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Evidence on: Due Dates

What is an estimated due date, and how is it determined? What are the risks of going past your due date?

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What does it mean to be "full term?"

For many years, a baby was defined as being born at "term" if it was born between 37 weeks 0 days and 41 weeks 6 days. Anything before that 5-week period was considered "preterm," and anything after those five weeks was "post-term."

Over time, though, research began to show that health problems were more common at certain points during this 5-week "term" period. In particular, newborns are more likely to die (although the overall risk was still very low) if they are born before 39 weeks, or after 41 weeks.

The chance of a newborn having problems is lowest if he or she is born between 39 weeks and 0 days and 40 weeks and 6 days (Spong, 2013).

In 2012, a group of experts came together to define term pregnancy. Based on their review of the research evidence, they broke the 5-week term period into separate groups (Spong, 2013).

- *Early term* babies are born between 37 weeks 0 days and 38 weeks 6 days
- *Full term* babies are born between 39 weeks 0 days and 40 weeks 6 days.
- *Late term* babies are born between 41 weeks 0 days and 41 weeks 6 days
- *Post term* babies are born at 42 weeks and 0 days or later

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Glossary

- **Estimated due date** = Traditionally considered to be 40 weeks and 0 days after the last menstrual period
- **Last menstrual period (LMP)** = First day of the last period
- **Apgar score** = A quick test given to newborns to assess their health status (usually done at 1 and 5 minutes after birth)
- **Stillbirth** = Death in utero due to any cause after 20 weeks gestation
- **Neonatal death** = Death at <28 days of life, further divided into early neonatal (<7 days), and late neonatal (7-27 days)
- **Perinatal death** = Either a stillbirth or a neonatal death
- **Post-dates pregnancy** = A common term that means any pregnancy that goes past the estimated 40-week due date; however, this term is imprecise and not recommended
- **Post-term pregnancy** = Any pregnancy that reaches 42 weeks and 0 days (294 days total) or later
- **Medical induction** = Starting labor with medical intervention before it begins on its own
- **Medically indicated induction** = An induction for an accepted medical indication from a professional guideline
- **Elective induction** = Induction that is not medically indicated
- **Spontaneous labor** = A labor starting on its own without medical intervention
- **Expectant management** = Waiting for labor to start on its own, usually with fetal testing to monitor the baby's status
- **Active management** = Medical induction for gestational age
- **Absolute risk** = The actual, or true risk of something happening to you (e.g., a 15% chance of the outcome means it happens to 15 people out of 100)
- **Relative risk** = The risk of something happening to you in comparison to someone else (e.g., if your absolute risk is 15% and someone else has an absolute risk of 10%, then your relative risk of the outcome is 50% higher than theirs)

How do you figure out your estimated due date?

Almost everyone—including doctors, midwives, and online due date calculators—uses Naegele's rule (listen to the pronunciation here (http://bit.ly/2eDYCEO)) to figure out an estimated due date (EDD).

Naegele's rule assumes that you had a 28-day menstrual cycle, and that you ovulated exactly on the 14th day of your cycle (Note: some health care providers will adjust your due date for longer or shorter menstrual cycles).

To calculate your EDD according to Naegele's rule, you add 7 days to the first day of your last period, and then count forward 9 months (or count backwards 3 months). This is equal to counting forward 280 days from the date of your last period.

For example, if your last menstrual period was on April 4 you would add seven days (April 11) and subtract 3 months = an estimated due date of January 11.

Another way to look at it is to say that your EDD is 40 weeks after the first day of your last period.

In cases where the date of conception is known precisely, such as with in vitro fertilization (http://bit.ly/2x5qolb) or fertility tracking (http://bit.ly/2x5dTWz) where people know their ovulation day, the EDD

is calculated by adding 266 days to the date of conception (or subtracting 7 days and adding 9 months). This increases the accuracy of the EDD because it no longer assumes a Day 14 ovulation based on the first day of the last menstrual period.

But where did Naegele's rule come from?

In 1744, a professor from the Netherlands named Hermann Boerhaave explained how to calculate an estimated due date. Based on the records of 100 pregnant women, Boerhaave figured out the estimated due date by adding 7 days to the last period, and then adding nine months (Baskett & Nagele, 2000).

However, Boerhaave never explained whether you should add 7 days to the *first day* of the last period, or to the *last day* of the last period.

In 1812, a professor from Germany named Carl Naegele quoted Professor Boerhaave, and added some of his own thoughts. (This is how Naegele's rule got its name!) However, Naegele, like Boerhaave, did not say when you should start counting—from the beginning of the last period, or the last day of the last period.

