc; Demirci, Nurdan; Effects of pushing techniques during the second stage of labor: A randomized controlled trial; Taiwanese journal of obstetrics & gynecology; 2017; vol. 56 (no. 5); 606-612

Study details

Country/ies where study was carried out	Turkey
Study type	Randomised controlled trial (RCT)
Study dates	June 2013 to March 2014
Inclusion criteria	• Nulliparous women aged 18-40. • Singleton, at gestational age between 38 to 40 weeks. • Expected vaginal birth. • Cephalic presentation. • First stage of labour. • Fetal weight estimated at 2500 to 4000 grams.
Exclusion criteria	• Not volunteering for participation. • Medical or obstetric complications affecting management of 2nd stage. • Epidural analgesia. • Inability to comply with group norms. • Participants who did not attend follow up visits.
Patient characteristics	<u>Maternal age - mean (SD):</u> Intervention - spontaneous pushing: 22.4 (3.5) Control - valsalva: 22.6 (3.6)

	BMI - mean (SD): Intervention: 29.1 (1.8) Control: 28.9 (1.7) Gestational age in weeks- mean (SD): Intervention: 39.2 (0.3) Control: 39.2 (0.7) No baseline differences between groups.
Intervention(s)/control	Intervention: • The investigator providing care instructed women to push only when they felt the urge. • They gave no specific instructions regarding the timing or duration of pushes, or their positions. • Woman informed to 'act as her body demands'. Control: • The investigated coached the woman to use closed-glottis pushing, 3 to 4 times during each contractions. • The woman was told to take a deep breath and hold it until the highest point of contraction. • The woman was then asked to push for 10 seconds. The investigated counted to 10 during each push. • She was told to take a deep breath again and push throughout the contraction.
Sources of funding	Not industry funded
Sample size	N=80 Intervention: n=40 Control: n=40

Outcomes

Outcome	Spontaneous pushing, , N = 40	Valsalva pushing, , N = 40
Spontaneous vaginal birth No of events	n = 40	n = 40
Third degree tears No of events	n = 0	n = 1
Length of second stage (Minutes) Mean (SD)	63.2 (21.3)	46.6 (23.4)
Neonatal admission No of events	n = 0	n = 0

Critical appraisal

Section	Question	Answer
Domain 1: Bias arising from the randomisation process	Risk of bias judgement for the randomisation process	Low *(Allocation random and concealed.)*
Domain 2a: Risk of bias due to deviations from the intended interventions (effect of assignment to intervention)	Risk of bias for deviations from the intended interventions (effect of assignment to intervention)	Low *(No deviations that could have arose from knowledge of intervention. Intention to treat analysis not specified but assumed by looking at the data presentation.)*
Domain 3. Bias due to missing outcome data	Risk-of-bias judgement for missing outcome data	Low *(Data available for nearly all participants for relevant outcomes.)*
Domain 4. Bias in measurement of the outcome	Risk-of-bias judgement for measurement of the outcome	Low *(Outcome assessor knowledge of intervention unlikely to influence outcome assessment as outcomes are not subjective.)*

Section	Question	Answer
Domain 5. Bias in selection of the reported result	Risk-of-bias judgement for selection of the reported result	Some concerns *(No pre-specified protocol available.)*
Overall bias and Directness	Risk of bias judgement	Low
Overall bias and Directness	Overall Directness	Indirectly applicable
Overall bias and Directness	Risk of bias variation across outcomes	No variation

Lemos, 2017

Bibliographic Reference	Lemos, A.; Amorim, M. M.; Dornelas de Andrade, A.; de Souza, A. I.; Cabral Filho, J. E.; Correia, J. B.; Pushing/bearing down methods for the second stage of labour; Cochrane Database of Systematic Reviews; 2017; vol. 2017 (no. 3); cd009124

Study details

Country/ies where study was carried out	Buxton 1988 UK Fitzpatrick 2002 Ireland Fraser 2000 Canada Goodfellow 1979 UK

	Hansen 2002 United States Jahdi 2011 Iran Kelly 2010 United States Lam 2010 Hong Kong Low 2013 United States Mayberry 1999 United States Plunkett 2003 United States Schaffer 2005 United States Thomson 1993 UK Vause 1998 UK Vaziri 2016 Iran Yildirim 2008 Turkey

Study type	Cochrane Systematic Review
Study dates	Buxton 1988 Not reported Fitzpatrick 2002 *July 1998 to July 1999 Fraser 2000 Not reported Goodfellow 1979 Not reported Hansen 2002 Not reported *Jahdi 2011 August to December 2009 Kelly 2010 Not reported Lam 2010 *2005 Low 2013 Not reported Mayberry 1999 *January 1996 to December 1996 Plunkett 2003 *June to December 1999

	Schaffer 2005 *June 2000 to August 2002 Thomson 1993 Not reported Vause 1998 *November 1993 to October 1996 Vaziri 2016 *March 2014 to late May 2014 Yildirim 2008 *July 2003 to June 2004
Inclusion criteria	Buxton 1988 • Singleton • vertex presentation • maternal age 17-35 years old • spontaneous labour or induction from 10 to 14 days after term Fitzpatrick 2002 • Primiparous • spontaneous or induced labour with a singleton fetus • cephalic presentation • between 37 - 42 weeks gestation • effective epidural analgesia in situ. Fraser 2000 • Nulliparous • ≥37 weeks gestation • single fetus with cephalic presentation • spontaneous or induced labour

	• normal fetal heart status • effective epidural analgesia with a standardised continuous-infusion technique. Goodfellow 1979 • normal primigravidae 158cm or more in height Hansen 2002 • Primigravid and multigravid Jahdi 2011 • Low risk pregnancy • singleton fetus with estimated birthweight of 2500g to 4000g • vertex presentation • gestational age between 37 and 42 weeks • parity between 1 to 5 • maternal age 18 to 40 years. Kelly 2010 • spontaneous, elective or medically induced labour induction • reassuring fetal heart rate • gestational age ≥38 weeks • maternal age 19 to 40 years • pain score of ≤3 on a 0 to 10 pain scale Lam 2010 • Nulliparous women aged 18-40 • healthy singleton baby with cephalic presentation • full term • planned vaginal birth • able to read Chinese or English

	• spontaneous or induced (as a result of premature rupture of membrane or post dates pregnancy) labour. Low 2013 • 18 years of age • no history of genitourinary pathology • continent during first 20 weeks of pregnancy • continent at 20 weeks' gestation by negative standing stress test • first pregnancy. Mayberry 1999 • Nulliparous • English speaking • healthy singleton pregnancy • full term. Plunkett 2003 • nulliparous women at term • cephalic presentation • received neuraxial analgesia Schaffer 2005 • nulliparous women • gestational age 31-42 weeks • singleton fetus in cephalic presentation • regular uterine contractions • cervical dilation at leave 4cm Thomson 1993 • aged 18 or over

	• primiparous • singleton pregnancy • >37 weeks gestation • cephalic presentation • no epidural • no maternal condition (obstetric or medical) or fetal condition affecting the management of the second stage Vause 1998 • Nulliparous women in spontaneous or induced labour • singleton fetus between 37 and 42 weeks gestation • with an effective epidural. Vaziri 2016 • nulliparous • live fetus with vertex presentation • gestational age 37-40 weeks • spontaneous labour Yildirim 2008 • low risk primiparous women • 38-42 weeks' gestation • single vertex fetus weighing between 2500 to 3999g
Exclusion criteria	Buxton 1988 • 4 previous deliveries • obstetric complications or indication for short second stage • fetal scalp blood sample upon diagnosis of full cervical dilation • occult fetal acidosis

	Fitzpatrick 2002 • diabetes • irritable bowel syndrome, or other bowel or neurological condition • if the vertex was visible at the introitus after randomisation Fraser 2000 • if women were already pushing spontaneously • fever with a temperature of >38 degrees C • pregnancy complications: hypertension, recent haemorrhage, suspicion of fetal malformation, intrauterine growth restriction • any condition which necessitated shortening of 2nd stage of labour Goodfellow 1979 • women with inadequate epidurals or complications such as fetal distress Hansen 2002 • refused an epidural • first epidural dose after complete dilation • known fetal anomaly • multiple gestation • nonvertex presentation • gestational age less than 37 weeks, or over 42 weeks • pregnancy complications: pregnancy related hypertension, heart disease, insulin dependent diabetes.

	Jahdi 2011 • Did not wish to participate • maternal medical or obstetric complications that affect the management of 2nd stage • baby with congenital anomalies • fetal compromise suspected. Kelly 2010 • first epidural dose after complete dilation • known fetal anomaly before birth • multiple gestation • non-vertex presentation • maternal heart disease • administration of magnesium sulphate • poor comprehension of English Lam 2010 • Not wishing to participate • already in established labour • epidural analgesia • maternal medical or obstetric complications that could affect management of 2nd stage • suspected fetal compromised or congenital anomalies. *Low 2013 • women with demonstrable stress incontinence

	Mayberry 1999 • Fetal complication. Plunkett 2003 • gestational or pre-gestational diabetes mellitus • contraindication to pushing in the second stage Schaffer 2005 • history of urinary incontinence, anal continence or pelvic organ prolapse • any known complication of pregnancy • fetal weight estimated greater than 4000g • use of oxytocin or epidural analgesia before the second stage • diagnosed with chorioamnionitis prior to second stage. Thomson 1993 • conception in-vitro • where the baby was adopted or where a 'care order' was to be taken out on the baby after delivery • use of epidural Vause 1998 • non-vertex presentation • any complication that might influence second stage management such as raised blood pressure, heart disease, dural tap. Vaziri 2016

	• Chronic diseases • pregnancy complications (pre-eclampsia and placental abruption) • premature rupture of membranes • caesarean birth. Yildirim 2008 • none specified
Patient characteristics	*Buxton 1988 **Maternal age, years - mean (SD):** Early pushing: 23.5 (4.1) Delayed pushing: 24.9 (4.8) **Nulliparous, n (%):** Early pushing: 16 (84) Delayed pushing: 20 (87) **Labour induced, n (%):** Early pushing: 6 (32) Delated pushing 6 (27) *Fitzpatrick 2002 **Maternal age, years - median (range)** Immediate pushing: 28 (18 to 38) Delayed pushing: 30 (18 to 40) **Gestation at delivery (days):** Immediate pushing: 284 Delayed pushing: 286

	Induced labour, n (%): Immediate pushing: 25 (28) Delayed pushing: 33 (37) *Fraser 2000 **Maternal age, years - mean (SD):** Delayed pushing: 27.6 (5) Early pushing: 27.7 (4.8) **Gestational age, weeks - mean (SD):** Delayed pushing: 39.4 (1.2) Early pushing 39.5 (1.2) **Spontaneous labour onset %:** Delayed pushing: 69.9 Early pushing: 68.5 *Goodfellow 1979 Birthweight and maternal heights reported only, and similar for both groups. *Hansen 2002 **Maternal age, y - mean (SD):** Passive fetal descent: 28.2 (4.31) Active pushing: 30.2 (4.6) p=0.14 between groups for maternal age. No significant differences for other demographic maternal characteristics but detail not provided. *Jahdi 2011

	Maternal age, years - mean (SD): Directed pushing: 26.18 (4.96) Physiological pushing: 25.71 (5.33) **Parity - mean (SD):** Directed pushing: 2.09 (1.37) Physiological pushing: 1.86 (1.16) **Gestational age, weeks - mean (SD):** Directed pushing: 39.5 (71.4) Physiological pushing: 39.4 (72.24) *(possible error in the study table and decimal points of SD for gestational age are incorrect)* *Kelly 2010 **Maternal age, years - mean (SD):** Immediate: 28.6 (0.8) Delayed: 28.1 (1.0) **Gestational age, weeks - mean (SD)**: Immediate: 39.9 (0.2) Delayed: 40.8 (0.3) *Lam 2010 All participants were Chinese. No significant differences for maternal age or BMI, no further details provided. **Gestational age, days - mean (SD):** Directed pushing: 275.7 (6.5) Spontaneous pushing: 277.5 (5.8) *Low 2013

	Reported for all participants. **Maternal age, years - mean (SD):** 29.7 (5) **BMI at 20 weeks gestation - mean (SD):** 24.6 (5.7). **All nulliparous.** No statistically significant differences between the 4 arms. *Mayberry 1999 No statistically significant differences between characteristics, although no details provided. *Plunkett 2003 **Maternal age, years - mean (SD):** Immediate pushing: 29.9 (6.1) Delayed pushing: 29.9 (5.7) **Gestational age, weeks - mean (SD):** Immediate pushing: 40.1 (1.2) Delayed pushing: 39.9 (1.1) **BMI, kg.m2 - mean (SD):** Immediate pushing: 29.5 (4.7) Delayed pushing: 28.5 (4.5) **Labour induction, n (%):** Immediate pushing: 27 (32) Delayed pushing: 23 (20) *Schaffer 2005

	Maternal age, years - mean (SD): Coached: 21.2 (3.4) Uncoached: 21.2 (3.9) **BMI kg/m2 - mean (SD):** Coached: 28.4 (4) Uncoached: 28.5 (3.8) *Thomson 1993 **Maternal age, years - mean (SD):** Exhalation pushing: 21.5 (4.2) Valsalva pushing: 23.6 (3.9) **Gestational age, weeks - mean (SD):** Exhalation pushing: 39.9 (1.2) Valsalva pushing: 39.8 (0.8) **Spontaneous onset of 1st stage, n (%):** Exhalation pushing: 13 (87) Valsalva pushing: 12 (71) *Vause 1998 No significant differences between groups **Maternal age, years - mean:** Early: 27.8 Delayed: 26.1 **Gestation, days - mean:** Early: 281.3 Delayed: 281.0

	*Vaziri 2016 **Maternal age, years - mean (SD):** Intervention: 22.23 (4.12) Control: 22.18 (4.60) *Yildirim 2008 **Maternal age, years - mean (SD):** Spontaneous: 22.7 (2.9) Valsalva: 23.1 (3.2) **BMI kg/m2 - mean (SD):** Spontaneous: 27.7 (3.5) Valsalva: 27.1 (3.3) **Gestational age, weeks - mean (SD):** Spontaneous: 39.7 (1.1) Valsalva: 39.7 (0.1)
Intervention(s)/control	Buxton 1988 **Pushing group:** commenced organised pushing immediately. **Delayed pushing:** women remained either sitting or in lateral position for up to 3 hours, or until the vertex was visible, then pushing commenced immediately. Fitzpatrick 2002 **Immediate pushing:** pushing right after full dilation. **Delayed pushing:** 60 minute delay. Fraser 2000

	Early pushing: women were encouraged to push immediately. **Delayed pushing:** women were advised to avoid voluntary expulsive efforts for 2 hours. Women could push if they felt an irresistible urge, the fetal head was visible (perineum inspected every 15 minutes), or if there was a medical indication to shorten 2nd stage. Goodfellow 1979 **Control group:** women made expulsive efforts without delay. No increase made to the rate of oxytocin infusion. **Treatment group:** participant lay on their side without making expulsive efforts. Rate of oxytocin increased by 4 miliunits per minute, every 4 minutes if there was no excessive uterine contraction. When the fetal head became visible, or after an hour, women were encouraged to begin expulsive efforts. Hansen 2002 **Passive fetal descent:** women began with a period of rest and descent at the time of complete dilation, and continued until head was visible, or after 120 minutes for primigravidas, or 60 minutes for multigravidas. Women were not encouraged to push. The introitus was examined every 30 minutes. **Active pushing:** primigravidas and multigravidas were encouraged to begin pushing as soon as fully dilated. Both groups consisted of coached Valsalva Maneuver directed by the nurse of physician during contractions. Jahdi 2011 **Directed pushing:** women were coached by the midwife to use closed-glottis pushing 3 to 4 times during each contraction. Pushing was immediately as cervical dilation reached 10cm and a fetal head plus 1. Women continued pushing using this method until birth. Breath was held for 10 seconds. They were limited to the bed in supine position.

