AIMS For a better birth...

Induction and the chance of a caesarean: what's the evidence?

Introduction

One concern many people have about having their labour induced is that it might increase their chance of having a caesarean. The main reasons for a caesarean to be offered following an induction are:

- the drugs used for the induction are putting the baby under stress
- the birth of the baby is not happening within the required time.

If you are considering an offer of induction, there are many factors that could affect the chance that this will lead to a caesarean birth. These include:

- the reason why the induction is being offered
- how far along your pregnancy is
- how ready your body is to go into labour
- how well you are supported to be calm and relaxed during the induction process and to use positions that help labour to progress
- the attitudes of the midwives or doctors who are caring for you.

The research evidence about how induction affects caesarean rates is contradictory and has been much debated by experts. In formal **randomised controlled trials** (RCT) it looks as though induction may actually reduce the chances of having a caesarean, but many **population studies** suggest that in real life it may increase the chances. However, a lot seems to depend on which comparison, e.g. the timing of induction, the authors of a population study use.

For an explanation of these different types of research see 'Understanding Quantitative Research Evidence.'

Guidelines, such as the NICE guideline 'Inducing Labour'[1] are often based only on the results of RCTs.

This article explains why the evidence about the effect of induction on the chances of an unplanned caesarean is not as clear as is often stated.

Key points

- In summary, none of the evidence tells us much about the risks for an individual woman or birthing person who is considering induction.
- There is good evidence that planning to birth at home or in a birth centre significantly reduces the chance of a caesarean from 16% to 7-9%[2]. As having an induction means birthing in hospital, this alone will increase the risk of having an unplanned caesarean compared with planning to birth in an out-of-hospital setting.
- If you need to make a decision about induction it may be best to ask your care team for a personalised view of the risks and benefits specific to you and your situation. Our Birth Information page Induction of Labour outlines the situations where induction of labour might be offered and your options, while Making decisions about your care suggests some ideas that might help you to make your decision. There is more detail on all these topics in our bookAIMS Guide to Induction of Labour.

Here are the key points about the research evidence, which are discussed in more detail below.

- **Randomised controlled trials** (RCTs) randomly allocate people to either have induction in certain weeks of pregnancy or **expectant management** (waiting for labour to start, at least until a later week of pregnancy). These studies tend to find a slightly lower caesarean rate in those allocated to be induced. However, such studies have a lot of limitations and there are a number of factors that may distort the results.
- The National Maternity Statistics for England[3] report that caesarean births are twice as common after an induction compared with a spontaneous labour. This may be partly due to the reason for the induction, but that seems unlikely to be the whole explanation.
- **Population studies** look at data that has already been collected and compare outcomes between

two groups. These report different findings depending on the comparison used. The findings can also be affected by whether adjustments are made for things like number of previous births, ethnicity, age and socioeconomic status.

When those who had an induction in a given week of pregnancy (induction group):

- are compared with those who birthed in the same week of pregnancy without induction of labour - studies typically report higher caesarean rates in the induction group.
- are compared with those who birthed in a later week of pregnancy (with or without induction) - studies report slightly lower rates in the induction group, or no difference.
- are compared with those from both the above groups - those who birthed without induction in that week **and** all those who birthed in the following weeks of pregnancy - studies tend to report slightly higher caesarean rates with induction.

If you are interested in understanding the full details of the research please read on.

What evidence is there that induction might *reduce* your chance of a caesarean?

RCTs (which compare two groups who have been randomly allocated to have different treatments) often find that induction makes no difference or reduces the chance of a caesarean. For example, a recent review[4] combined the results of many RCTs of induction at 37 weeks of pregnancy or beyond, for women at 'low risk' of complications. It concluded that there were around 19 fewer caesareans for every 1000 women in the induction group, compared to those randomised to expectant management (waiting for labour to start), and probably no difference in the number of births assisted with forceps or ventouse.