His text can be interpreted one of two ways: either you add 7 days to the first day of the last period, or you add 7 days to the last day of the last period.

As the 1800s went on, different doctors interpreted Naegele's rule in different ways. Most added 7 days to the *last day* of the last period.

However, by the 1900s, for some unknown reason, American textbooks adopted a form of Naegele's rule that added 7 days to the *first day* of the last period (Baskett & Nagele, 2000).

And so this brings us to today, where almost all doctors use a form of Naegele's rule that adds 7 days to the *first day* of your last period, and then counts forward 9 months—a rule that is not based on any current evidence, and may not have even been intended by Naegele.

What is the most accurate way to tell how far along you are?

Doctors started using ultrasound in the 1970s. Soon after, ultrasound measurement replaced last menstrual period (LMP) as the most reliable way to define gestational age (Morken et al., 2014).

A large body of evidence shows that ultrasounds done in early pregnancy are more accurate than using LMP to date a pregnancy. In a 2015 Cochrane review, researchers combined the results from 11 randomized clinical trials that compared routine early ultrasound to a policy of not routinely offering ultrasound (Whitworth et al., 2015).

The researchers found that people who had an early ultrasound to date the pregnancy were less likely to be induced for a post-term pregnancy.

In other words, using the LMP to estimate your due date makes it more likely that you will be mislabeled as "post-term" and experience an unnecessary induction.

In a large observational study that enrolled more than 17,000 pregnant people in Finland, researchers found that ultrasound at any time point between 8 and 16 weeks was more accurate than the LMP. When ultrasound was used instead of a "certain" LMP (in other words, the mother is "certain" about the date she had her last period), the number of "post-term" pregnancies decreased from 10.3% to 2.7% (Taipale & Hiilesmaa, 2001).

Why is LMP less accurate than using ultrasound?

There are several reasons why the LMP is usually less accurate than an ultrasound (Savitz et al., 2002; Jukic et al., 2013; ACOG, 2017). LMP is less accurate because it can have these problems:

- People can have irregular menstrual cycles, or cycles that are not 28 days
- People may be uncertain about the date of their LMP
- Many people do not ovulate on the 14th day of their cycle
- The embryo may take longer to implant in the uterus for some people
- Research indicates that some people are more likely to recall a date that includes the number 5, or even numbers, so they may inaccurately recall that the first day of their LMP has one of these numbers in it.

What is the best time to have an ultrasound to determine gestational age?

In a 2013 study, researchers grouped ultrasound scans by <7 weeks, 7-10 weeks, 11-14 weeks, 14-19 weeks, and 20-27 weeks (Khambalia et al., 2013).

The authors found that the most accurate time to perform an ultrasound to determine the gestational age was 11-14 weeks. About 68% of people gave birth ±11 days of their estimated due date as calculated by ultrasound at 11-14 weeks. This was a more accurate result than any of the other ultrasound scans, and more accurate than the LMP.

The accuracy of the ultrasound saw a significant decline starting at about 20 weeks. Using an estimated due date from either the LMP or an ultrasound at 20-27 weeks led to a higher rate of pre- and post-term births.

Should a due date be changed based on a third trimester ultrasound?

In the Listening to Mothers III study, one in four mothers (26%) reported that their care provider changed their estimated due date based on a late pregnancy ultrasound. For 66% of the mothers, the estimated due date was moved up to an earlier date, while for 34% of the mothers, the date was moved back to a later date (Declercq et al., 2013).

Ultrasounds in the third trimester are less accurate than earlier ultrasounds or the LMP at predicting gestational age. Ultrasounds in the third trimester are not as accurate because they are measuring the size of the baby and comparing him or her to a "standard" sized baby. All babies are about the same size early in pregnancy. But if your baby will be larger than average, it will be perceived as "closer to done" when the ultrasound is done, and your due date will be moved up (incorrectly).

The reverse is also true for babies that will be smaller than average at term—their due date might be moved to a later date. This could be risky if the baby is experiencing growth restriction, as growth-restricted babies have a higher risk of stillbirth towards the end of pregnancy. Because of these problems with third trimester ultrasounds, the American College of Obstetricians and Gynecologists states that due dates should only be changed in the third trimester in very rare circumstances (2017).

They suggest that the due date should only be changed after a third trimester pregnancy ultrasound if 1) it is the pregnant person's first ultrasound, and 2) it is more than 21 days different than the due date suggested by the LMP (ACOG, 2017).

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How long is a normal pregnancy? Is it really 40 weeks?