	Physiological pushing: women only pushed when they felt the urge. No specific instructions about the timing and the duration of pushing were given. Women used upright position, including standing, sitting, and squatting. If delivery was not imminent after 120 minutes, for primiparous, and 60 minutes for multiparous, any method which was clinically appropriate was used for both groups. Both groups delivered in a birth chair in a sitting position. <u>Kelly 2010</u> **Immediate pushing:** VAS completed when dilation reached 10cm and women were directed to begin pushing. They were instructed to push 3 to 4 times during each contraction by bearing down in a manner similar to bearing during a bowel movement. No counting during pushing occurred. Both open and closed glottis methods were used. **Delated pushing:** VAS completed when dilation reached 10cm and women were told to rest for 90 minutes, or until they felt an uncontrollable urge to push, then they began pushing. Instructions for pushing were provided in the same manner as the immediate pushing group. <u>Lam 2010</u> **Directed pushing:** at complete dilation of cervix, and fetal head station plus 1 below the level of ischial spines of the pelvis, the midwife suggested pushing commenced using the directed pushing technique regardless of whether she felt the urge to push,. **Spontaneous pushing:** at complete dilation of cervix, and fetal head station plus 1 below the level of ischial spines of the pelvis, the midwife suggested pushing commenced only when the woman felt the urge to push. No specific instructions about timing or duration of pushing given. In both groups, if midwives or obstetricians were concerned about fetal or maternal wellbeing, or if delivery was not imminent after 60 minutes, the woman was reassessed and whatever clinical management necessary to facility birth was provided.

	Low 2013 4-arm trial **1. Directed group or coached group:** using a closed glottis Valsalva Maneuver. Routine care at the recruitment hospital. **2. Spontaneous group:** instruction provided prenatally via a standardised training video. Women instructed to follow her body sensations and push when she felt the urge. Directions regarding pushing position, or how to hold her breath were discouraged. Statements such as 'you are so strong' were considered supportive and not directive. **3. Prenatal perineal massage:** initiated in the 3rd trimester with a standardised training, and then directed pushing during second stage labour. **4. Combination of group 2 and 3:** spontaneous pushing plus perineal massage. *only arms 1 and 2 (without perineal massage) were considered.* Mayberry 1999 **Non-delayed pushing:** pushing commenced immediately following confirmation of full dilation of cervix, regardless of presence or lack of bearing down pressured. **Delayed pushing:** pushing commenced 1 hour after full dilation, or in the presence of involuntary pressure accompanied by the urge to bear down. Type of pushing in both groups: breath holding no longer than 6-8 seconds, documented adequate contraction pattern (3-5 contractions in a 10 minute period), change bed position every 20 to 30 minutes. Plunkett 2003 **Immediate pushing:** women encouraged to push as soon as reached complete dilation.

	Delayed pushing: women were instructed to wait until they experienced a strong urge to push (50mm or more on an unmarked 100mm VAS; 0= no urge, 100=overwhelming urge). If they did not feel a strong urge to push after 90 minutes, they were instructed to started pushing without an urge. Schaffer 2005 **Coached:** pushing down using a closed glottis, take a deep breath and hold during the peak of contraction, bear down and push for 10 seconds, repeat for as long as contraction continues. Instructions to the woman to pull back on both knees and tuck her chin in while the provider or partner supported the legs. **Uncoached:** no specific instructions given on pushing technique - 'do what comes naturally' Thomson 1993 **Exhalation pushing:** spontaneous pushing activity. **Valsalva**: take a deep breath, hold it and push for as long as possible. Women were free to adopt any position. If delivery is not imminent in 90 minutes, adopt appropriate clinical management. Advised to discontinue the trial if there were concerns for maternal and/or fetal wellbeing. Vause 1998 **Early pushing:** pushing would commence within 1 hour of full dilation, whether vertex was visible or not. **Delayed pushing:** women were encouraged to rest without pushing for a maximum of 3 hours from full dilation, unless the vertex was visible at the introitus earlier Vaziri 2016 **Intervention:** women pushed when they felt the urge to push while in the left lateral position.

	Control: women pushed from the onset of the second stage using Valsalva method, while in supine position, according to the routine practice of the maternity unit. Yildirim 2008 **Valsalva pushing:** women were encouraged and supported to use Valsalva type pushing in the second stage of labour. **Spontaneous pushing:** women were encouraged and supported to push spontaneously in the second stage of labour, bearing down in response to contractions. If delivery is not imminent in 90minutes, appropriate clinical management adopted. Advised to discontinue the trial if concerns about maternal and/or fetal wellbeing.
Sources of funding	Buxton 1988 Not clear. Fitzpatrick 2002 Not industry funded Fraser 2000 Industry funded medication and salary for one of the trial authors (research fellow) Goodfellow 1979 Not reported. Hansen 2002 Not industry funded. Jahdi 2011 Not industry funded

	Kelly 2010 Not industry funded. Lam 2010 Not specified. Low 2013 Not industry funded. Mayberry 1999 Not industry funded. Plunkett 2003 Not industry funded. Schaffer 2005 Not specified. Thomson 1993 Not specified. Vause 1998 Not specified. Vaziri 2016 Not industry funded. Yildirim 2008 Not industry funded.
Sample size	Buxton 1988 N=42 randomised Pushing group: n=19 Delayed pushing: n=23

	Fitzpatrick 2002 N=178 randomised Immediate pushing: n=90 Delated pushing: n=88 Fraser 2000 N=1862 randomised Early pushing: n=926 Delayed pushing: n=936 Goodfellow 1979 N=37 randomised Control group: n=16 Treatment group: n=21 Hansen 2002 N=312 randomised (N=252 analysed) Passive fetal descent: n=130 Active pushing: n=122 Jahdi 2011 N=258 randomised Directed pushing: n=130 Physiological pushing: n=128 Kelly 2010

	N= 59 randomised (44 analysed) Immediate pushing: n=33 (28 analysed) Delayed pushing: n=26 (16 analysed) Lam 2010 N=73 randomised Directed pushing: n=38 Spontaneous pushing: n=35 Low 2013 N=249 randomised (data available for 145) Directed group or coached group: n=39 Spontaneous group: n=32 *4 arm trial, only 2 arms were considered as they are relevant to the protocol.* Mayberry 1999 N=153 randomised Non-delayed pushing: n=72 Delayed pushing: n=81 Plunkett 2003 N=202 randomised Immediate pushing: n=85 Delayed pushing: n=117 Schaffer 2005

	N=325 randomised (some data for 320 women) Coached: n=157 Uncoached: n=163 Thomson 1993 N=32 randomised. Exhalation pushing: n=15 Valsalva: n=17 Vause 1998 N=135 randomised Early: n=67 Delayed: n=68 Vaziri 2016 N=72 randomised Intervention: n=36 Control: n=36 Yildirim 2008 N=100 randomised Valsalva pushing: n=50 Spontaneous pushing: n=50
Other information	Jahdi 2011 reported length of labour by parity, but no information on total number in each group therefore unable to use this data.

**Study information marked with an Asterix was extracted directly from the study.*

Outcomes

Buxton 1988

Outcome	Immediate, N = 19	Delayed, N = 22
Spontaneous vaginal birth with epidural, mixed parity No of events	n = 11	n = 6
Instrumental birth with epidural No of events	n = 7	n = 16
Caesarean birth with epidural No of events	n = 1	n = 0
Duration of pushing (Minutes) with epidural, mixed parity Mean (SD)	81 (48)	79 (44)
Duration of waiting (passive second stage) (Minutes) with epidural, mixed parity Mean (SD)	37 (4)	130 (65)

Fitzpatrick 2002

Outcome	Immediate, N = 90	Delayed, N = 88
Spontaneous vaginal birth with epidural, nulliparous No of events	n = 50	n = 46
Instrumental birth with epidural No of events	n = 35	n = 39
Caesarean birth with epidural No of events	n = 5	n = 3
3rd or 4th degree tears with epidural (n=85 vs 85) No of events	n = 9	n = 6
Duration of pushing (Minutes) with epidural, nulliparous Mean (SD)	67 (42.9)	62.5 (36.8)
Duration of second stage (Minutes) with epidural, nulliparous Mean (SD)	67 (42.9)	130.5 (57.8)
***Duration of waiting (minutes)** **Median (IQR)**	0 (0 to 0)	60 (25 to 140)

Fraser 2000

Outcome	Immediate, N = 926	Delayed, N = 936
Spontaneous vaginal birth with epidural, nulliparous No of events	n = 718	n = 769
Instrumental birth with epidural No of events	n = 373	n = 345
Caesarean birth with epidural No of events	n = 53	n = 47
3rd or 4th degree tears with epidural No of events	n = 88	n = 87
Duration of pushing (Minutes) with epidural, nulliparous Mean (SD)	136.3 (73.5)	82 (46.1)
Duration of second stage (Minutes) with epidural, nulliparous Mean (SD)	135.8 (57.8)	193.5 (65.9)

Outcome	Immediate, N = 926	Delayed, N = 936
Admission to neonatal intensive care with epidural (n=926 vs 934) No of events	n = 47	n = 46

Goodfellow 1979

Outcome	Immediate, N = 16	Delayed, N = 21
Spontaneous vaginal birth with epidural, nulliparous No of events	n = 4	n = 12
Instrumental birth with epidural No of events	n = 12	n = 9
Duration of pushing (Minutes) with epidural, nulliparous Mean (SD)	62.5 (8.8)	43 (24.8)

Hansen 2002

Outcome	Immediate, N = 122	Delayed, N = 130
Spontaneous vaginal birth with epidural, nulliparous (n=67 vs 62) No of events	n = 45	n = 48
Spontaneous vaginal birth with epidural, multiparous (n=55 vs 65) No of events	n = 48	n = 63
Instrumental birth with epidural, nulliparous (n=64 vs 62) No of events	n = 19	n = 14
Instrumental birth with epidural, multiparous (n=55 vs 65) No of events	n = 7	n = 2

Outcome	Immediate, N = 122	Delayed, N = 130
Duration of pushing (Minutes) with epidural, nulliparous (n=65 vs 64) Mean (SD)	75.8 (41.4)	58.2 (44.1)
Duration of pushing (Minutes) with epidural, multiparous (n=57 vs 66) Mean (SD)	24.1 (22.7)	12.8 (14.3)
Duration of second stage (Minutes) with epidural, nulliparous (n=65 vs 64) Mean (SD)	75.8 (41.3)	171 (56.8)
Duration of second stage (Minutes) with epidural, multiparous (n=57 vs 66) Mean (SD)	24.1 (22.7)	62.9 (31.6)

Jahdi 2011

Outcome	Spontaneous, N = 99	Directed, N = 91
Spontaneous vaginal birth No of events	n = 98	n = 89
Caesarean birth No of events	n = 1	n = 2

Kelly 2010

Outcome	Immediate, N = 33	Delayed, N = 26
Spontaneous vaginal birth with epidural, nulliparous No of events	n = 29	n = 24
Caesarean birth with epidural No of events	n = 4	n = 2
3rd or 4th degree tears with epidural No of events	n = 2	n = 1
Duration of pushing (Minutes) with epidural, nulliparous (n= 28 vs 16) Mean (SD)	78.7 (41.8)	38.9 (27.6)

Outcome	Immediate, N = 33	Delayed, N = 26
Duration of second stage (Minutes) with epidural, nulliparous (n= 28 vs 16) Mean (SD)	87.1 (45.5)	117.6 (48.4)

Lam 2010

Outcome	Spontaneous, N = 35	Directed, N = 38
Spontaneous vaginal birth No of events	n = 35	n = 34
Instrumental birth No of events	n = 0	n = 4
Duration of second stage (Minutes) nulliparous Mean (SD)	38.1 (26.8)	31.9 (19.1)
Admission to neonatal intensive care unit No of events	n = 3	n = 4

Low 2013

Outcome	Spontaneous, N = 34	Directed, N = 39
Spontaneous vaginal birth No of events	n = 24	n = 31
Caesarean birth No of events	n = 11	n = 5
Duration of second stage (Minutes) nulliparous Mean (SD)	151.7 (133.3)	131.1 (91.1)