Issues with this type of research

In the review discussed above, the findings are dominated by one large study of induction for length of pregnancy beyond 41 weeks (the Hannah trial)[5]. This study has been criticised for several reasons[6] that are also likely to apply to a greater or lesser extent to other RCTs, so we will use this as an illustration.

- **Cross-over**

RCTs report their findings by what is called 'intention to treat'. This means that if a woman was randomly allocated to have her labour induced, she will be counted in the induction group whether she actually had an induction or went into spontaneous labour before the planned induction. Similarly, a woman who was randomly allocated to wait for her labour to start spontaneously ('expectant management') will be

counted in that group even if she later went on to be induced for some other reason. The random allocation is done to try to ensure that the groups are as similar as possible. Otherwise any difference in outcomes for the two groups could be because the people in one group had a higher risk of an outcome to begin with compared to those in the other group. This is a major problem in other types of study.

This approach gives good results providing the 'cross-over' (the proportion who were allocated one treatment, but had the other) remains small, but not when the cross-over is large. In that case, it is desirable to also do the analysis based on the treatment actually received (induction or not). Another way to look at this is that 'intention to treat' shows whether *planning* an induction makes a difference to the chances of having a caesarean, rather than whether *having* an induction does.

The authors of another recent meta-analysis[7] comment that in the 31 RCTs they analysed, "Compliance with treatment in the induction groups was not uniformly high, with reported rates of <70% in six of the trials. In almost all of the studies induction of labour became necessary in many of the expectantly managed patients. The reported rates varied from 4 to a high of 50%." This suggests that there was a very high rate of cross-over in most of the studies. There is no explanation of why induction was considered "necessary" for so many in the expectant management group.

The Hannah trial[5] found that 21.2% of women who were in the induction group and 24.5% in the expectant management group had a caesarean . What these figures don't show is that over a third of the expectant management group had their labours induced. Also, around a third of the induction group went into labour spontaneously or had a caesarean before they were induced. So, more than 1 in 3 women allocated to *not* be induced *were* induced and nearly 1 in 3 women allocated to *be* induced were *not* induced.

- **Difference in methods of induction**

An RCT can only produce valid findings if the two groups differ only in the treatment of intervention being tested, in this case whether labour is induced at a specified number of weeks of pregnancy compared to waiting for spontaneous labour. Also, those in the expectant management group who do go on to have their labours induced need to be treated using the same methods as those in the planned induction group. In the Hannah trial women in the induction group were given prostaglandin if their cervix was not already dilated to 3cm or more. Those in the expectant management group who had induction went straight to having their waters broken or a Syntocinon drip, and this may have made it less likely that the induction would be successful, and so more likely that the baby would be born by caesarean. As the authors of the study say, "*One can only speculate about what the results would have been if prostaglandin gel had been used for women in the monitoring group or for all women who had evidence of* ***fetal compromise***".

However, in the latest update to the Cochrane review[4] the authors found similar caesarean rates when the results of the Hannah trial were left out. They say that therefore "this is not likely to have been the

reason for the effect observed."

- **Lack of blinding and observer bias**

Ideally in an RCT those providing and receiving treatment are not able to tell which group they are in, which is referred to as blinding. In studies of induction blinding is not possible - women and their carers inevitably know which group they are in. If women, midwives and doctors believe that pregnancy carries an increasing risk to the baby the longer it goes on beyond 40 weeks this could affect their decision-making. It has been questioned whether this made the people in these studies more ready to request or offer a caesarean if labour has not begun by 40 weeks, or if an induction was tried for some reason and failed to bring on labour quickly.