In the U.S. and other Western countries, induction is common at or even before 40 weeks, so it is impossible to know exactly what percentage of people today would naturally go into labor and give birth before, on, or after their estimated due date.

In the past, researchers figured out the average length of a normal pregnancy by looking at a large group of pregnant people, and measuring the time from ovulation (or the last menstrual period, or an ultrasound) until the date the person gave birth—and calculating the average. However, this method is wrong and does not give us accurate results.

Why is this method wrong?

This method does not work because many people are induced when they reach 39, 40, 41, or 42 weeks.

If you do include these induced people in your average, then you are including people who gave birth earlier than they would have otherwise, because they were not given time to go into labor on their own.

But this puts researchers in a bind, because if you *exclude* a person who was induced at 42 weeks from your study, then you are ignoring a pregnancy that was induced because it went longer—and by excluding that case, you artificially make the average length of pregnancy too short.

So how can we deal with this problem?

Researchers today use a method called "survival analysis" or "time to event analysis." This is a special method that allows you to include all of these people in your study, and still get an accurate picture of how long it takes the average person to go into spontaneous labor. There have been two studies that measured the average length of pregnancy using survival analysis:

Study finds that estimated due date is 3 to 5 days AFTER 40 weeks

In a very important study published in 2001, Smith looked at the length of pregnancy in 1,514 healthy women whose estimated due dates, as calculated by the first day of the last menstrual period, were perfect matches with estimated due dates from their first trimester ultrasound (Smith, 2001a).

The researchers found that 50% of all women giving birth for the first time gave birth by 40 weeks and 5 days, while 75% gave birth by 41 weeks and 2 days.

Meanwhile, 50% of all women who had given birth at least once before gave birth by 40 weeks and 3 days, while 75% gave birth by 41 weeks.

This means that for both first-time and experienced mothers in Smith's study, the traditional "estimated due date" of 40 weeks was wrong!

The actual pregnancy was about 5 days longer than the traditional due date (using Naegele's rule) in a first-time mother, and 3 days longer than the traditional due date in a mother who has given birth before.

Study finds that estimated due date should be closer to 40 weeks and 5 days

In 2013, Jukic et al. used survival analysis to look at the normal length of a pregnancy. This was a smaller study—there were only 125 healthy women, and they all gave birth between the years 1982 and 1985.

However, this was also an important study, because researchers followed the participants even before conception and measured their hormones daily for six months (Jukic et al., 2013).

This means that the researchers knew the exact days that the participants ovulated, conceived, and even when their pregnancies implanted!

So what was the average length of a pregnancy in this study?

After excluding women who had preterm births or pregnancy-related medical conditions, the final sample of 113 women had a median time from *ovulation* to *birth* of 268 days (38 weeks, 2 days after ovulation).

The median time from the first day of the *last menstrual period* to birth was 285 days (or 40 weeks, 5 days after the last menstrual period).

The length of pregnancy ranged from 36 weeks and 6 days to one person who gave birth 45 weeks and 6 days after the last menstrual period. The 45 weeks and 6 days sounds really long... but this particular person actually gave birth 40 weeks and 4 days after ovulation. Her ovulation did not fit the normal pattern, so we know her LMP due date was not accurate.

The researchers also found that:

- 10% gave birth by 38 weeks and 5 days after the LMP
- 25% gave birth by 39 weeks and 5 days after the LMP
- 50% gave birth by 40 weeks and 5 days after the LMP
- 75% gave birth by 41 weeks and 2 days after the LMP
- 90% gave birth by 44 weeks and zero days after the LMP

Remember though, some of the participants did not ovulate on the 14th day of their period (that's why you saw the statistic that 10% still haven't given birth by 44 weeks after the LMP!) So if we look at when people give birth after ovulation, you'll see this pattern:

- 10% gave birth by 36 weeks and 4 days after ovulation
- 25% gave birth by 37 weeks and 3 days after ovulation
- 50% gave birth by 38 weeks and 2 days after ovulation
- 75% gave birth by 39 weeks and 2 days after ovulation
- 90% gave birth by 40 weeks and zero days after ovulation

Women who had **embryos that took longer to implant were more likely to have longer pregnancies**. Also, women who had a specific sort of hormonal reaction right after getting pregnant (a late rise in progesterone) had a pregnancy that was 12 days shorter, on average.

So is the traditional "due date" really your due date?

Based on the best evidence, there is no such thing as an exact "due date," and the estimated due date of 40 weeks is not accurate. Instead, it would be more appropriate to say that there is a normal range of time in which most people give birth. About half of all pregnant people will go into labor on their own by 40 weeks and 5 days (for first-time mothers) or 40 weeks and 3 days (for mothers who have given birth before). The other half will not.