Mayberry 1999

Outcome	Immediate, N = 72	Delayed, N = 81
Spontaneous vaginal birth with epidural, nulliparous No of events	n = 46	n = 58
Instrumental birth with epidural No of events	n = 21	n = 20
Caesarean birth with epidural No of events	n = 5	n = 3

Outcome	Immediate, N = 72	Delayed, N = 81
3rd or 4th degree tears with epidural No of events	n = 5	n = 5
Duration of second stage (Minutes) nulliparous Mean (SD)	106 (73.5)	119.7 (65.3)

Plunkett 2003

Outcome	Immediate, N = 85	Delayed, N = 117
Spontaneous vaginal birth with epidural, nulliparous No of events	n = 59	n = 82
Instrumental birth with epidural No of events	n = 16	n = 28
Caesarean birth with epidural No of events	n = 10	n = 7
3rd or 4th degree tears with epidural No of events	n = 10	n = 11

Outcome	Immediate, N = 85	Delayed, N = 117
Duration of pushing (Minutes) with epidural, nulliparous Mean (SD)	67.3 (22.9)	68.5 (27.1)
Duration of second stage (Minutes) with epidural, nulliparous Mean (SD)	78.8 (27.2)	101.5 (32.4)
Admission to neonatal intensive care with epidural No of events	n = 3	n = 2

Schaffer 2005

Outcome	Spontaneous, , N = 157	Directed, , N = 163
Spontaneous vaginal birth No of events	n = 149	n = 152
Instrumental birth No of events	n = 7	n = 6
Caesarean birth No of events	n = 1	n = 5

Outcome	Spontaneous, , N = 157	Directed, , N = 163
3rd or 4th degree tears No of events	n = 15	n = 18
Apgar score <7 in 5 minutes No of events	n = 0	n = 1
Duration of second stage (Minutes) nulliparous Mean (SD)	59.1 (49.1)	46.3 (41.5)
Admission to neonatal intensive care No of events	n = 1	n = 0

Thomson 1993

Outcome	Spontaneous, , N = 15	Directed, , N = 17
Spontaneous vaginal birth No of events	n = 12	n = 15
Duration of second stage (Minutes) nulliparous Mean (SD)	121.4 (58.4)	58 (42)

Outcome	Spontaneous, , N = 15	Directed, , N = 17
Maternal satisfaction 0-10 scale (n=14 vs 17) Mean (SD)	7.8 (3.5)	6.9 (2.7)

Vause 1998

Outcome	Immediate, N = 67	Delayed, N = 68
Spontaneous vaginal birth with epidural, nulliparous No of events	n = 32	n = 34
Instrumental birth with epidural No of events	n = 29	n = 25
Caesarean birth with epidural No of events	n = 35	n = 34
Duration of pushing (Minutes) with epidural, nulliparous (n=62 vs 60) Mean (SD)	77.3 (19.5)	56.3 (17.2)

Outcome	Immediate, N = 67	Delayed, N = 68
Duration of second stage (Minutes) with epidural, nulliparous (n=63 vs 60) Mean (SD)	120.5 (19.1)	207.3 (68.6)
Admission to neonatal intensive care with epidural No of events	n = 3	n = 5

Vaziri 2016

Outcome	Spontaneous, N = 35	Directed, N = 34
Duration of pushing (Minutes) Mean (SD)	49.3 (11.7)	64.6 (15.2)
Duration of second stage (Minutes) nulliparous Mean (SD)	76.3 (8.3)	64.6 (15.2)

Yildirim 2008

Outcome	Spontaneous, , N = 50	Directed, , N = 50
Duration of pushing (Minutes) Mean (SD)	9.6 (5.5)	14.8 (7.5)
Duration of second stage (Minutes) nulliparous Mean (SD)	40.8 (19.1)	50.1 (26.3)

Critical appraisal - NGA Critical appraisal - ROBIS checklist

Section	Question	Answer
Study eligibility criteria	Concerns regarding specification of study eligibility criteria	Low
Identification and selection of studies	Concerns regarding methods used to identify and/or select studies	Low
Data collection and study appraisal	Concerns regarding methods used to collect data and appraise studies	Low
Synthesis and findings	Concerns regarding the synthesis and findings	Low
Overall study ratings	Overall risk of bias	Low
Overall study ratings	Applicability as a source of data	Partially applicable *(Some of the included studies were not used as they did not meet the protocol criteria.)*

Limitations for each of the included studies assessed with the Cochrane Risk of Bias Tool v1, based on the Cochrane review assessments

Study	Answer
Buxton 1988	Random sequence generation: Low risk Allocation concealment: Some concerns Blinding of participants and personnel: High risk Blinding of outcome assessment: Some concerns Incomplete outcome data: Some concerns Selective reporting: High risk Other bias: Low risk
Fitzpatrick 2002	Random sequence generation: Low risk Allocation concealment: Low risk Blinding of participants and personnel: High risk Blinding of outcome assessment: Low risk Incomplete outcome data: Low risk Selective reporting: High risk Other bias: Low risk
Fraser 2000	Random sequence generation: Some concerns Allocation concealment: Low risk Blinding of participants and personnel: High risk Blinding of outcome assessment: Some concerns Incomplete outcome data: Low risk Selective reporting: High risk Other bias: Low risk
Goodfellow 1979	Random sequence generation: Some concerns Allocation concealment: Some concerns Blinding of participants and personnel: High risk Blinding of outcome assessment: Some concerns Incomplete outcome data: Some concerns Selective reporting: High risk Other bias: Low risk
Hansen 2002	Random sequence generation: Low risk

Study	Answer
	Allocation concealment: Some concerns Blinding of participants and personnel: High risk Blinding of outcome assessment: Some concerns Incomplete outcome data: High risk Selective reporting: High risk Other bias: Low risk
Jahdi 2011	Random sequence generation: Some concerns Allocation concealment: Some concerns Blinding of participants and personnel: High risk Blinding of outcome assessment: Some concerns Incomplete outcome data: Some concerns Selective reporting: High risk Other bias: Low risk
Kelly 2010	Random sequence generation: Low risk Allocation concealment: Some concerns Blinding of participants and personnel: High risk Blinding of outcome assessment: High risk Incomplete outcome data: Low risk Selective reporting: High risk Other bias: Low risk
Lam 2010	Random sequence generation: High risk Allocation concealment: Some concerns Blinding of participants and personnel: High risk Blinding of outcome assessment: Some concerns Incomplete outcome data: Some concerns Selective reporting: High risk Other bias: Low risk
Low 2013	Random sequence generation: Low risk Allocation concealment: Some concerns Blinding of participants and personnel: High risk

Study	Answer
	Blinding of outcome assessment: Low risk Incomplete outcome data: High risk Selective reporting: High risk Other bias: Low risk
Mayberry 1999	Random sequence generation: Low risk Allocation concealment: Low risk Blinding of participants and personnel: High risk Blinding of outcome assessment: Some concerns Incomplete outcome data: Some concerns Selective reporting: High risk Other bias: Low risk
Plunkett 2003	Random sequence generation: Low risk Allocation concealment: Low risk Blinding of participants and personnel: High risk Blinding of outcome assessment: Some concerns Incomplete outcome data: Low risk Selective reporting: High risk Other bias: Low risk
Schaffer 2005	Random sequence generation: Low risk Allocation concealment: Low risk Blinding of participants and personnel: High risk Blinding of outcome assessment: Low risk Incomplete outcome data: High risk Selective reporting: Low risk Other bias: Low risk
Thomson 1993	Random sequence generation: Low risk Allocation concealment: Low risk Blinding of participants and personnel: High risk Blinding of outcome assessment: Some concerns Incomplete outcome data: Low risk

Study	Answer
	Selective reporting: High risk Other bias: High risk
Vause 1998	Random sequence generation: Low risk Allocation concealment: Low risk Blinding of participants and personnel: High risk Blinding of outcome assessment: Some concerns Incomplete outcome data: Low risk Selective reporting: High risk Other bias: Low risk
Vaziri 2016	Random sequence generation: Low risk Allocation concealment: Some concerns Blinding of participants and personnel: High risk Blinding of outcome assessment: Some concerns Incomplete outcome data: Low risk Selective reporting: High risk Other bias: Low risk
Yildirim 2008	Random sequence generation: High risk Allocation concealment: Some concerns Blinding of participants and personnel: High risk Blinding of outcome assessment: Some concerns Incomplete outcome data: High risk Selective reporting: High risk Other bias: Low risk

Parnell, 1993

Bibliographic Reference	Parnell, C.; Langhoff-Roos, J.; Iversen, R.; Damgaard, P.; Pushing method in the expulsive phase of labor. A randomized trial; Acta obstetricia et gynecologica Scandinavica; 1993; vol. 72 (no. 1); 31-5

Study details

Country/ies where study was carried out	Denmark
Study type	Randomised controlled trial (RCT)
Study dates	October 1990 to October 1991
Inclusion criteria	• Danish speaking women over 18 years old • primiparous • or secundiparae after a previous caesarean • singleton pregnancy • gestation of 37 weeks • vertex presentation • expected vaginal delivery
Exclusion criteria	None specified
Patient characteristics	Maternal age, years - mean (SD): Intervention (forced): 27.8 (4.2) Comparison (spontaneous): 26.9 (4.1) Gestational age, completed weeks - mean (SD) Intervention (forced): 40 (1.3) Comparison (spontaneous): 40 (1.2)
Intervention(s)/control	Women were allowed to use their urge to push without encouragement, until the presenting part could be seen. After this they were told to push according to their group assignment. Intervention (forced): • women were encouraged to push using the Valsalva maneuver: take a deep breath, hold and then push for as long and as hard as possible. They were also instructed to push 2 or 3 times during each contraction.

	Comparison (spontaneous): • women were encouraged to use their own urge to push, for as long as, and as many times as felt necessary during each contraction.
Sources of funding	Not reported
Sample size	N=306 Intervention (forced): n=155 Comparison (spontaneous): n=151

Outcomes

Outcome	**Intervention - forced, , N = 155**	**Comparison - spontaneous, , N = 151**
Duration of expulsive phase (Minutes) Mean (SD)	33 (23.7)	38 (25.8)
Duration of second stage Mean (SD)	54 (33.8)	57 (35.6)

Critical appraisal

Section	**Question**	**Answer**
Domain 1: Bias arising from the randomisation process	Risk of bias judgement for the randomisation process	Low *(Allocation random and concealed.)*

Section	Question	Answer
Domain 2a: Risk of bias due to deviations from the intended interventions (effect of assignment to intervention)	Risk of bias for deviations from the intended interventions (effect of assignment to intervention)	Some concerns *(Some women withdrew after randomisation, this could be due to knowledge of the intervention but it is a small number and unlikely to impact results. Not enough information analysis, although assumed intention to treat.)*
Domain 3. Bias due to missing outcome data	Risk-of-bias judgement for missing outcome data	Low
Domain 4. Bias in measurement of the outcome	Risk-of-bias judgement for measurement of the outcome	Low *(Outcome assessors were aware of assignment but outcomes are not subjective.)*
Domain 5. Bias in selection of the reported result	Risk-of-bias judgement for selection of the reported result	Some concerns *(No pre-specified protocol available.)*
Overall bias and Directness	Risk of bias judgement	Some concerns
Overall bias and Directness	Overall Directness	Indirectly applicable
Overall bias and Directness	Risk of bias variation across outcomes	No variation

Walker, 2012

Bibliographic Reference	Walker, Carolina; Rodriguez, Tania; Herranz, Ana; Espinosa, Jose A.; Sanchez, Emilia; Espuna-Pons, Montserrat; Alternative model of birth to reduce the risk of assisted vaginal delivery and perineal trauma; International urogynecology journal; 2012; vol. 23 (no. 9); 1249-56

Study details

Country/ies where study was carried out	Spain
Study type	Randomised controlled trial (RCT)
Study dates	Not reported
Inclusion criteria	• Nulliparous or multiparous • Gestational age >36 or <42 weeks • Singleton fetus • Cephalic presentation • Spontaneous or induced labour • Effective epidural analgesia with a continuous infusion technique
Exclusion criteria	• Complicated pregnancy • Previous caesarean birth • Hypertension • Fetal growth restriction • Lack of understanding of the study
Patient characteristics	Maternal age, years - mean (SD) Intervention: 30.4 (5.3) Control: 30.5 (5.5) BMI, kg/m2 - mean (SD) Intervention: 27.8 (4.8) Control: 27.4 (3.6) Gestational age, weeks - mean (SD)

	Intervention: 39.4 (1.2) Control: 39.1 (1.4) <u>Labour induced - number (%)</u> Intervention: 20 (20) Control: 25 (26.9)
Intervention(s)/control	Intervention - alternative model of birth • During the passive stage of the second stage of labour, women moved to different positions, while delaying the onset of pushing. • Women changed positions such as sitting, kneeling, lateral or hands and knees every 20-30 minutes. • The active phase started when women felt a strong urge to push. If women did not feel an urge after 120 minutes in the passive stage, they were asked to start pushing with each contraction. • Women were placed in the modified lateral Gasquet positive during the active pushing phase. • The push was directed by midwives by using the abdominal straining maneuver. It involves forceful expiration against a closed glottis. Control - traditional model of birth • Women were encouraged to push with each contraction as soon as they were full dilated. • Delivery was in lithotomy position. • Method of pushing was the same as in the intervention group.
Sources of funding	Not industry funded
Sample size	N=199 randomised Intervention, n=103 (101 analysed) Control, n=96 (95 analysed)

Outcomes

Outcome	Intervention, N = 101	Control, N = 95
Spontaneous vaginal birth No of events	n = 81	n = 55
Assisted vaginal delivery No of events	n = 20	n = 40
Duration of pushing efforts (Minutes) Mean (SD)	85.52 (52.1)	52.06 (36.2)
Apgar score <7 at 5 minutes No of events	n = 0	n = 0

Critical appraisal

Section	Question	Answer
Domain 1: Bias arising from the randomisation process	Risk of bias judgement for the randomisation process	Low *(Allocation random and concealed.)*
Domain 2a: Risk of bias due to deviations from the intended interventions (effect of assignment to intervention)	Risk of bias for deviations from the intended interventions (effect of assignment to intervention)	Some concerns *(No deviations from intended information, but no information on analysis although intention to treat assumed from presentation of data.)*
Domain 3. Bias due to missing outcome data	Risk-of-bias judgement for missing outcome data	Low *(Data available for nearly all participants)*
Domain 4. Bias in measurement of the outcome	Risk-of-bias judgement for measurement of the outcome	Low *(Outcome assessor knowledge of the intervention unlikely to influence as outcomes are not subjective.)*

Section	Question	Answer
Domain 5. Bias in selection of the reported result	Risk-of-bias judgement for selection of the reported result	Some concerns *(Pre-specified protocol not available.)*
Overall bias and Directness	Risk of bias judgement	Some concerns
Overall bias and Directness	Overall Directness	Directly applicable
Overall bias and Directness	Risk of bias variation across outcomes	No variation

Yuksel, 2017

Bibliographic Reference	Yuksel, Hilal; Cayir, Yasemin; Kosan, Zahide; Tastan, Kenan; Effectiveness of breathing exercises during the second stage of labor on labor pain and duration: a randomized controlled trial; Journal of integrative medicine; 2017; vol. 15 (no. 6); 456-461

Study details

Country/ies where study was carried out	Turkey
Study type	Randomised controlled trial (RCT)
Study dates	May 2016 to June 2016
Inclusion criteria	• Nulliparous pregnant women • gestational age between 37 - 42 weeks.