It's also quite likely that there is 'observer bias' with doctors involved responding differently to any worrying signs either before or during labour depending on whether the mother is having induction or expectant management. Something that they might regard as insignificant in the induction group might lead them to suggest a caesarean to a woman in the expectant management group simply because of their own belief that a longer pregnancy puts these babies at higher risk. As the authors of the Hannah study say, *"Because our trial did not use blinding, the differences in the rates of cesarean section may have been due to differences in the interpretation of fetal heart-rate tracings."*

The authors of a review[7] which included studies both of "high and low risk" pregnancies say, "It may be that the results of our review reflect doctors' discomfort with delayed delivery in high-risk women that, once they are in labour, manifests as more frequent caesarean sections: an example of research confirming the biases of the health care community."

- **Abnormally high caesarean rates**

RCTs looking at the effect of induction often seem to find caesarean rates for both induction and expectant management groups that are well above what would normally be expected, which casts doubt on the relevance of the findings. For example, a recent study of induction at 39 weeks in women aged 35 or over (the so-called "35/39 trial")[8] reported no difference in caesarean rates, but the figures were 32% for the induction group and 33% for the expectant management group. These are extraordinarily high rates for first-time mothers with no known pregnancy complications[9]. The study was conducted between August 2012 and March 2015, and the National Maternity Statistics for England in 2014-15[10] showed an unplanned caesarean rate for all first-time mothers of 21%, and for all mothers aged over 35 of 18% - and that is including mothers who had known complications.

A recent RCT in the USA that compared induction at 39 weeks with expectant management for first time mothers who had no risk factors (the ARRIVE trial)[11] found a slightly lower rate of caesareans in the induction group (19% vs 22%). These again are high caesarean rates for a group of first-time mothers

who were considered to be at low risk. There are many unanswered questions about this trial. In particular it is not clear how many women in the expectant management group actually had their labours induced, but there is reason to think that *"a large percentage of women in the expectant-management group underwent unnecessary induction with an unfavorable cervix"* which would have increased the chances of them needing a caesarean.[12]

In contrast to these two RCTs, one conducted in the Netherlands (the INDEX trial)[13] comparing induction at 41 weeks with expectant management to 42 weeks found much lower, and almost identical caesarean rates (10.8%) in both groups.

- **Self-selected samples**

Another characteristic of many RCTs is the very low recruitment rate, indicating that the majority of those eligible for inclusion in a study do not want the decision about whether to have induction or expectant management to be taken away from them. In the 35/39 trial[8] over 86% of eligible women declined to participate, and in the ARRIVE trial[11] the figure was 73%. This could mean that women in the trial were more willing to accept induction than the general population, or even preferred it (seeing joining the trial as a way to increase their chance of being induced earlier).

The lead author of a recent observational study that was designed to match the ARRIVE trial (Langen E.S. et al 2023[14] see below) commented in an online article[15] "previous research has indicated that women in the general United States population often may feel pressured into agreeing to have their labor induced… Better outcomes may have occurred in the trial because the participants were fully accepting of this process."

- **Generalisability**

As a result of the above issues, it is uncertain whether the findings of an RCT looking at induction are 'generalisable'. This means whether they accurately reflect what happens in real life in the general population. A recent cohort study[17] has looked at trends in the outcomes for first-time mothers who gave birth at or after 39 weeks in a group of 13 US hospitals, both before and after publication of the ARRIVE trial.[11] It found that elective induction increased by 42% immediately after publication and continued to trend upwards. However, in contrast to the findings of the ARRIVE trial there was no statistically significant change in caesarean birth rates. The authors comment "Our study raises questions about the generalizability of the randomized controlled trial results to other populations and their effect on clinical practice and outcomes."

What evidence is there that induction might *increase* your chance of a caesarean?

National Maternity Statistics for England in 2021-22[2] show that when labour started spontaneously,

72% of mothers had a straightforward vaginal birth and just under 12% had an unplanned caesarean. When labour was induced only 59% of mothers had a straightforward vaginal birth and compared with those whose labour started spontaneously almost twice as many – 23% - had an unplanned caesarean. Unfortunately, there is no information about how the characteristics of mothers in the two groups might have differed. Both groups are likely to have included a mix of high and low risk pregnancies, and we don't know whether more of those that had inductions were classed as high risk.