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Are there some things that can make your pregnancy longer?

By far, the most important predictor of a longer pregnancy is a family history of long pregnancies—including your own personal history, your mother and sisters' history, and your baby's biological father's family history (Jukic et al., 2013; Oberg et al., 2013; Mogren et al., 1999; Olesen, et al., 1999; Olesen et al., 2003).

In 2013, Oberg et al. published a large study that looked at more than 475,000 Swedish births, most of which were dated with an ultrasound before 20 weeks. They found that genetics has an incredibly strong influence on your chance of having a birth after 42 weeks:

- If you've had a post-term birth before, you have 4.4 times the chance of having another post-term birth with the same partner
- If you've had a post-term birth before, and then you switch partners, you have 3.4 times the chance of having another post-term birth with your new partner
- If your sister had a post-term birth, you have 1.8 times the chance of having a post-term birth

Overall, researchers found that half of your chance for having a post-term birth comes from genetics. This includes the baby's genetic tendency to gestate longer (due to genes the baby inherited from the mother and the father), and the mother's genetic tendency to carry a pregnancy longer. The Swedish researchers even proposed that you could call some pregnancies "resistant," because these mothers and/or fetuses have a genetically decreased tendency to start labor.

Other factors that may make your pregnancy more likely to go longer include:

- Higher body mass index before you get pregnant (Halloran et al., 2012; Jukic et al., 2013; Oberg et al., 2013)
- Higher weight gain during pregnancy (Halloran et al., 2012)
- Longer time between when you ovulated and when your pregnancy implanted (Jukic et al., 2013)
- Older maternal age (Oberg et al., 2013; Jukic et al., 2013)
- Heavier birth weight of the mother (Jukic et al., 2013)
- Higher education level of the mother (Oberg et al., 2013)
- Being pregnant for the first time (Oberg et al., 2013)
- Being pregnant with a male baby (Divon et al., 2002; Oberg et al., 2013)
- Your mother had a post-term birth (Mogren et al., 1999; Olesen et al., 1999; Olesen et al., 2003)
- The baby is measuring small by ultrasound at 10–24 weeks (Johnsen et al., 2008)
- Experiencing environmental stress towards the end of pregnancy (at 33-36 weeks) (Margerison-Zilko et al., 2015)

What are the risks of going past your due date?

The risks of some complications go up as you go past your due date, and there are at least three important studies that have shown us what the risks are.

1. In 2003, Caughey et al. looked at 135,560 people who gave birth at term in California between the years 1995 and 1999 (Caughey et al., 2003). The participants in this sample all gave birth at Kaiser Permanente hospitals in northern California. The overall use of interventions (Cesareans and inductions) in this sample was not listed.
2. In 2004, Caughey et al. looked at the records of 45,673 people who gave birth in a single hospital in California from 1992 to 2002 (Caughey & Musci, 2004). The participants in this study were mostly

well-educated. As far as intervention rates go, 18% gave birth by Cesarean and 16% with the help of vacuum or forceps. The rate of inductions was not listed.

3. In 2007, Caughey et al. studied the medical records of 119,254 people who gave birth after 37 weeks at Kaiser Permanente between the years of 1995 and 1999. This was the same time period and same hospital as his 2003 study, but this time the researchers only looked at low-risk people who had health insurance. The overall Cesarean rate was 13.8%, and 9.3% gave birth with the help of vacuum or forceps. The authors also took whether or not people had inductions into account when they calculated the risks of going past your due date (Caughey et al., 2007).

Risks for mothers:

- The risk of chorioamnionitis (infection of the membranes) was lowest at 37 weeks (0.16%) and increased every week after that to a high of 6.15% at ≥ 42 weeks (Caughey et al., 2003)
- The risk of endomyometritis (infection of the uterus) was lowest at 38 weeks (0.64%) and increased every week after that to a high of 2.2% at ≥ 42 weeks (Caughey & Musci, 2004)
- The risk of having a placenta abruption (placenta separates prematurely from the uterus) was lowest at 37 weeks (0.09%), and increased every week to a high of 0.44% at ≥ 42 weeks (Caughey et al., 2003)
- The risk of preeclampsia was lowest at 37 weeks (0.4%) and highest at 40 weeks (1.5%), after which the risk did not change (Caughey et al., 2003)
- The risk of postpartum hemorrhage was lowest at 37 weeks (1.1%) and increased almost every week to a high of 5% at 42 weeks (Caughey et al., 2007)
- The risk of a primary Cesarean (in people who have never had a Cesarean before) increased from 14.2% at 39 weeks to a high of 25% at ≥42 weeks (Caughey & Musci, 2004)
- The risk of having a primary Cesarean for a non-reassuring fetal heart rate was lowest at 37-39 weeks (13.3-14.5%) and reached a high of 27.5% at 42 weeks (Caughey et al., 2007)
- The risk of receiving forceps or vacuum assistance increased from 14.1% at 38 weeks to a high of 18.5% at 41 weeks (Caughey & Musci, 2004)
- The risk of having a 3rd or 4th degree tear was lowest at 37 weeks (3.4%) and increased every week to a high of 9.1% at 42 weeks. However, these numbers are much higher than are typically seen, and are partially related to the high use of vacuum and forceps in this study.