Exclusion criteria	• Those using analgesia or anaesthetics • clinical instability • psychiatric disorders • inability to cooperate with breathing exercises.
Patient characteristics	Maternal age, years - mean (SD): Intervention: 23.5 (4.6) Control: 22.8 (3.8) Gestational age, weeks - mean (SD): Intervention: 39.48 (0.82) Control: 39.47 (0.79) Comorbidities *(hypothyroidism, hepatitis B carriage, migraine)* - number (%): Intervention: 11 (8.8) Control: 118 (5.6)
Intervention(s)/control	Intervention: • Women received one session of breathing exercises in the first stage of labour. • Training was given by the principle investigator. • Women were given brochures before the training to read on their own. • The training instructed women to perform abdominal breathing during the second stage of birth. • Women were told to: fill their stomach then then lungs with air while breathing in. feel stomach expand. Relax the muscles from your stomach to your knee as if urinating while breathing out. When there is pain, perform deep abdominal breathing, take a deep breath in and hold as much as your can. Try and push the baby downward. You can do it by holding your breath, or breathing out slowly. At this stage do not fill the stomach with air, and push the baby downward. Control: • Women received standard care. No details were given.
Sources of funding	Not reported

Sample size	N=250 Intervention, n=125 Control. n=125

Outcomes

Outcome	**Intervention, N = 125**	**Control, N = 125**
Duration of second stage (Minutes) no information on passive or active Mean (SD)	369.6 (92)	440.7 (142.5)

Critical appraisal

Section	**Question**	**Answer**
Domain 1: Bias arising from the randomisation process	Risk of bias judgement for the randomisation process	Some concerns *(Allocation random but no information on concealment.)*
Domain 2a: Risk of bias due to deviations from the intended interventions (effect of assignment to intervention)	Risk of bias for deviations from the intended interventions (effect of assignment to intervention)	Some concerns *(Not enough information on deviations or analysis.)*
Domain 3. Bias due to missing outcome data	Risk-of-bias judgement for missing outcome data	Low *(Data available for all participants)*
Domain 4. Bias in measurement of the outcome	Risk-of-bias judgement for measurement of the outcome	Low *(Outcome assessors aware of assignment but no concerns as outcomes not subjective.)*

Section	Question	Answer
Domain 5. Bias in selection of the reported result	Risk-of-bias judgement for selection of the reported result	Some concerns *(Pre-specified protocol not available.)*
Overall bias and Directness	Risk of bias judgement	Some concerns
Overall bias and Directness	Overall Directness	Indirectly applicable
Overall bias and Directness	Risk of bias variation across outcomes	No variation

BMI: body mass index; IQR: interquartile range; RCT: randomised controlled trial; ROBINS: risk of bias in systematic reviews; SD: standard deviation; VAS visual analogue scale

Appendix E Forest plots

Forest plots for review question: What are the benefits and risks of the different pushing techniques (immediate, spontaneous, delayed, directed) in the second stage of labour in women with and without regional analgesia?

This section includes forest plots only for outcomes that are meta-analysed. Outcomes from single studies are not presented here; the quality assessment for such outcomes is provided in the GRADE profiles in appendix F.

Comparison 2: Spontaneous versus Directed (Valsalva/closed glottis)

Figure 2: Spontaneous vaginal birth, without epidural, nulliparous

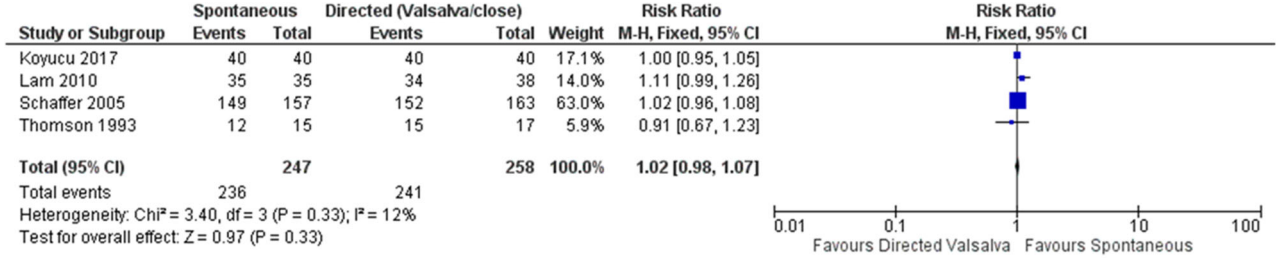


Figure 3: Spontaneous vaginal birth, without epidural, mixed parity

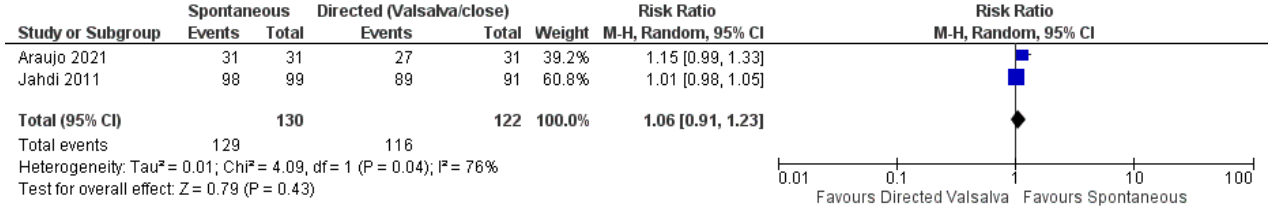


Figure 4: Instrumental birth, without epidural, nulliparous

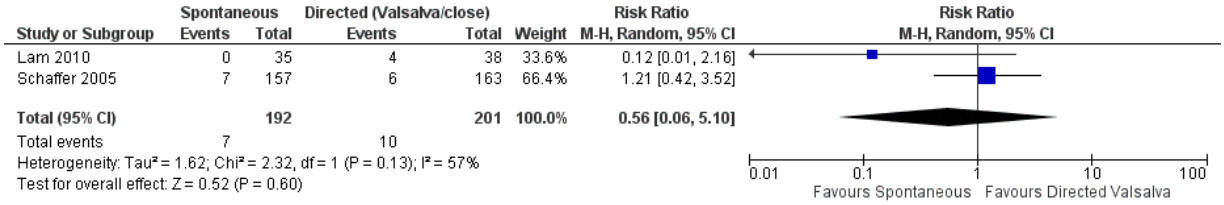


Figure 5: Caesarean birth, without epidural, mixed parity

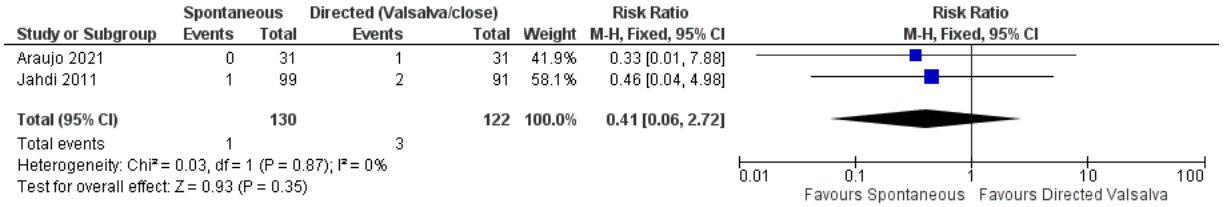


Figure 6: Third/fourth degree tears, without epidural, nulliparous

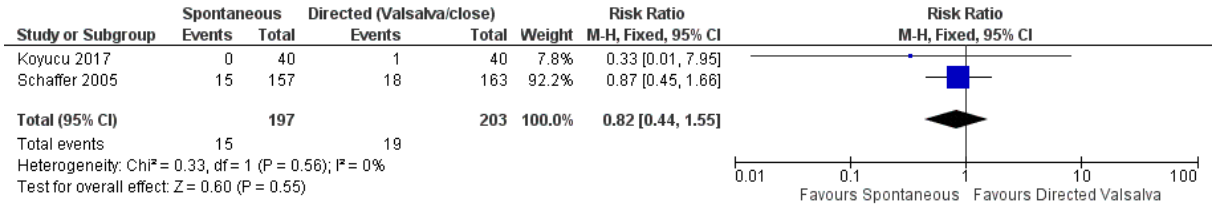


Figure 7: Duration of active second stage, without epidural, nulliparous

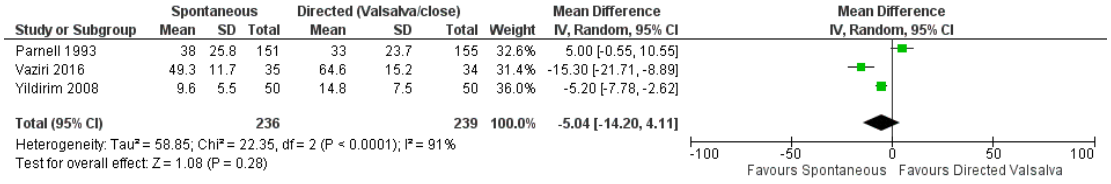


Figure 8: Duration of second stage, without epidural, nulliparous

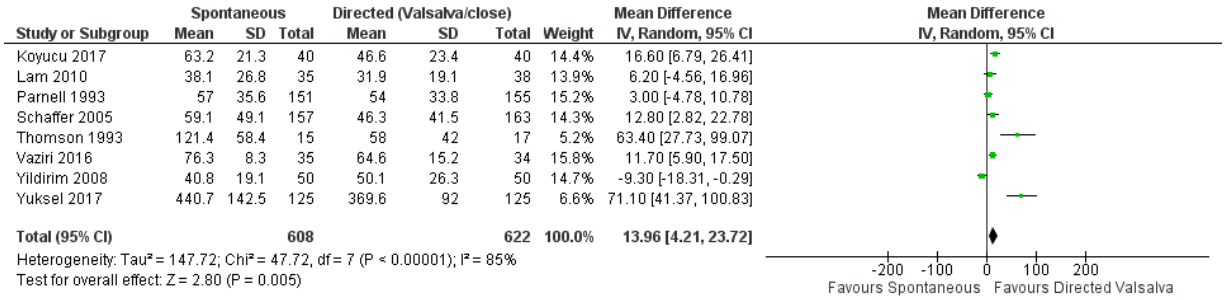
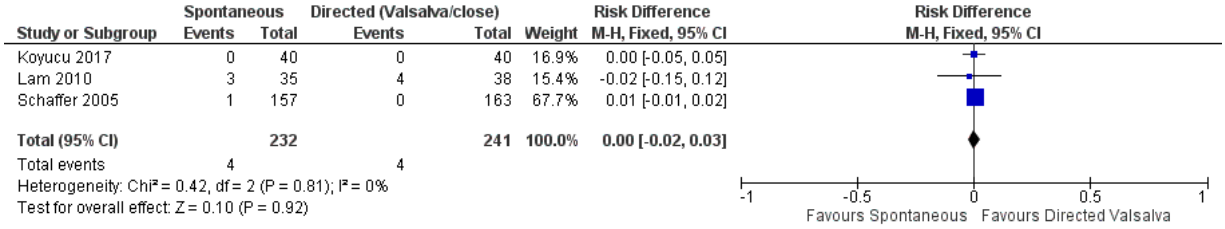