Some of the difference in caesarean rates may be due to the reason for the induction (e.g., the baby or mother's health was already at risk). However, as most inductions nowadays seem to be done to avoid a possible increase in risk rather than because there is a known health problem, this seems unlikely to be the whole story. Failure of the induction or distress to the baby as a result of the induction are likely to be factors.

Another type of research evidence comes from population studies (also known as observational or cohort studies), which look back and compare what happened in different groups of women and birthing people. The reliability of population studies depends on how similar the two groups are that are being compared. For example, in one study[14] that showed a higher caesarean rate with induction, once adjustment was made for age, ethnicity and private health insurance there was no longer a significant difference in caesarean rates. However, well-conducted population studies which adjust for such factors can provide information about what happens in a 'real-world' situation, which could be very different from the conditions of an RCT.

In the past many population studies have reported *higher* caesarean rates when labour is induced than when labour is spontaneous. These studies typically showed the caesarean rate to be twice as high when labour is induced, similar to the National Maternity statistics.[17],[18],[19],[20]

What's the right comparison: 'all above' versus 'at or above'?

More recently, some authors[21],[22] have argued that such studies should not be comparing induction with spontaneous labours in the same week of pregnancy, as the choice is between induction in a given week and **expectant management** (watchful waiting) until some future point when labour either starts spontaneously or is induced, or a planned caesarean is performed. They have therefore looked at the comparison between induction and expectant management – but the findings of these studies seem to vary according to what definition of expectant management is used:

- All above: induction in a given week of pregnancy versus an expectantly managed group that gave birth in the following week of pregnancy or later (for example, induction at 40 weeks versus births in the expectantly managed group that occurred at 41 or more weeks)[23]
- At or above: induction in a given week of pregnancy versus all people being expectantly managed in that week of pregnancy, including those who laboured spontaneously in that week of pregnancy

and those who laboured spontaneously or were induced later in pregnancy[23]

The problem with the 'all above' definition is that the expectant management group does not include those who decline induction but go into spontaneous labour later that same week. In fact, this is likely to be quite common, given that according to the National Maternity statistics for England 32.5% of spontaneous labours start during the 40th week and another 16.5% during the 41st week[2].

When the 'all above' definition is used studies have variously reported slightly lower caesarean rates with induction at 39, 40 or 41 weeks[21] or at 40 and 41 weeks but not at 39 weeks[22] depending on the study; a slightly lower rate at 39 or 40 weeks for first births but no significant difference for subsequent ones[24] or no significant difference at any week.[23]

In contrast, several population studies that used the 'at or above' definition have found that induction is associated with a higher caesarean rate at least at or after 38 or 39 weeks[22],[23],[25] though one found a lower caesarean rate but higher instrumental delivery rate for first-time mothers induced at 39 weeks, and otherwise no significant difference.[24]

Of particular interest is a recent study of 'lower risk' first births in Victoria, Australia[25] that excluded anyone with a medical reason for induction, such as symptoms of pre-eclampsia. The outcomes for those who had their labours induced in a given week of pregnancy from 37 to 41 weeks were compared with an expectant management group of similarly 'lower risk' first-time mothers who went into spontaneous labour during or after the corresponding week, or had an induction or planned caesarean in a later week (i.e. an 'at or above' comparison). Even after adjusting for age, birth weight and socioeconomic status there was no significant difference in caesarean rates at 37 weeks, but in each week from 38 to 41 weeks induction was associated with a statistically significant increase in the caesarean rate compared with expectant management. The difference increased over time from around 3% more women in the group induced at 38 weeks having a caesarean, to 8.6% more in the group induced at 41 weeks.

Does simply planning an induction increase the chance of a caesarean?