In their 2007 study, Caughey et al. reported that high use of induction, Cesareans, and vacuum/forceps for people with increasing gestational age may contribute to an increase in maternal risks. However, when the researchers used a statistical method to control for the use of interventions, the risks still increased with gestational age.

Risks for infants:

- The risk of moderate or thick meconium increased every week starting at 38 weeks, and peaked at ≥42 weeks (3% at 37 weeks, 5% at 38 weeks, 8% at 39 weeks, 13% at 40 weeks, 17% at 41 weeks, and 18% at >42 weeks) (Caughey & Musci, 2004)
- Neonatal intensive care unit (NICU) admission rates were lowest at 39 weeks (3.9%) and rose to 5% at 40 weeks and 7.2% at ≥42 weeks (Caughey & Musci, 2004)
- The risk of the baby being large at birth (>9 lbs 15 oz or >4500 grams) rose starting at 38 weeks (0.5%), and doubled every week after that up until 42 weeks (6%) (Caughey & Musci, 2004)
- The odds of having a low 5-minute Apgar score went up starting at 40 weeks and increased each week until ≥42 weeks (exact numbers not reported; Caughey & Musci, 2004)

Other risks for post-term pregnancy include having low fluid, and something called dysmaturity syndrome (growth restriction plus muscle wasting), which happens in about 10% of babies who go past 42 weeks. For more information about meconium, see this article by Midwife Thinking about meconium stained waters (https://bit.ly/2FSH15T).

What about the risk of stillbirth?

In this section, we will talk about how the risk of stillbirth increases towards the end of pregnancy.

There are two very important things for you to understand when learning about stillbirth rates.

First, there is a difference between absolute risk and relative risk.

Absolute risk is the actual risk of something happening to you.

For example, if the absolute risk of having a stillbirth at 41 weeks was 1.7 out of 1,000, then that means that 1.7 mothers out of 1,000 (or 17 out of 10,000) will experience a stillbirth.

Relative risk is the risk of something happening to you in comparison to somebody else.

If someone said that the risk of having a stillbirth at 42 weeks compared to 41 weeks is 94% higher, then that sounds like a lot. But some people may consider the actual (or absolute) risk to still be low—1.7 per 1,000 versus 3.2 per 1,000.

Yes—3.2 is about 94% higher than 1.7, if you do the math! So, while it is a true statement to say "the risk of stillbirth increases by 94%," it can be a little misleading if you are not looking at the actual numbers behind it.

The second important thing that you need to understand is that there are different ways of measuring stillbirth rates. Depending on how the rate is calculated, you can end up with different rates.

How do you measure stillbirth rates?

Up until the 1980s, some researchers thought that the risk of stillbirth past 41-42 weeks was similar to the risk of stillbirth earlier in pregnancy. So, they did not think there was any increase in risk with going past your due date.

However, in 1987, a researcher named Dr. Yudkin published a paper introducing a new way to measure stillbirth rates. Dr. Yudkin said that earlier researchers used the wrong math when they calculated stillbirth rates—they used the wrong denominator! (Yudkin, Wood et al., 1987).

Before 1987, researchers calculated stillbirth rates like this:

$$\text{Risk of Stillbirth at Week 41} = \frac{\text{\# of Stillbirths at 41 weeks}}{\text{\# of Births at 41 weeks}}$$

(Excluded babies still in the womb and born after 41 weeks)

Here's why this formula is wrong: We don't need to know how many stillbirths happen out of every 1,000 births at 41 weeks. Instead, we need to know how many stillbirths happen at 41 weeks compared to all pregnancies and births at 41 weeks. In other words, you have to include the healthy, living babies that have not been born yet in your denominator.