Figure 9: Neonatal admission, without epidural, nulliparous



Comparison 3: Immediate versus delayed

Figure 10: Spontaneous vaginal birth, nulliparous

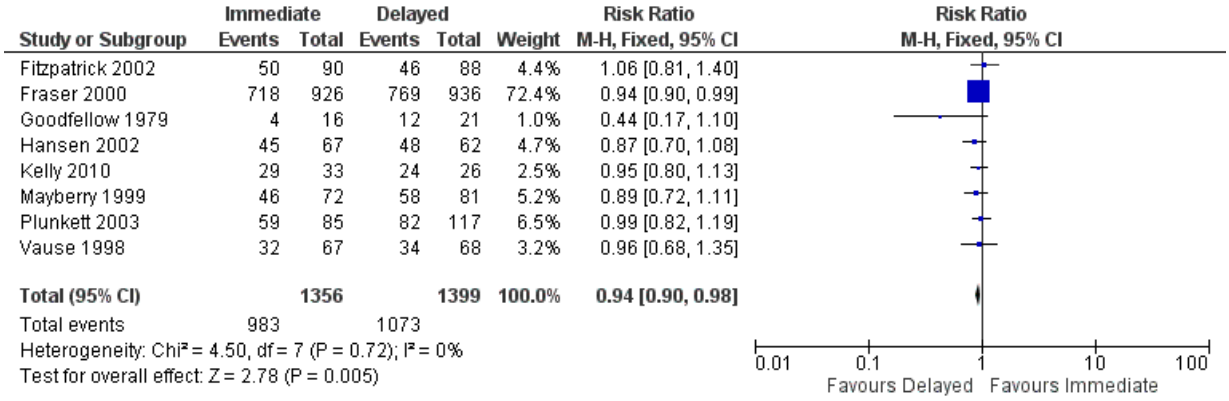


Figure 11: Spontaneous vaginal birth, mixed parity

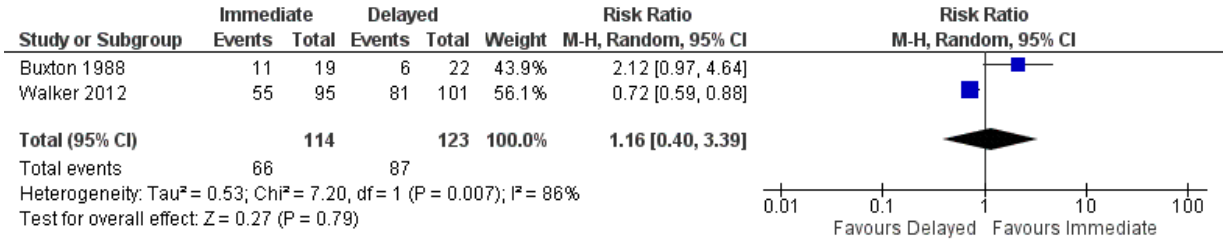


Figure 12: Instrumental birth, nulliparous

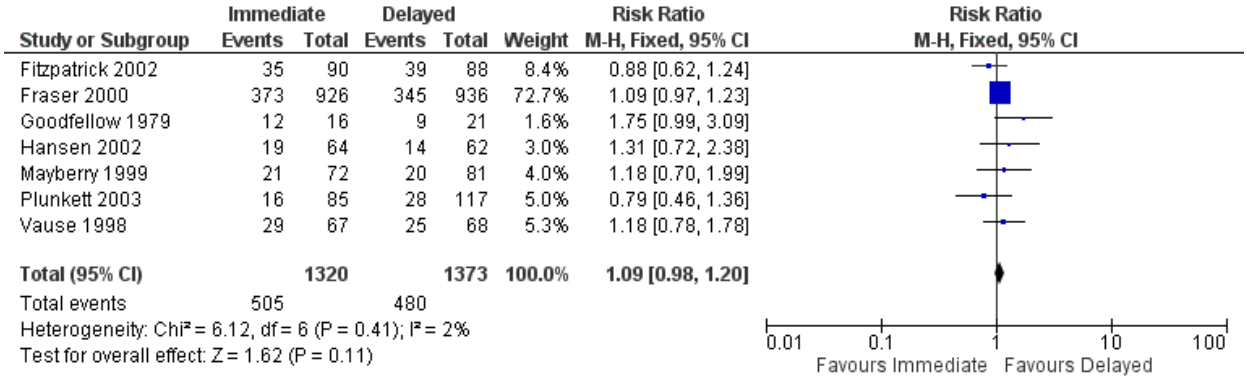


Figure 13: Instrumental birth, mixed parity

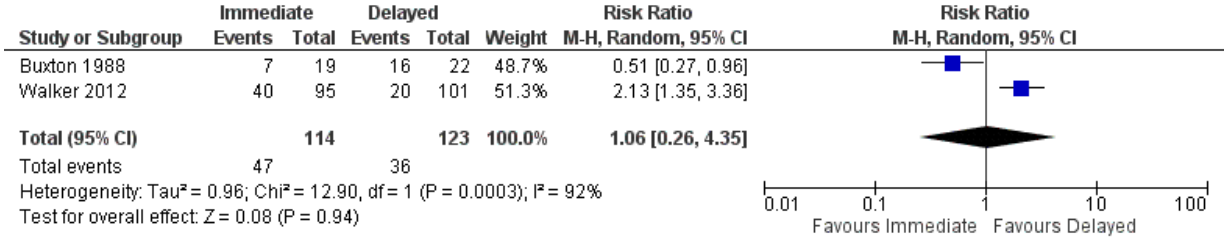


Figure 14: Caesarean birth, nulliparous

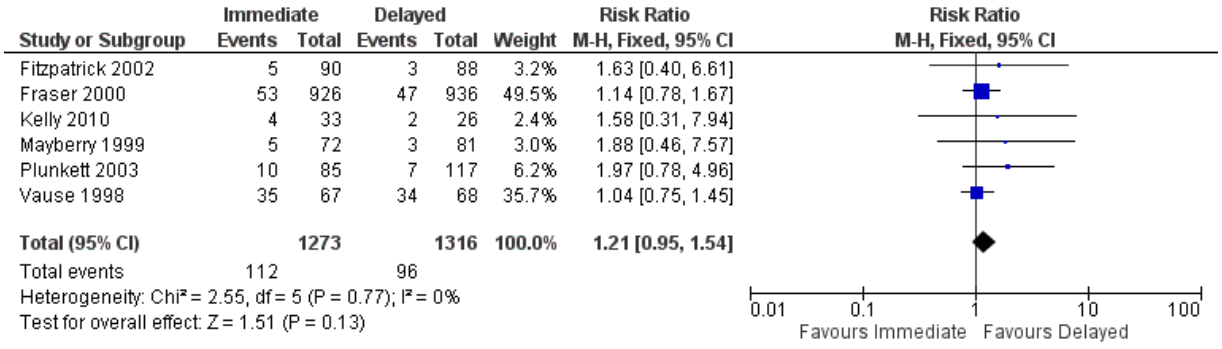


Figure 15: Third/fourth degree tears, nulliparous

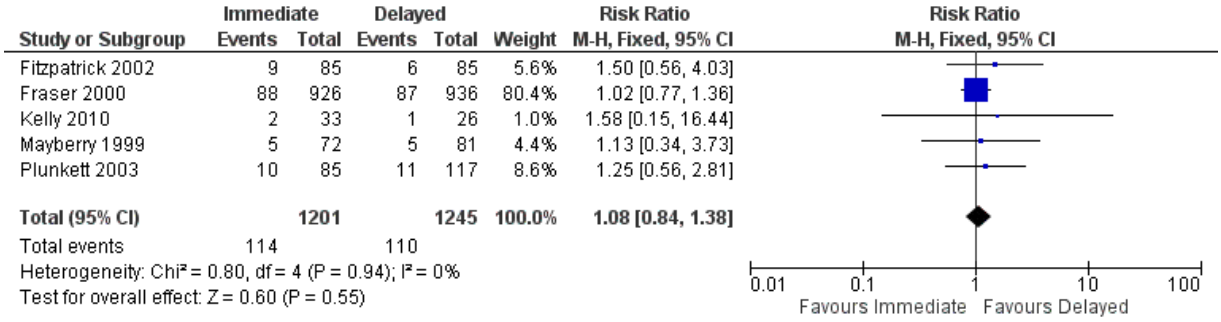


Figure 16: Apgar score <7 in 5 minutes, nulliparous

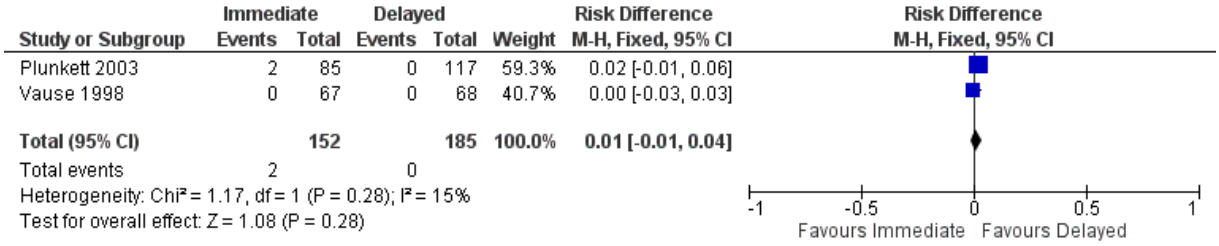


Figure 17: Duration of active second stage, nulliparous

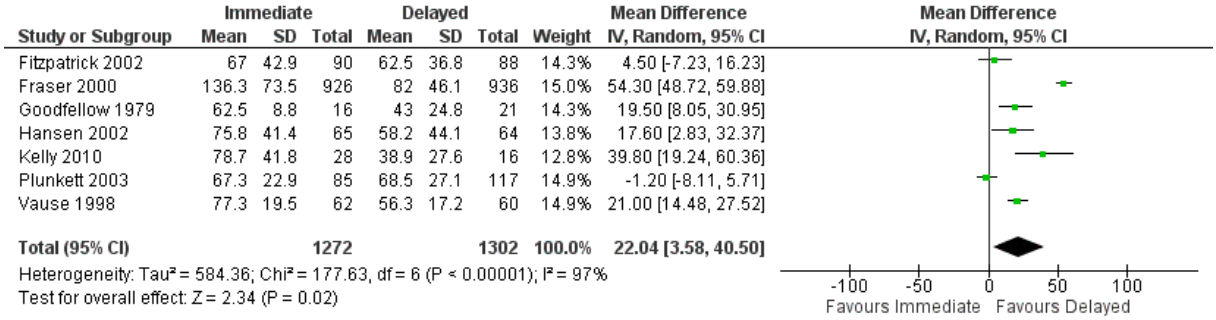


Figure 18: Duration of active second stage, mixed parity

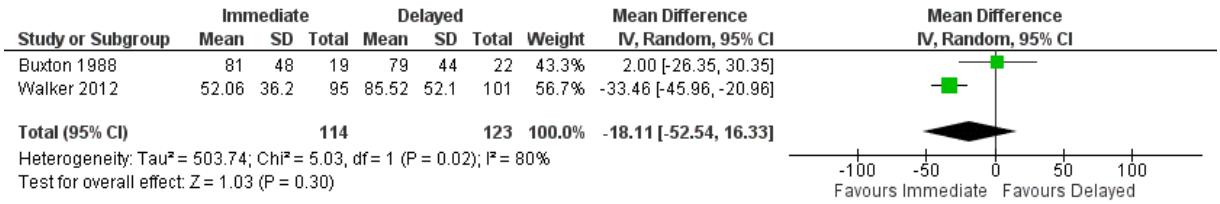


Figure 19: Duration of second stage, nulliparous

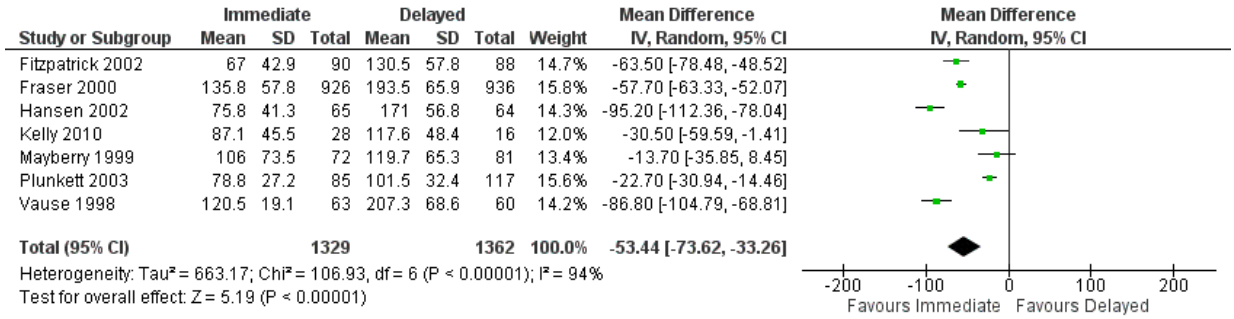
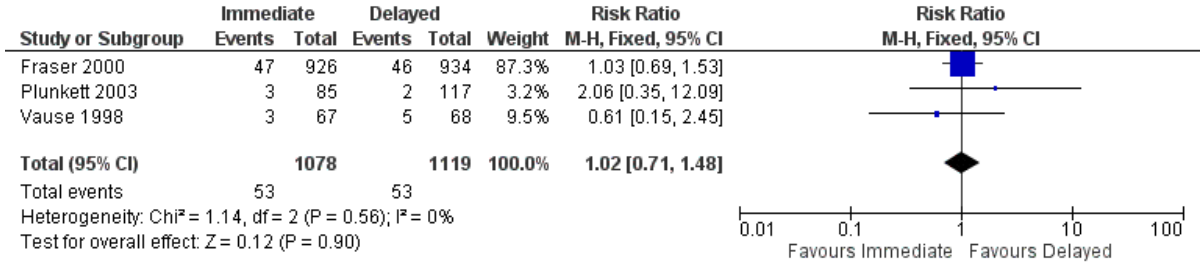


Figure 20: Neonatal admission, nulliparous



Appendix F GRADE tables

GRADE tables for review question: What are the benefits and risks of the different pushing techniques (immediate, spontaneous, delayed, directed) in the second stage of labour in women with and without regional analgesia?