Inducing labour means giving birth in a hospital obstetric unit. There is good evidence that planning to birth at home or in a birth centre significantly reduces the chance of a caesarean from 16% to 7-9%[3]. Agreeing to induction will therefore increase the risk of having an unplanned caesarean compared with planning to birth in an out-of-hospital setting just because of the 'being in hospital' factor.

RCTs will not have been able to account for this difference in caesarean rates as all women agreeing to be included in a study will have been expected to birth in hospital, and this may also have contributed to the high caesarean rates.

There is evidence that the use of continuous monitoring of the baby's heart rate increases the chances of a caesarean birth (see Monitoring your baby's heartbeat in labour). It is standard practice to offer continuous monitoring if a hormone drip is being used, which is the case in many induced labours.

What's the conclusion?

In summary the research evidence about the impact of induction on caesarean rates is contradictory and confusing. In formal RCTs it looks as though induction may reduce the chances of having a caesarean, though the evidence is far from robust and we can't be sure whether the effects would be the same in a real-life as in an experimental situation.

Population studies give different results – increase, decrease or no difference – depending on what group is used for comparison, which week or weeks of pregnancy the induction occurs, whether they look separately at first births and subsequent births and whether they adjust for other characteristics. However, when the more realistic 'at or above' comparison is used most of these studies seem to show higher caesarean rates when labour is induced.

This means that none of the evidence tells us much about the risks for an individual woman or birthing person who is considering induction. What they need is a personalised view of their individual risks and consideration of their preferences rather than blanket recommendations to induce certain groups at a particular week of pregnancy.

References

[1] NICE Guideline 'Inducing Labour' 2021 www.nice.org.uk/guidance/ng207

[2] Birthplace in England Collaborative Group "Perinatal and maternal outcomes by planned place of birth for healthy women with low risk pregnancies: the Birthplace in England national prospective cohort study" BMJ 2011;343:d
7400 www.bmj.com/content/343/bmj.d7400

[3] NHS Maternity Statistics, England - 2021-22 - NHS Digital https://digital.nhs.uk/data-and-information/publications/statistical/nhs-maternity-statistics/2021-22

[4] Middleton P. et al Cochrane review: " Induction of labour at or beyond 37 weeks' gestation" (2020) www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD004945.pub5/full

[5] Hannah M.E. et al "Induction of labor as compared with serial antenatal monitoring in post-term pregnancy. A randomized controlled trial. The Canadian Multicenter Post-term Pregnancy Trial Group." N Engl J Med 1992; 326:1587-1592, June 1992 www.nejm.org/doi/10.1056/NEJM199206113262402?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%20%200www.ncbi.nlm.nih.gov11;326(24):1587-92 www.nejm.org/doi/10.1056/NEJM199206113262402?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%3dwww.ncbi.nlm.nih.gov

[6] Menticoglu S.M. and Hall S.F. "Routine induction of labour at 41 weeks: nonsensus consensus" BJOG 109 (5) May 2002 pp485-491 obgyn.onlinelibrary.wiley.com/doi/abs/10.1111/j.1471-0528.2002.01004.x

[7] Wood S, Cooper S & Ross S "Does induction of labour increase the risk of caesarean section? A systematic review and meta-analysis of trials in women with intact membranes" BJOG 2014 May;121(6):674-85 https://obgyn.onlinelibrary.wiley.com/doi/full/10.1111/1471-0528.12328

[8] Walker K.F. et al "Randomized Trial of Labor Induction in Women 35 Years of Age or Older" (The "35/39 trial") N Engl J Med 2016; 374:813-822 2016www.nejm.org/doi/full/10.1056/NEJMoa1509117

[9] Roberts A. "Informed Decision Making – does research help us?" AIMS Journal, 2019, Vol 31, No 1 www.aims.org.uk/journal/item/35-39

[10] NHS Maternity Statistics, 2014-15 NHS Maternity Statistics - England, 2014-15 - NHS Digital

[11] Grobman W.A. et al "The ARRIVE Trial (A Randomized Trial of Induction Versus Expectant Management)" N Engl J Med 2018 379:513 -523.www.nejm.org/doi/full/10.1056/NEJMoa1800566