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New formula for calculating calculated stillbirth rates:

$$\text{Risk of Stillbirth at Week 41} = \frac{\text{\# of Stillbirths at 41 weeks}}{\text{\# of Births and Pregnancies at 41 weeks}}$$

(Includes babies still in the womb and born after 41 weeks)

When researchers began using this new formula to figure out stillbirth rates, they found something very surprising—the risk of stillbirth decreased throughout pregnancy, until it reached a low point at 37-38 weeks, after which the risk started to rise again.

This finding—that the risk of stillbirth decreases throughout pregnancy, and then increases sometime after 37-38 weeks—has been found many times by different researchers in different countries. This phenomenon is called the "U-shaped curve" of stillbirth. In other words, there are higher rates of stillbirth earlier in pregnancy, then they go down until around 37-38 weeks, after which they rise again.

Because the risk of stillbirth starts to go up even more at 40, 41, and 42 weeks, some researchers argue that although 40 weeks and 3-5 days may be the physiological length of pregnancy, 40 weeks may be the functional length of a pregnancy.

In other words, the average pregnancy normally lasts about 40 weeks and 5 days, but in some researchers' *opinion*, because of the increased risk of stillbirth and newborn death; 40 weeks may be as long as a pregnancy *should* go.

And although the stillbirth rates may seem low overall, if you happen to be a parent who experiences the 1 in 315 event at 42 weeks (Muglu et al., 2019), then the risk doesn't seem so low anymore.

Actual stillbirth rates vs. open-ended stillbirth rates

Even after researchers began using the new way of calculating stillbirth rates, there was still controversy about the best way to calculate this new formula for measuring stillbirth rates.

Different than what Yudkin proposed in 1987, some researchers preferred an "open-ended" stillbirth rate (also known as the "prospective risk of stillbirth"). An open-ended stillbirth rate at 40 weeks would tell us what a pregnant person's risk of stillbirth was for any time after 40 weeks, if she let the pregnancy continue indefinitely.

Other researchers argued that most people (and doctors!) don't want to know what the risk of stillbirth would be if a pregnant person chose to let the pregnancy continue on and on! (Hilder et al., 2000). They just want to know what the risk would be if they waited one more week until the next appointment, or even a few days.

But the "open-ended" stillbirth rate tells you what your risk of stillbirth at 40 weeks would be if you include babies born not just at 40 weeks, but 41 weeks, 42 weeks, 43 weeks, and on! (Boulvain et al., 2000).

In the end, you will find that stillbirth rates vary from study to study, depending on whether the researchers report the actual stillbirth rate, or the open-ended stillbirth rate.

So what is the risk of stillbirth as you go past your due date?

Since the late 1980's, there have been at least 12 large studies that looked at the risk of stillbirth during each week of pregnancy. Some of the researchers used open-ended stillbirth rates, and some of them used actual stillbirth rates.

All of the researchers found a relative increase in the risk of stillbirth as pregnancy advanced.

To get an accurate picture of stillbirth in people who go past their due date, it would be best to look at studies that took place in more recent times. I've chosen 3 of the most recent studies to show you from Norway, Germany, and the U.S. To see all of the other studies, click to view the entire table here (http://bit.ly/2iY937p).

All 3 of these studies used the actual stillbirth rate—not the open-ended stillbirth rate. Two studies used ultrasound to calculate gestational age, and one study used the LMP.

First Author (Year)	Sample	Findings
Morken (2014)	• Stillbirth rates of 1,855,682 people in Norway who gave birth to single babies at 37-44 gestational weeks between the years 1967 and 2006 • Ultrasound was introduced in 1986; for this study, due dates were calculated per LMP from 1967 to 1998 and by ultrasound from 1999 to 2006 • Excluded cases with preeclampsia, diabetes, and congenital problems • Data are from the Norwegian birth registry	When Morken, et al. only looked at stillbirth rates from the years 1999 to 2006 (when ultrasound was used to determine gestational age), they found that **the stillbirth rates for infants who were not small for gestational age were**: 37 weeks = 0.14 per 1,000 38 weeks = 0.18 per 1,000 39 weeks = 0.26 per 1,000 40 weeks = 0.52 per 1,000 41 weeks = 0.68 per 1,000 ≥ 42 weeks = 1.17 per 1,000 Babies who were small for gestational age had much higher stillbirth rates: 37 weeks = 0.81 per 1,000 38 weeks = 1.93 per 1,000 39 weeks = 1.72 per 1,000 40 weeks = 1.82 per 1,000 41 weeks = 3.38 per 1,000 ≥ 42 weeks = 7.00 per 1,000