Table 4: Evidence profile for comparison 1: Directed (open glottis) versus Directed (Valsalva/closed glottis)

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Directed (open glottis)	Directed (Valsalva/closed glottis)	Relative (95% CI)	Absolute		
Spontaneous vaginal birth - with epidural - mixed parity												
1 (Barasinski 2020)	randomised trials	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[1]	none	89/125 (71.2%)	98/125 (78.4%)	RR 0.91 (0.79 to 1.05)	71 fewer per 1000 (from 165 fewer to 39 more)	MODERATE	CRITICAL
Instrumental births - with epidural - mixed parity												
1 (Barasinski 2020)	randomised trials	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[2]	none	30/125 (24%)	25/125 (20%)	RR 1.2 (0.75 to 1.92)	40 more per 1000 (from 50 fewer to 184 more)	LOW	CRITICAL
Caesarean births - with epidural - mixed parity												
1 (Barasinski 2020)	randomised trials	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[2]	none	6/125 (4.8%)	2/125 (1.6%)	RR 3 (0.62 to 14.58)	32 more per 1000 (from 6 fewer to 217 more)	LOW	CRITICAL
3rd/4th degree tears - without epidural - nulliparous												
1 (Ahmadi 2017)	randomised trials	serious[3]	no serious inconsistency	no serious indirectness	very serious[2]	none	0/83 (0%)	3/83 (3.6%)	POR 0.13 (0.01 to 1.29)	31 fewer per 1000 (from 36 fewer to 10 more)	VERY LOW	CRITICAL
3rd/4th degree tears - with epidural - mixed parity												
1 (Barasinski 2020)	randomised trials	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[2]	none	5/84 (6%)	1/89 (1.1%)	RR 5.3 (0.63 to 44.41)	48 more per 1000 (from 4 fewer to 488 more)	LOW	CRITICAL

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Directed (open glottis)	Directed (Valsalva/closed glottis)	Relative (95% CI)	Absolute		
Duration of active second stage/ duration of pushing - with epidural - mixed parity (measured with: minutes; Better indicated by lower values)												
1 (Barasinski 2020)	randomised trials	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[4]	none	125	125	-	MD 6.4 higher (2.37 to 10.43 higher)	MODERATE	IMPORTANT
Duration of active second stage/duration of pushing - without epidural - multiparous (measured with: seconds; Better indicated by lower values)												
1 (Barnett 1982)	randomised trials	very serious[5]	no serious inconsistency	serious[6]	no serious imprecision	none	5	5	-	MD 5.55 lower (8.07 to 3.03 lower)	VERY LOW	IMPORTANT
Duration of passive second stage - with epidural - mixed parity (measured with: minutes; Better indicated by lower values)												
1 (Barasinski 2020)	randomised trials	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[4]	none	122	123	-	MD 19 higher (0.64 to 37.36 higher)	MODERATE	IMPORTANT
Duration of second stage - without epidural - multiparous (measured with: minutes; Better indicated by lower values)												
1 (Barnett 1982)	randomised trials	very serious[5]	no serious inconsistency	serious[6]	no serious imprecision	none	5	5	-	MD 19 higher (7.11 lower to 45.11 higher)	VERY LOW	IMPORTANT
Neonatal admission												
1 (Barasinski 2020)	randomised trials	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[2]	none	2/125 (1.6%)	1/125 (0.8%)	RR 2 (0.18 to 21.78)	8 more per 1000 (from 7 fewer to 166 more)	LOW	IMPORTANT

CI: confidence interval; MD: mean difference; POR: Peto odds ratio; RR: risk ratio
1 95% CI crosses 1 MID
2 95% CI crosses 2 MIDs
3 Serious risk of bias in the evidence contributing to the outcomes as per RoB 2
4 95% CI crosses 1 MID (0.5x control group SD, for 'duration active stage, with ep, mixed' = 7.5; 'duration passive stage, with ep, mixed = 36.1)
5 Very serious risk of bias in the evidence contributing to the outcomes as per RoB 2
6 Population indirect due to not enough information on women who were induced.

Table 5: Evidence profile for comparison 2: Spontaneous versus Directed (Valsalva/closed glottis)

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Spontaneous	Directed (Valsalva/closed glottis)	Relative (95% CI)	Absolute		
Spontaneous vaginal birth - without epidural, nulliparous												
4 (Koyuco 2017; Lam 2010; Schaffer 2005; Thomson 1993)	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision	none	236/247 (95.5%)	241/258 (93.4%)	RR 1.02 (0.98 to 1.07)	19 more per 1000 (from 19 fewer to 65 more)	MODERATE	CRITICAL
Spontaneous vaginal birth - without epidural, mixed parity												
2 (Araujo 2021; Jahdi 2011)	randomised trials	serious[1]	serious[2]	serious[3,4]	no serious imprecision	none	129/130 (99.2%)	116/122 (95.1%)	RR 1.06 (0.91 to 1.23)	57 more per 1000 (from 86 fewer to 219 more)	VERY LOW	CRITICAL
Spontaneous vaginal birth - with epidural, nulliparous												
1 (Low 2013)	randomised trials	very serious[5]	no serious inconsistency	serious[3]	serious[6]	none	24/34 (70.6%)	31/39 (79.5%)	RR 0.89 (0.68 to 1.16)	87 fewer per 1000 (from 254 fewer to 127 more)	VERY LOW	CRITICAL
Instrumental births - without epidural - nulliparous												
2 (Lam 2010; Schaffer 2005)	randomised trials	very serious[5]	serious[2]	no serious indirectness	very serious[7]	none	7/192 (3.6%)	10/201 (5%)	RR 0.56 (0.06 to 5.10)	22 fewer per 1000 (from 47 fewer to 204 more)	VERY LOW	CRITICAL
Instrumental birth - without epidural - mixed parity												
1 (Araujo 2021)	randomised trials	serious[1]	no serious inconsistency	serious[4]	very serious[7]	none	0/31 (0%)	3/31 (9.7%)	POR 0.13 (0.01 to 1.26)	84 fewer per 1000 (from 96 fewer to 25 more)	VERY LOW	CRITICAL
Caesarean births - without epidural - nulliparous												

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Spontaneous	Directed (Valsalva/closed glottis)	Relative (95% CI)	Absolute		
1 (Schaffer 2005)	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	very serious[7]	none	1/157 (0.64%)	5/163 (3.1%)	RR 0.21 (0.02 to 1.76)	24 fewer per 1000 (from 30 fewer to 23 more)	VERY LOW	CRITICAL
Caesarean births - without epidural - mixed parity												
2 (Araujo 2021; Jahdi 2011)	randomised trials	serious[1]	no serious inconsistency	serious[3,4]	very serious[7]	none	1/130 (0.77%)	3/122 (2.5%)	RR 0.41 (0.06 to 2.72)	15 fewer per 1000 (from 23 fewer to 42 more)	VERY LOW	CRITICAL
Caesarean births - with epidural - nulliparous												
1 (Low 2013)	randomised trials	very serious[5]	no serious inconsistency	serious[3]	serious[6]	none	11/34 (32.4%)	5/39 (12.8%)	RR 2.52 (0.97 to 6.54)	195 more per 1000 (from 4 fewer to 710 more)	VERY LOW	CRITICAL
3rd/4th degree tears - without epidural - nulliparous												
2 (Koyucu 2017; Schaffer 2005)	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	very serious[7]	none	15/197 (7.6%)	19/203 (9.4%)	RR 0.82 (0.44 to 1.55)	17 fewer per 1000 (from 52 fewer to 51 more)	VERY LOW	CRITICAL
Apgar score <7 in 5 minutes - without epidural - nulliparous												
1 (Schaffer 2005)	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	very serious[7]	none	0/157 (0%)	1/163 (0.61%)	POR 0.14 (0.00 to 7.08)	5 fewer per 1000 (from 6 fewer to 37 more)	VERY LOW	CRITICAL
Apgar score <7 in 5 minutes - without epidural - mixed parity												
1 (Araujo 2021)	randomised trials	serious[1]	no serious inconsistency	serious[4]	very serious[8]	none	0/31 (0%)	0/31 (0%)	RD 0 (-0.06 to 0.06)	0 more per 1000 (from 60 fewer to 60 more)	VERY LOW	CRITICAL

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Spontaneous	Directed (Valsalva/closed glottis)	Relative (95% CI)	Absolute		
Duration of active second stage/ duration of pushing - without epidural - nulliparous (measured with: minutes; Better indicated by lower values)												
3 (Parnell 1993; Vaziri 2016; Yildirim 2008)	randomised trials	very serious[5]	very serious[9]	no serious indirectness	serious[10]	none	236	239	-	MD 5.04 lower (14.2 lower to 4.11 higher)	VERY LOW	IMPORTANT
Duration of active second stage/ duration of pushing - without epidural - mixed parity (measured with: minutes; Better indicated by lower values)												
1 (Araujo 2021)	randomised trials	serious[1]	no serious inconsistency	serious[4]	serious[10]	none	31	31	-	MD 3.3 lower (5.12 to 1.48 lower)	VERY LOW	IMPORTANT
Duration of second stage - without epidural - nulliparous (measured with: minutes; Better indicated by lower values)												
8 (Koyucu 2017; Lam 2010; Parnell 1993; Schaffer 2005; Thomson 1993; Vaziri 2016; Yildirim 2008; Yuksel 2017)	randomised trials	serious[1]	very serious[9]	serious[3]	serious[10]	none	608	622	-	MD 13.96 higher (4.21 to 23.72 higher)	VERY LOW	IMPORTANT
Duration of second stage - without epidural - mixed parity (measured with: minutes; Better indicated by lower values)												
1 (Araujo 2021)	randomised trials	serious[1]	no serious inconsistency	serious[4]	serious[10]	none	31	31	-	MD 12.8 lower (26.63 lower to 1.03 higher)	VERY LOW	IMPORTANT
Duration of second stage - with epidural - nulliparous (measured with: minutes; Better indicated by lower values)												
1 (Low 2013)	randomised trials	very serious[5]	no serious inconsistency	serious[3]	serious[10]	none	34	39	-	MD 20.6 higher (32.55 lower to 73.75 higher)	VERY LOW	IMPORTANT
High maternal satisfaction - without epidural - mixed parity												
1 (Araujo 2021)	randomised trials	very serious[5]	no serious inconsistency	serious[4]	no serious imprecision	none	27/31 (87.1%)	27/31 (87.1%)	RR 1 (0.83 to 1.21)	0 fewer per 1000 (from 148 fewer to 183 more)	VERY LOW	IMPORTANT

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Spontaneous	Directed (Valsalva/closed glottis)	Relative (95% CI)	Absolute		
Maternal satisfaction - without epidural - nulliparous (measured with: Visual analogue scale; range of scores: 0-10; Better indicated by higher values)												
1 (Thomson 1993)	randomised trials	very serious[5]	no serious inconsistency	no serious indirectness	serious[10]	none	14	17	-	MD 0.9 higher (1.34 lower to 3.14 higher)	VERY LOW	IMPORTANT
Neonatal admission - without epidural - nulliparous												
3 (Koyucu 2017; Lam 2010; Schaffer 2005)	randomised trials	very serious[5]	no serious inconsistency	serious[3]	no serious imprecision	none	4/232 (1.7%)	4/241 (1.7%)	RD 0 (-0.02 to 0.03)	0 more per 1000 (from 20 fewer to 30 more)	VERY LOW	IMPORTANT
Neonatal admission - without epidural - mixed parity												
1 (Araujo 2021)	randomised trials	serious[1]	no serious inconsistency	serious[4]	very serious[8]	none	0/31 (0%)	0/31 (0%)	RD 0 (-0.06 to 0.06)	0 more per 1000 (from 60 fewer to 60 more)	VERY LOW	IMPORTANT

CI: confidence interval; MD: mean difference; POR: Peto odds ratio; RD: risk difference; RR: risk ratio
1 Serious risk of bias in the evidence contributing to the outcomes as per RoB 2
2 Serious heterogeneity unexplained by subgroup analysis
3 Population is indirect due to not enough information on number of women who were induced.
4 Population is indirect due to not enough information on high risk women.
5 Very serious risk of bias in the evidence contributing to the outcomes as per RoB 2
6 95% CI crosses 1 MID
7 95% CI crosses 2 MIDs
8 Sample size <200
9 Very serious heterogeneity unexplained by subgroup analysis
10 95% CI crosses 1 MID (0.5x control group SD, for 'duration of active stage, without ep, nulli' = 7.7; 'duration active stage, without ep, mixed' = 1.9; 'duration second stage without ep, nulli' = 18.3; 'duration second stage without ep. mixed' = 14.6; 'duration of second stage with ep, nulli' = 45.6; 'maternal satisfaction, without ep, nulli' = 1.35)

Table 6: Evidence profile for comparison 3: Immediate versus delayed

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Immediate	Delayed	Relative (95% CI)	Absolute		
Spontaneous vaginal birth - nulliparous												
8 (Fitzpatrick 2002; Fraser 2000; Goodfellow 1979; Hansen 2002; Kelly 2010; Mayberry 1999; Plunkett 2003; Vause 1998)	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision	none	983/1356 (72.5%)	1073/1399 (76.7%)	RR 0.94 (0.9 to 0.98)	46 fewer per 1000 (from 15 fewer to 77 fewer)	MODERATE	CRITICAL
Spontaneous vaginal birth - multiparous												
1 (Hansen 2002)	randomised trials	very serious[2]	no serious inconsistency	serious[3]	no serious imprecision	none	48/55 (87.3%)	63/65 (96.9%)	RR 0.9 (0.81 to 1)	97 fewer per 1000 (from 184 fewer to 0 more)	VERY LOW	CRITICAL
Spontaneous vaginal birth - mixed parity												
2 (Buxton 1988; Walker 2012)	randomised trials	serious[1]	very serious[4]	no serious indirectness	very serious[5]	none	66/114 (57.9%)	87/123 (70.7%)	RR 1.16 (0.4 to 3.39)	113 more per 1000 (from 424 fewer to 1000 more)	VERY LOW	CRITICAL
Instrumental birth - nulliparous												
7 (Fitzpatrick 2002; Fraser 2000; Goodfellow 1979; Hansen 2002; Mayberry 1999; Plunkett 2003; Vause 1998)	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision	none	505/1320 (38.3%)	480/1373 (35%)	RR 1.09 (0.98 to 1.2)	31 more per 1000 (from 7 fewer to 70 more)	MODERATE	CRITICAL
Instrumental birth - multiparous												
1 (Hansen 2002)	randomised trials	very serious[2]	no serious inconsistency	serious[3]	serious[6]	none	7/55 (12.7%)	2/65 (3.1%)	RR 4.14 (0.9 to 19.1)	97 more per 1000 (from 3 fewer to 557 more)	VERY LOW	CRITICAL
Instrumental birth - mixed parity												
2 (Buxton 1988; Walker 2012)	randomised trials	serious[1]	very serious[4]	no serious indirectness	very serious[5]	none	47/114 (41.2%)	36/123 (29.3%)	RR 1.06 (0.26 to 4.35)	18 more per 1000 (from 217 fewer to 980 more)	VERY LOW	CRITICAL