[12] Goer H. "Parsing the ARRIVE Trial:Should First-time Parents be Routinely Induced at 39 weeks?" 2018 www.lamaze.org/Connecting-the-Dots/parsing-the-arrive-trial-should-first-time-parents-be-routinely-induced-at-39-weeks

[13] Keulen JK et al. Induction of labour at 41 weeks versus expectant management until 42 weeks (INDEX): multicentre, randomised non-inferiority trial.BMJ 2019;20(364):1344

[14] Langen E.S. et al Outcomes of Elective Induction of Labor at 39 Weeks from a Statewide Collaborative Quality Initiative Am J Perinatol DOI: 10.1055/s-0043-1761918 February 2023 https://pubmed.ncbi.nlm.nih.gov/36796400

[15] University of Michigan Institute for Healthcare Policy and Innovation "Labor induction doesn't always reduce caesarean birth risk or improve outcomes for term pregnancies" May 2023

[16] Nethery E. et al 'Effects of the ARRIVE (A Randomized Trial of Induction Versus Expectant Management) Trial on Elective Induction and Obstetric Outcomes in Term Nulliparous Patients' Obstetrics & Gynecology 142(2):p 242-250, August 2023. https://journals.lww.com/greenjournal/fulltext/2023/08000/effects_of_the_arrive__a_randomized_trial_of.5.aspx?WT.mc_id=EMxALLx20100222xxFRIEND

[17] Vrouenraets F.P. et al "Bishop score and risk of cesarean delivery after induction of labor in nulliparous women" Obstet. Gynecol. 2005 Apr;105(4):690-7www.ncbi.nlm.nih.gov/pubmed/15802392

[18] Vardo J.H. et al "Maternal and neonatal morbidity among nulliparous women undergoing elective induction of labor." J. Reprod. Med. 2011 Jan-Feb;56(1-2):25-30. www.ncbi.nlm.nih.gov/pubmed/21366123

[19] Jacquemyn Y. et al "Elective induction of labour increases caesarean section rate in low risk multiparous women" Journal of Obstetrics & Gynecology Volume 32 (3), 2012 www.tandfonline.com/doi/abs/10.3109/01443615.2011.645091?journalCode=ijog20

[20] Davey M. and King J. "Caesarean section following induction of labour in uncomplicated first births-a population-based cross-sectional analysis of 42,950 births" BMC Pregnancy & Childbirth, April 2016, 16: 92 bmcpregnancychildbirth.biomedcentral.com/articles/10.1186/s12884-016-0869-0

[21] Cheng YW, Kaimal AJ, Snowden JM, Nicholson JM, Caughey AB. Induction of labor compared to expectant management in low-risk women and associated perinatal outcomes. Am J Obstet Gynecol 2012; 207: 502–8. www.ncbi.nlm.nih.gov/pmc/articles/PMC3719847

[22] Stock SJ, Ferguson E, Duffy A, Ford I, Chalmers J, Norman JE. Outcomes of elective induction of labour compared with expectant management: population based study. BMJ 2012; 344: e2838 www.bmj.com/content/344/bmj.e2838

[23] Glantz JC. Term labor induction compared with expectant management. Obstet Gynecol 115:70-6. 2010 journals.lww.com/greenjournal/abstract/2010/01000/term_labor_induction_compared_with_expectant.13.aspx

[24] Souter V. et al "Maternal and newborn outcomes with elective induction of labor at term" Am J Obstet Gynecol 2019 Mar;220(3):273.e1-273.e11www.ajog.org/article/S0002-9378(19)30253-4/fulltext

[25] Butler S. E. et al Induction of labor and cesarean birth in lower-risk nulliparous women at term: A retrospective cohort study, Birth Issues in Perinatal Care online version 03 January 2024 doi.org/10.1111/birt.12806