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First Author (Year)	Sample	Findings
Weiss (2014)	• Stillbirth rates of 472,843 low-risk people who were pregnant with a single baby and gave birth in Germany between the years 2004 and 2009 • During this time, all hospitals did non-stress tests every 2 days, starting at 40 weeks and 0 days • Excluded premature births (<37 weeks 0 days), babies with congenital problems, and babies that did not have ultrasound dating.	The stillbirth rates in this study were: 37.0-37.6 days = 2.77 per 1,000 38.0-38.6 days = 1.09 per 1,000 39.0-39.6 days = 0.90 per 1,000 40.0-40.6 days = 0.72 per 1,000 41.0-41.6 days = 0.44 per 1,000 42.0-42.6 days = 0.70 per 1,000 >42.6 days = 8.85 per 1,000 (2 babies stillborn out of 226 pregnancies) The authors note that the stillbirth rates they observed at 41 and 42 weeks were much lower than what has been observed in other studies—probably because their study is more recent (2004-2009 vs. 1980s-1990s). They also think that perhaps their fetal monitoring policy could be responsible for the lower stillbirth rates.
Rosenstein (2012)	• Stillbirth rates of 3,820,826 singleton infants who were born between 37 weeks and 42 weeks 6 days in California during the years 1997 to 2006 • Excluded infants with genetic or congenital problems, and those born to mothers with diabetes or chronic hypertension. • Last menstrual period (LMP) used to determine due dates • Data came from birth certificates	The stillbirth rates were: 37 weeks = 0.21 per 1,000 38 weeks = 0.27 per 1,000 39 weeks = 0.35 per 1,000 40 weeks = 0.42 per 1,000 41 weeks = 0.61 per 1,000 42 weeks = 1.08 per 1,000 The authors also looked at the combined risk of the baby **either being stillborn or dying in the first year of life** if the mother waited one more week to give birth (combined stillbirth + infant death risk): 37 weeks = 1.26 per 1,000 38 weeks = 1.16 per 1,000 39 weeks = 1.29 per 1,000 40 weeks = 1.40 per 1,000 41 weeks = 1.76 per 1,000

The largest meta-analysis to date on risks of stillbirth and newborn death at each week of term pregnancies was published in 2019 (Muglu et al., 2019). A meta-analysis is when researchers take multiple studies and combine all the data together into one big "meta" study. The researchers included 13 studies (15 million pregnancies, nearly 18,000 stillbirths). All of the studies were conducted in countries defined as "high-income" by the World Bank.

The risk of stillbirth per 1,000 was 0.11, 0.16, 0.42, 0.69, 1.66, and 3.18 at 37, 38, 39, 40, 41, and 42 weeks of pregnancy, respectively. Based on their data, Muglu et al. (2019) calculated the "number needed to harm" by waiting for labor for one more week in order to experience one additional stillbirth. To experience one additional stillbirth, there would need to be at least 2,367 people waiting for labor for one more week starting at 39 weeks. At 40 weeks, 1,449 people would have to wait for labor for one more week to experience one additional stillbirth. At 41 and 42 weeks, only 604 and 315 people, respectively, would have to wait for labor for one more week to experience one additional stillbirth.

The researchers also found evidence that health care systems are failing Black mothers and babies—an alarming but common theme in health care research. Black mothers were 1.5 to 2 times more likely than White mothers to have a stillbirth at every week of pregnancy.

When they looked only at low-risk pregnancies, the risk of stillbirth was 0.12, 0.14, 0.33, 0.80, and 0.88 at 38, 39, 40, 41, and 42 weeks of pregnancy. Low-risk pregnancy was defined as pregnancies with a single baby, no congenital abnormalities, and no medical conditions in the mother.

There was no additional risk of newborn death when giving birth between 38 and 41 weeks, but the risk of newborn death did increase beyond 41 weeks.

So, although most researchers have found an increase in stillbirth rates in the late term and post term period, some might consider the "absolute" increase in risk to be small until 41 weeks, after which it reaches about 0.80-1.66 out of 1,000, depending on the mother's risk factors for stillbirth.

What factors can increase the risk of stillbirth?

Researchers have found several factors are related to a higher risk of stillbirth:

Post-term babies who are small for gestational age (body weight <10th percentile) have a 6-7 times higher chance of stillbirth and newborn death than post-term babies who are not small for gestational age.

- Also, small for gestational age babies are often growth restricted at the 18-week ultrasound. So, the gestational age for these babies is often under-estimated.
- This means that babies who are small for gestational age may be more post-term than we realize they are—increasing their risk while also leaving us unaware of their true gestational age (Morken et al., 2014).