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Immediate	Delayed	Relative (95% CI)	Absolute		
Caesarean birth - nulliparous												
6 (Fitzpatrick 2002; Fraser 2000; Kelly 2010; Mayberry 1999; Plunkett 2003; Vause 1998)	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	serious[6]	none	112/1273 (8.8%)	96/1316 (7.3%)	RR 1.21 (0.95 to 1.54)	15 more per 1000 (from 4 fewer to 39 more)	LOW	CRITICAL
Caesarean birth - mixed parity												
1 (Buxton 1988)	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	very serious[5]	none	1/19 (5.3%)	0/22 (0%)	POR 8.65 (0.17 to 440.70)	50 more per 1000 (from 80 fewer to 180 more)	VERY LOW	CRITICAL
3rd/4th degree tears - nulliparous												
5 (Fitzpatrick 2002; Fraser 2000; Kelly 2010; Mayberry 1999; Plunkett 2003)	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	serious[6]	none	114/1201 (9.5%)	110/1245 (8.8%)	RR 1.08 (0.84 to 1.38)	7 more per 1000 (from 14 fewer to 34 more)	LOW	CRITICAL
Apgar score <7 in 5 minutes - nulliparous												
2 (Plunkett 2003; Vause 1998)	randomised trials	serious[1]	no serious inconsistency	serious[7]	serious[8]	none	2/152 (1.3%)	0/185 (0%)	RD 0.01 (-0.01 to 0.04)	10 more per 1000 (from 10 fewer to 40 more)	VERY LOW	CRITICAL
Apgar score <7 in 5 minutes - mixed parity												
1 (Walker 2012)	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	very serious[9]	none	0/95 (0%)	0/101 (0%)	RD 0 (-0.02 to 0.02)	20 more per 1000 (from 20 fewer to 20 more)	VERY LOW	CRITICAL
Duration of active second stage/ duration of pushing - nulliparous (measured with: minutes; Better indicated by lower values)												
7 (Fitzpatrick 2002; Fraser 2000; Goodfellow 1979; Hansen 2002; Kelly 2010; Plunkett 2003; Vause 1998)	randomised trials	serious[1]	very serious[4]	serious[7]	serious[8]	none	1272	1302	-	MD 22.04 higher (3.58 to 40.50 higher)	VERY LOW	IMPORTANT
Duration of active second stage/ duration of pushing - multiparous (measured with: minutes; Better indicated by lower values)												

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Immediate	Delayed	Relative (95% CI)	Absolute		
1 (Hansen 2002)	randomised trials	very serious[2]	no serious inconsistency	serious[3]	serious[10]	none	57	66	-	MD 11.3 higher (4.47 to 18.13 higher)	VERY LOW	IMPORTANT
Duration of active second stage/ duration of pushing - mixed parity (measured with: minutes; Better indicated by lower values)												
2 (Buxton 1988; Walker 2012)	randomised trials	serious[1]	very serious[4]	no serious indirectness	serious[10]	none	114	123	-	MD 18.11 lower (52.54 lower to 16.33 higher)	VERY LOW	IMPORTANT
Duration of passive stage - nulliparous (measured with: minutes; Better indicated by lower values)												
1 (Fitzpatrick 2002)	randomised trials	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[9]	none	90	88	-	Median in immediate: 0 (range 0 to 0), Median in delayed: 60 (range 25 to 140)	LOW	IMPORTANT
Duration of passive stage - nulliparous (Better indicated by lower values)												
1 (Vause 1998)	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	very serious[9]	none	62	60	-	Median in immediate: 52 (range 15 to 64), Median in delayed: 168 (range 87 to 180)	VERY LOW	IMPORTANT
Duration of passive second stage - mixed parity (measured with: minutes; Better indicated by lower values)												
1 (Buxton 1988)	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision	none	19	22	-	MD 93 lower (120.22 to 65.78 lower)	MODERATE	IMPORTANT
Duration of second stage - nulliparous (measured with: minutes; Better indicated by lower values)												
7 (Fitzpatrick 2002; Fraser 2000; Hansen 2002; Kelly 2010; Mayberry 1999; Plunkett 2003; Vause 1998)	randomised trials	serious[1]	very serious[4]	serious[7]	no serious imprecision	none	1329	1362	-	MD 53.44 lower (73.62 to 33.26 lower)	VERY LOW	IMPORTANT
Duration of second stage - multiparous (measured with: minutes; Better indicated by lower values)												
1 (Hansen 2002)	randomised trials	very serious[2]	no serious inconsistency	serious[3]	no serious imprecision	none	57	66	-	MD 38.8 lower (48.44 to 29.16 lower)	VERY LOW	IMPORTANT
Neonatal admission - nulliparous												

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Immediate	Delayed	Relative (95% CI)	Absolute		
3 (Fraser 2000; Plunkett 2003; Vause 1988)	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	very serious[5]	none	53/1078 (4.9%)	53/1119 (4.7%)	RR 1.02 (0.71 to 1.48)	1 more per 1000 (from 14 fewer to 23 more)	VERY LOW	IMPORTANT

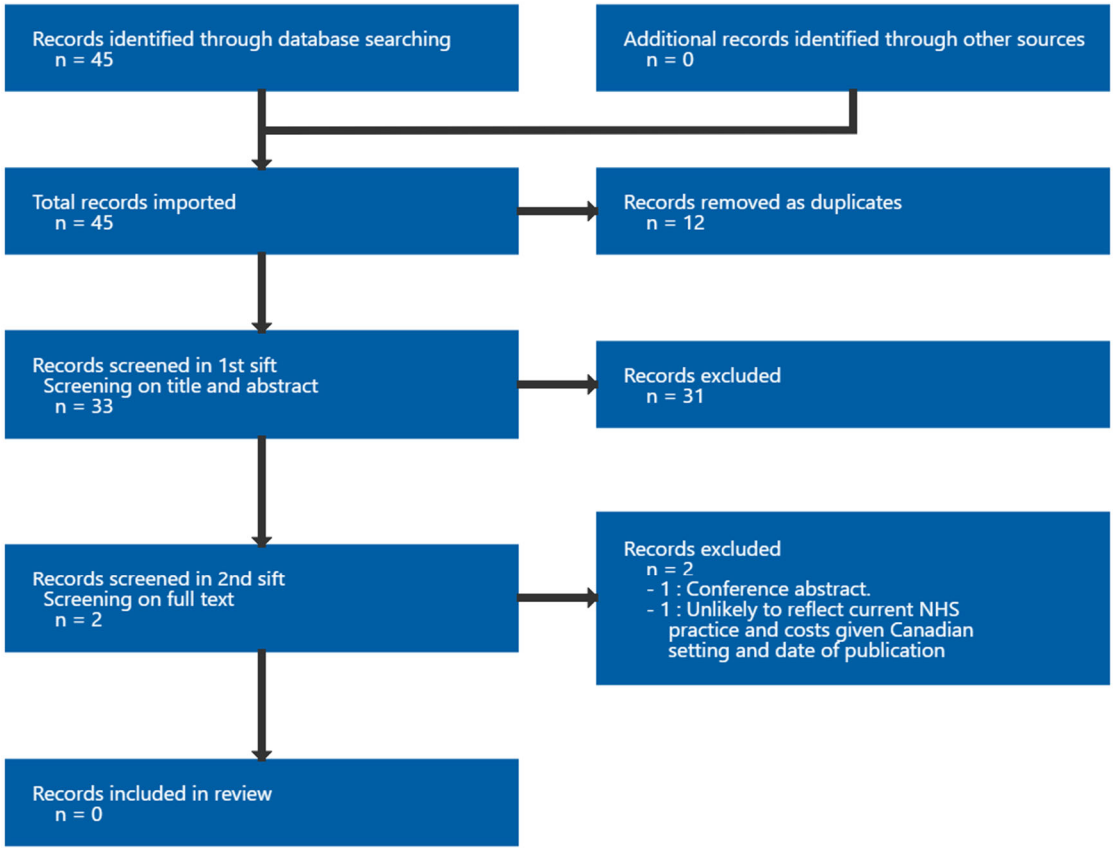
CI: confidence interval; MD: mean difference; RD: risk difference; RR: risk ratio
1 Serious risk of bias in the evidence contributing to the outcomes as per RoB 2
2 Very serious risk of bias in the evidence contributing to the outcomes as per RoB 2
3 Population is indirect due to women who were induced being included, but no information on proportion of total number included.
4 Very serious heterogeneity unexplained by subgroup analysis
5 95% CI crosses 2 MIDs
6 95% CI crosses 1 MID
7 Population is indirect due to some women having their labour induced before active labour, and proportion not balanced between arms.
8 Sample size between 200 and 400
9 Sample size <200
10 95% CI crosses 1 MID (0.5x control group SD, for 'duration active stage – nulliparous' = 17.27; 'duration active stage - multiparous' = 7.15; 'duration of active stage - mixed parity' = 24).

Appendix G Economic evidence study selection

Study selection for: What are the benefits and risks of the different pushing techniques (immediate, spontaneous, delayed, directed) in the second stage of labour in women with and without regional analgesia?

No economic evidence was identified which was applicable to this review question.

Figure 21: Study selection flow chart



Appendix H Economic evidence tables

Economic evidence tables for review question: What are the benefits and risks of the different pushing techniques (immediate, spontaneous, delayed, directed) in the second stage of labour in women with and without regional analgesia?

No evidence was identified which was applicable to this review question.

Appendix I Economic model

Economic model for review question: What are the benefits and risks of the different pushing techniques (immediate, spontaneous, delayed, directed) in the second stage of labour in women with and without regional analgesia?

No economic analysis was conducted for this review question.

Appendix J Excluded studies

Excluded studies for review question: What are the benefits and risks of the different pushing techniques (immediate, spontaneous, delayed, directed) in the second stage of labour in women with and without regional analgesia?

Excluded effectiveness studies

Study	Reason
Abenhaim, Haim A. and Fraser, William D. (2008) Impact of pain level on second-stage delivery outcomes among women with epidural analgesia: results from the PEOPLE study. American journal of obstetrics and gynecology 199(5): 500.e1-6	- Intervention Secondary analysis of a RCT. Analysis only looked at suboptimal analgesia and related outcomes, therefore not relevant to the protocol. Primary RCT included under Fraser 2000
Amin, S. (2022) To push or not to push with neuraxial analgesia at full dilatation. BJOG: An International Journal of Obstetrics and Gynaecology 129(supplement1): 108	- Study design Conference abstract only
Barasinski, C., Legrand, A., Lemery, D. et al. (2018) Directed open-glottis pushing versus directed closed-glottis pushing during labor-eole study. International Journal of Gynecology and Obstetrics 143(supplement3): 235	- Study design Conference abstract
Barasinski, C.; Lemery, D.; Vendittelli, F. (2016) Do maternal pushing techniques during labour affect obstetric or neonatal outcomes?. Gynecologie, obstetrique & fertilite 44(10): 578-583	- More recent systematic review available More recent review with relevant studies available
Barasinski, Chloe, Debost-Legrand, Anne, Savary, Denis et al. (2022) Does the type of pushing at delivery influence pelvic floor function at 2 months postpartum? A pragmatic randomized trial-The EOLE study. Acta obstetricia et gynecologica Scandinavica	- Secondary analysis Secondary analysis of Barasinski 2020. Main outcomes relevant to the review have been included under Barasinski 2020. This publication adds additional outcomes that do not match the outcomes for the review
Barasinski, Chloe and Vendittelli, Francoise (2016) Effect of the type of maternal pushing during the second stage of labour on obstetric and neonatal outcome: a multicentre randomised trial-the EOLE study protocol. BMJ open 6(12): e012290	- Study design Study protocol only. Full results assessed under Barasinski 2020
Bloom, Steven L., Casey, Brian M., Schaffer, Joseph I. et al. (2006) A randomized trial of coached versus uncoached maternal pushing during the second stage of labor. American journal of obstetrics and gynecology 194(1): 10-3	- Results included under another publication Results included under Schaffer 2005, which is included under Lemos 2017
Brancato, Robyn M.; Church, Sara; Stone, Patricia W. (2008) A meta-analysis of passive descent versus immediate pushing in nulliparous women with epidural analgesia in the second stage of labor. Journal of obstetric, gynecologic, and neonatal nursing : JOGNN 37(1): 4-12	- More recent systematic review available All relevant studies included in more recent systematic reviews

Study	Reason
Cahill, A. G., Srinivas, S. K., Tita, A. T. N. et al. (2018) Effect of Immediate vs Delayed Pushing on Rates of Spontaneous Vaginal Delivery Among Nulliparous Women Receiving Neuraxial Analgesia: a Randomized Clinical Trial. JAMA 320(14): 1444-1454	- Population Over 33% of women had their labour induced
Cahill, A. G., Srinivas, S. K., Tita, A. T. N. et al. (2019) Effect of immediate vs delayed pushing on rates of spontaneous vaginal delivery among nulliparous women receiving neuraxial analgesia: A randomized clinical trial. Obstetrical and Gynecological Survey 74(3): 131-133	- Study design Editorial commentary
Cahill, Alison G. (2017) Identifying the Best Way to Manage Labor. Missouri medicine 114(3): 160-162	- Study design Not an experiment study design
Chang, S. C., Chou, M. M., Lin, K. C. et al. (2011) Effects of a pushing intervention on pain, fatigue and birthing experiences among Taiwanese women during the second stage of labour. Midwifery 27(6): 825-831	- Study design Not a randomised controlled trial
d, R. B. R. (2018) Efficacy of Pushing Down Free Compared to Pushing Down With Command in Maternal and Neonatal Outcomes: A Randomized Clinical Trial. https://trialsearch.who.int/Trial2.aspx?TrialID=RBR-556d22	- Study design Trial entry only, unable to locate protocol or published results
de Tayrac, Renaud and Letouzey, Vincent (2016) Methods of pushing during vaginal delivery and pelvic floor and perineal outcomes: a review. Current opinion in obstetrics & gynecology 28(6): 470-476	- Study design Not a randomised controlled trial, or systematic review. Relevant references checked and all have been identified by the search and assessed at full text stage
Di Mascio, Daniele, Saccone, Gabriele, Bellussi, Federica et al. (2020) Delayed versus immediate pushing in the second stage of labor in women with neuraxial analgesia: a systematic review and meta-analysis of randomized controlled trials. American journal of obstetrics and gynecology 223(2): 189-203	- More recent systematic review available More recent review available with all relevant references included
Fitzpatrick, M., O'Brien, C., McQuillan, K. et al. (2000) Comparison of immediate and delayed pushing in second stage of labor on anal sphincter integrity and mode of delivery. American journal of obstetrics and gynecology 182: 37	- Study design Abstract only
Flynn, P., Franiek, J., Janssen, P. et al. (1997) How can second-stage management prevent perineal trauma? Critical review. Canadian family physician Medecin de famille canadien 43: 73-84	- Intervention References checked but studies included for review did not meet the intervention criteria set out in the protocol
Gillesby, Erica, Burns, Suzan, Dempsey, Amy et al. (2010) Comparison of delayed versus immediate pushing during second stage of labor for nulliparous women with epidural anesthesia. Journal of obstetric, gynecologic, and neonatal nursing : JOGNN 39(6): 635-44	- Population Over 33% of population had labour induced
Gregory, T., Cahill, A. G., Woolfolk, C. et al. (2022) Impact of Pushing Timing on Occult Injury of Levator Ani: a Multicenter Randomized Controlled Trial. American Journal of Obstetrics and Gynecology 226(1supplement): S81-S82	- Study design Conference abstract