Other factors that do not necessarily *cause* stillbirth but may *increase* the risk of stillbirth, in general, include:

- Belonging to an ethnic group at increased risk for stillbirth* (Ananth et al., 2009; Stillbirth Collaborative, 2011)
- Being pregnant with your first baby (Huang et al., 2000; Smith, 2001b; Stillbirth Collaborative, 2011; Flenady et al., 2011)
- Fewer than four prenatal visits or no prenatal care (Huang et al., 2000; Flenady et al., 2011)
- Low socioeconomic status (Huang et al., 2000; Flenady et al., 2011)
- A body mass index (BMI) over 25 to 30 (Huang et al., 2000; Stillbirth Collaborative, 2011; Flenady et al., 2011)
- Smoking (Morken et al., 2014; Flenady et al., 2011)
- Pre-existing diabetes (Stillbirth Collaborative, 2011; Flenady et al., 2011)
- Pre-existing hypertension (Flenady et al., 2011)
- Older maternal age (≥40 years) (Stillbirth Collaborative, 2011)
- Not living with a partner (Stillbirth Collaborative, 2011)
- History of previous stillbirth (Stillbirth Collaborative, 2011)
- Being pregnant with multiples (Stillbirth Collaborative, 2011)

* Racism, including the effects of prejudice and institutional racism, can increase the risk of poor outcomes, including stillbirth, in certain populations (Giscombe and Lobel, 2005).

Of course, parents can still experience the stillbirth of a child even when none of these risk factors are present. **As many as a third of all stillbirths that take place before labor have no known cause** (Warland & Mitchell, 2014). To read more about theories of unexplained stillbirth, read this article here (http://bit.ly/2vl2Q5C).

We have heard some clinicians state that the "aging of the placenta" is a potential cause of stillbirths with no official known cause. However, up until recently, there was no research on this topic.

In 2017, researchers published the first study looking at biological markers of aging in placentas. In this study, researchers in Australia collected placentas from 34 people who gave birth between 37-39 weeks of pregnancy, 28 people who gave birth between 41-42 weeks, and 4 people who experienced stillbirths between 32 and 41 weeks (Maiti et al., 2017).

Five or more tissue samples were removed from each placenta, and the samples were analyzed using a variety of biochemical tests. For example, one of the tests looked for a marker of DNA/RNA damage that was previously observed in other aging tissues, such as the brain in Alzheimer's disease. There was a significant increase in DNA/RNA damage in late-term and stillbirth placentas compared to the placentas from 37-39 weeks.

Overall, the analysis of the placentas from the 41-42 week pregnancies and from the stillbirths showed increased signs of aging, with decreased ability to transport nutrients to the baby and waste products away from the baby, compared to the placentas from the earlier term births. The rate of placental aging varied in different pregnancies, and the authors stated that not all of the 41-42 week placentas showed signs of aging. We reached out to the authors to find out more, and they told us that one-third of the 41-42 week placentas showed increased signs of aging compared to the 37-39 week placentas. This means that two-thirds of the 41-42 week placentas did not show signs of aging.

Interestingly, the authors say that in the future it may be possible to predict which babies are at increased risk of stillbirth by measuring markers of placental aging in the mother's blood. You can watch a 10-minute video describing the findings of this emerging research here (https://bit.ly/2szc0B2).

Induction for Going Past Your Due Date

Check out our Signature Article on Inducing for Due Dates (www.ebbirth.com/inducingduedates) for more information about the Pros/Cons of induction versus waiting for labor.

What's the bottom line?

- The traditional way of calculating the estimated due date (40 weeks after the last menstrual period) is not evidence-based. Instead, it is more accurate to give people a range of time that they will probably give birth:
  - About half of first-time mothers will give birth by 40 weeks and 5 days after the first day of their last menstrual period, with the other half giving birth after that time point
  - About half of mothers who have given birth before will give birth by 40 weeks and 3 days after the first day of their last menstrual period, with the other half giving birth after that
- The estimated due date can also be calculated using the ovulation day (which is known with in vitro fertilization and fertility tracking). This is more accurate than using the last menstrual period because it no longer assumes a Day 14 ovulation.
- An ultrasound before 20 weeks is usually more accurate than using the last menstrual period, and the accuracy of an ultrasound is highest if it is done between 11 and 14 weeks.

- Changes to the estimated due date in late pregnancy should only be made in rare circumstances.
- A large body of evidence shows that there is an increase in the risk of stillbirth at the end of pregnancy, although some might consider the "absolute" increase in risk to be small until 41 weeks.
- Some individuals, such as first-time mothers, are at higher risk for experiencing stillbirth in late pregnancy than other individuals.

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