Study	Reason
Gregory, W. T., Cahill, A. G., Woolfolk, C. et al. (2022) Impact of Pushing Timing on Occult Injury of Levator Ani: Secondary Analysis of a Randomized Trial. American journal of obstetrics and gynecology	- Outcome Secondary analysis of RCT assessed under Cahill 2018. Secondary analysis doesn't provide relevant outcomes matching protocol criteria
Grobman, W. (2015) Obstetric outcomes associated with the duration of pushing in nulliparas. American Journal of Obstetrics and Gynecology 212(1suppl1): 281	- Study design Conference abstract
Irct138805252170N (2011) Comparing effects of Spontaneous pushing versus Valsalva pushing technique in Birth on outcome of delivery in primiparous in Iran hospital in 2009. https://trialsearch.who.int/Trial2.aspx?TrialID=IRCT138805252170N2	- Study design Reference to trial protocol. Unable to locate access protocol, or published results
Irct138807192248N (2012) The effect of abdominal massage with breathing techniques on the resulting outcomes of labor in primiparous women. https://trialsearch.who.int/Trial2.aspx?TrialID=IRCT138807192248N4	- Study design Reference to trial protocol. Unable to locate access protocol, or published results
Irct201102041845N (2011) kind of pushing and postpartum fatigue. https://trialsearch.who.int/Trial2.aspx?TrialID=IRCT201102041845N3	- Study design Trial protocol only. Unable to locate full published results
Irct2014051210327N (2014) The effect of pushing with the open glottis in lateral position on maternal and fetal outcomes. https://trialsearch.who.int/Trial2.aspx?TrialID=IRCT2014051210327N6	- Study design Clinical trial entry only. Full results assessed under Vaziri 2015
Irct201405258801N (2014) Effect of pushing with breathing techniques on perineal statue and delivery outcome in nulliparous in Kamali hospital in Karaj. https://trialsearch.who.int/Trial2.aspx?TrialID=IRCT201405258801N7	- Study design Reference to trial protocol. Unable to locate access protocol, or published results
Irct2014092819310N (2014) Effect of pushing with breathing techniques on perineal statue and delivery outcome in nulliparous in Kamali hospital in Karaj. https://trialsearch.who.int/Trial2.aspx?TrialID=IRCT2014092819310N1	- Study design Reference to trial protocol. Unable to locate access protocol, or published results
Knauth, D. G. and Haloburdo, E. P. (1986) Effect of pushing techniques in birthing chair on length of second stage of labor. Nursing research 35(1): 49-51	- Outcome Not enough data provided for outcomes of interest
Lai, M. L., Lin, K. C., Li, H. Y. et al. (2009) Effects of delayed pushing during the second stage of labor on postpartum fatigue and birth outcomes in nulliparous women. The journal of nursing research : JNR 17(1): 62-72	- Study design Not a randomised controlled trial
Lin, P. and Newton, W. (2000) Does delayed pushing reduce difficult deliveries for nulliparous women with epidural analgesia?. The Journal of family practice 49(9): 783-784	- Study design Commentary on randomised trial already included (Fraser 2000)
Maresh, M.; Choong, K. H.; Beard, R. W. (1983) Delayed pushing with lumbar epidural analgesia in labour. British journal of obstetrics and gynaecology 90(7): 623-7	- Population Over 33% of women had their labour induced

Study	Reason
Menez-Orieux, C., Linet, T., Philippe, H. J. et al. (2005) Delayed versus immediate pushing in the second stage of labor for nulliparous parturients with epidural analgesia: a meta-analysis of randomized trials. Journal de gynecologie obstetrique ET biologie de la reproduction 34(5): 440-447	- Language Article not in English (French article)
Moore, Thomas R. (2007) Randomized trial of coached versus uncoached maternal pushing in the second stage of labor. American journal of obstetrics and gynecology 196(1): e34-e34	- Study design Editorial letter
Nct (2015) Study of the Type of Pushing at Delivery. https://clinicaltrials.gov/show/NCT02474745	- Study design Study protocol only. Full results assessed under Barasinski 2020
Nct (2014) Optimizing Management of the 2nd Stage of Labor: Multicenter Randomized Trial. https://clinicaltrials.gov/show/NCT02137200	- Study design Trial protocol only. Full results assessed under Cahill 2008
Nct (2014) Randomized Control Trial of Second Stage of Labor. https://clinicaltrials.gov/show/NCT02101515	- Population Trial protocol only, however published results show over 33% of women had labour induced
Nct (2017) BREATHING EXERCISES FOR LABOR PAIN AND DURATION. https://clinicaltrials.gov/show/NCT03066973	- Study design Trial protocol only, full results assessed under Yuksel 2017
Nct (2017) Alternative to Intensive Management of the Active Phase of the Second Stage of Labor. https://clinicaltrials.gov/show/NCT03018860	- Study design Trial protocol only, unable to locate full published results
Nct (2017) Early Versus Delayed Pushing in the Second Stage of Labor. https://clinicaltrials.gov/show/NCT03121274	- Study design Trial protocol only. Full results assessed under Saad 2022
Nct (2019) The Effects Of Pushing Techniques During Second Stage Of Labour On Maternal and Newborn Health. https://clinicaltrials.gov/show/NCT04207658	- Study design Trial protocol only, unable to locate full published results
Nct (2020) Effectiveness of Breathing Exercises During the Second Stage of Labor. https://clinicaltrials.gov/show/NCT04556643	- Study design Trial protocol only. Unable to locate full published results
Nct (2020) Regulated Expiratory Breathing Method During Childbirth. https://clinicaltrials.gov/show/NCT04219631	- Study design Trial protocol only. Unable to locate full published results
Nct (2021) Pushing and Manual Perineal Protection Techniques. https://clinicaltrials.gov/show/NCT04823598	- Study design Trial protocol only. Study is ongoing (April 2022)
Neta, Joana Nunes, Amorim, Melania Maria, Guendler, Julianna et al. (2022) Vocalization during the second stage of labor to prevent perineal trauma: A randomized controlled trial. European journal of obstetrics, gynecology, and reproductive biology 275: 46-53	- Intervention Intervention does not meet the criteria specified in the protocol. Women were directed with pushing but

Study	Reason
	not as described in the protocol
Parnell, J. C., Langhoff-Roos, J., Iversen, R. et al. (1993) Pushing technique in the expulsive phase of labor. A randomized study. Ugeskrift for laeger 155(29): 2259-2262	- Language Article not in English (German)
Prins, M., Boxem, J., Lucas, C. et al. (2011) Effect of spontaneous pushing versus Valsalva pushing in the second stage of labour on mother and fetus: a systematic review of randomised trials. BJOG : an international journal of obstetrics and gynaecology 118(6): 662-70	- More recent systematic review available All relevant studies included in more recent systematic reviews
Richter, H. E., Gregory, W., Lowder, J. et al. (2020) Impact of second stage pushing timing on post partum pelvic floor morbidity: Multicenter randomized controlled trial. International Urogynecology Journal 31(suppl1): S20-S21	- Study design Conference abstract
Saad, Hany, Maged, Ahmed M., Meshaal, Hadeer et al. (2022) Delayed versus early pushing during the second stage of labour in primigravidas under epidural anaesthesia with occipitoposterior malposition: a randomised controlled study. Journal of obstetrics and gynaecology : the journal of the Institute of Obstetrics and Gynaecology 42(1): 23-27	- Population Over 1/3 of population are women who had their labour induced.
Saucedo, A. M., Tuuli, M. G., Gregory, T. et al. (2022) Intrapartum Risk Factors for Pelvic Organ Prolapse Postpartum. American Journal of Obstetrics and Gynecology 226(1supplement): S250-S251	- Study design Conference abstract
Saucedo, Alexander M, Richter, Holly E, Gregory, W Thomas et al. (2022) Intrapartum Risk Factors Associated with Pelvic Organ Prolapse at Six Months Postpartum: Intrapartum Factors for Pelvic Organ Prolapse. American journal of obstetrics & gynecology MFM: 100692	- Study design Full text is abstract only
Schaffer, J. I., Bloom, S. L., Casey, B. M. et al. (2005) A randomized trial of the effects of coached vs uncoached maternal pushing during the second stage of labor on postpartum pelvic floor structure and function. American journal of obstetrics and gynecology 192(5): 1692-6	- Duplicate
Shinozaki, Katsuko, Suto, Maiko, Ota, Erika et al. (2022) Postpartum urinary incontinence and birth outcomes as a result of the pushing technique: a systematic review and meta-analysis. International urogynecology journal	- Cochrane systematic review included Overlap in included studies with a Cochrane systematic review (Lemos 2017). Cochrane review prioritised as methods are more aligned with NICE methods
Simpson, Ben and Waring, Gareth J. (2021) Regarding Delayed vs immediate pushing in the second stage of labor in women with neuraxial analgesia: a systematic review and meta-analysis of randomized controlled trials. American journal of obstetrics and gynecology 225(4): 468-469	- Study design Comment article
Simpson, Kathleen Rice and James, Dotti C. (2005) Effects of immediate versus delayed pushing during second-stage labor on fetal well-being: a randomized clinical trial. Nursing research 54(3): 149-57	- Population All women having an elective induction of labour
Szu, Li-Ting, Chou, Pao-Yu, Lin, Pu-Hung et al. (2021) Comparison of maternal and fetal outcomes between delayed and immediate pushing in the second stage of vaginal delivery: systematic review and meta-	- More recent systematic review available A Cochrane systematic review, and more recent

Study	Reason
analysis of randomized controlled trials. Archives of gynecology and obstetrics 303(2): 481-499	systematic include the same relevant studies
Tctr (2019) The success rate of spontaneous vaginal birth : directed and spontaneous pushing method in Phramongkutklao hospital. https://trialsearch.who.int/Trial2.aspx?TrialID=TCTR20190817005	- Study design Trial protocol only. Study has not begun recruitment (April 2022)
Thomson, A. M. (1995) Maternal behaviour during spontaneous and directed pushing in the second stage of labour. Journal of advanced nursing 22(6): 1027-34	- Study design Observational part of a randomised controlled trial. Randomised controlled trial assessed separately under Thomson 1993
Tuuli, M. G., Gregory, T., Arya, L. A. et al. (2020) 7: Impact of second stage pushing timing on maternal pelvic floor morbidity: Multicenter randomized controlled trial. American Journal of Obstetrics and Gynecology 222(1supplement): 6	- Study design Conference abstract
Tuuli, Methodius G., Frey, Heather A., Odibo, Anthony O. et al. (2012) Immediate compared with delayed pushing in the second stage of labor: a systematic review and meta-analysis. Obstetrics and gynecology 120(3): 660-8	- More recent systematic review available All relevant studies included in more recent systematic reviews
Vause, S.; Congdon, H. M.; Thornton, J. G. (1998) A randomized controlled trial of immediate and delayed pushing in the second stage of labour for nulliparous women with epidural analgesia. Br-j-obstet-gynaecol 105: 85	- Study design Full text is abstract only
Waghmare, S. V. and Upendra, S. (2020) A systematic literature review on pushing down technique during second stage of labour on maternal and neonatal outcome. Indian Journal of Forensic Medicine and Toxicology 14(4): 3976-3978	- Full text unavailable
Walker, C., Rodriguez, T., Herranz, A. et al. (2011) Second stage of labor with postural change and lateral position in women with epidural analgesia: A randomized controlled trial. International Urogynecology Journal and Pelvic Floor Dysfunction 22(suppl1): S11-S12	- Study design Conference abstract
Yao, Jiasi, Roth, Heike, Anderson, Debra et al. (2022) Benefits and risks of spontaneous pushing versus directed pushing during the second stage of labour among women without epidural analgesia: A systematic review and meta-analysis. International journal of nursing studies 134: 104324	- Study design Systematic review, with relevant studies already included under Cochrane systematic review
Yildirim, G. and Beji, N. K. (2008) Effects of pushing techniques in birth on mother and fetus: A randomized study. Obstetrical and Gynecological Survey 63(8): 488-489	- Study design Editorial comment

Excluded economic studies

Study	Code [Reason]
Greiner, K., Tuuli, M. G., Srinivas, S. K. et al. (2020) 702: Immediate versus delayed pushing in nulliparous women: A cost-effectiveness analysis. American Journal of Obstetrics and Gynecology 222(1supplement): S444-S445	- Conference abstract

Study	Code [Reason]
Petrou, S.; Coyle, D.; Fraser, W. D. (2000) Cost-effectiveness of a delayed pushing policy for patients with epidural anesthesia. The PEOPLE (Pushing Early or Pushing Late with Epidural) Study Group. American journal of obstetrics and gynecology 182(5): 1158-64	- Unlikely to reflect current NHS practice and costs given Canadian setting and date of publication

Appendix K Research recommendations – full details

Research recommendations for review question: What are the benefits and risks of the different pushing techniques (immediate, spontaneous, delayed, directed) in the second stage of labour in women with and without regional analgesia?

No research recommendations were made for this review question.