



Vaginal or Cesarean Birth:
What Is at Stake for Women and Babies?
A Best Evidence Review

Contributors

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About Childbirth Connection

Childbirth Connection is a national not-for-profit organization founded in 1918 as Maternity Center Association. Our mission is to improve the quality and value of maternity care through consumer engagement and health system transformation. Childbirth Connection promotes safe, effective and satisfying evidence-based maternity care and is a voice for the needs and interests of childbearing families. Through the *Transforming Maternity Care* Partnership, Childbirth Connection works with stakeholders from across the health care system to implement priority recommendations from the consensus, direction-setting *Blueprint for Action: Steps Toward a High-Quality, High-Value Maternity Care System*. This Blueprint for Action, the companion report, *2020 Vision for a High-Quality, High-Value Maternity Care System*, and other related resources are available at <http://transform.childbirthconnection.org>.

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Executive Summary

Introduction and Background

With about one in three babies born surgically, cesarean delivery is the most common operating room procedure in the United States. Over the past two decades, the cesarean rate has increased among women with and without prior cesareans, in both preterm and term pregnancies, in women at low and high risk of complications, and across all ages, races, and ethnicities.^{1, 2} As cesarean rates increase, proportionally more low-risk women experience cesarean delivery.^{3, 4} Overuse of cesarean delivery in low-risk women exposes more women and babies to potential harms of cesarean with minimal likelihood of benefit. Of particular consequence are downstream effects including childhood chronic illness and placental complications in any subsequent pregnancies. These include life-threatening complications that occur more frequently with accumulating surgeries. In light of these and other concerns, in 2012, the National Priorities Partnership, a consortium of major national organizations facilitating coordinated action within targeted areas of health and healthcare improvement, convened a Maternity Action Team to address inappropriate and unsafe maternity care.⁵ A major goal of the Maternity Action Team is to reduce cesarean delivery in low-risk women to 15% or less.

With escalating multi-stakeholder attention on cesarean overuse, an ever-growing body of evidence, and new opportunities for consumer education and shared decision making, Childbirth Connection undertook a scientific review to summarize for all stakeholders the most current best evidence on the health consequences of cesarean delivery. While the expected benefits of cesarean delivery vary depending on the indication and would be minimal in low-risk women, the potential harms are generally intrinsic to surgical delivery. Thus, this report focuses on adverse consequences of cesarean, and also explores adverse outcomes that may be intrinsic to labor or vaginal birth. This report presents the methods, findings, and implications of this best evidence review. Companion consumer-oriented materials, including a downloadable booklet, are available at <http://www.childbirthconnection.org/cesarean>.


Methods

This report intends to present the best available evidence for the direction and strength of the harms associated with cesarean delivery versus vaginal birth measured within contemporary maternity practice in high-resource countries. To be included in this best evidence review, systematic reviews or studies had to have been published in English in the year 2000 or later, been conducted in high-income countries (as defined by the World Bank⁶) and compared outcomes with cesarean delivery versus either actual or planned vaginal birth. To examine outcomes unique to surgery (e.g., cesarean scar ectopic pregnancy, operative injury to internal organs) or vaginal birth (i.e., perineal or genital injury), however, we relied on studies without comparison groups.

Where an eligible systematic review was available—that is, a review of studies on a defined question that described its search methods, specified inclusion and exclusion criteria and used meta-analysis when appropriate—we used it as our exclusive source. If more than one eligible systematic review was identified covering the same topic, we chose the most recent, unless including multiple systematic reviews enabled reporting of additional outcomes. If no eligible systematic review could be identified, we resorted to observational studies of any design including cohort, cross sectional, or case-control. Evidence for some outcomes was only available in case series and reports. In this situation, we included only the largest of the case series, excluding single case reports or series of only a few cases.

Where differences between modes of birth could be quantified, we reported the size of those differences (“absolute risk difference”) on a scale of “very small” to “very large” according to orders of magnitude standardized to a denominator of 10,000.⁷ (See Table 1.) The standardized scale allows readers to make comparisons at a glance, and 10,000 was chosen as the common denominator to capture the wide variation in rates of various outcomes. In some cases, studies reported only odds or risk ratios, which meant that differences could not be quantified. These have been so noted. Unless stated otherwise, all differences are *statistically significant*, that is, unlikely to be due to chance.

Table 1: Magnitude of Absolute Risk Difference in Reported Outcome

Excess number of women or babies having a specific problem	Compared with the safer form of care, the care with more risk may cause problems for an additional	
VERY LARGE	1,000 to 10,000	 <p data-bbox="1161 884 1388 961">of every 10,000 women or babies</p>
LARGE	100 to 999	
MODERATE	10 to 99	
SMALL	1 to 9	
VERY SMALL	less than 1	

Results

Our comprehensive assessment reveals the following: Of 14 maternal adverse outcomes in the current pregnancy, sufficient evidence demonstrates that 8 favor vaginal or planned vaginal birth, and limited evidence suggests the remaining 6 favor vaginal or planned vaginal birth. Of 4 neonatal adverse outcomes, sufficient evidence demonstrates that 1 favors vaginal or planned vaginal birth, limited evidence suggests that 2 favor vaginal or planned vaginal birth and evidence is conflicting for the remaining 1 outcome. Of 4 childhood chronic diseases, sufficient evidence demonstrates that 3 favor vaginal or planned vaginal birth and evidence is limited and conflicting for the remaining 1. Seven adverse outcomes are unique to cesarean delivery while 3 are unique to vaginal birth. Of 3 psychosocial outcomes examined, evidence conflicts but suggests a possible association with cesarean delivery for all 3. In subsequent pregnancies, of 9 adverse maternal outcomes, sufficient evidence demonstrates that 6 favor vaginal birth in the prior delivery and limited evidence suggests the remaining 3 also favor prior vaginal birth. Of 6 perinatal adverse outcomes in subsequent pregnancies, limited evidence suggests that 2 favor prior vaginal birth, and data conflict for the remaining 4. Of 5 outcomes related to pelvic floor dysfunction, none favors vaginal birth, mode of birth makes no difference for 2, and 3 favor cesarean delivery, but of these 3, 2 favor cesarean only in the short term or only with respect to mild or moderate symptoms. Of 4 outcomes related to delivery injury of the baby, mode of birth appears to make no difference for 3, none favors vaginal birth, and limited evidence suggests that 1 favors cesarean.

Individual results are listed below.

What physical effects may occur in women more frequently with cesarean delivery?

Maternal death: More women appear to die as a result of cesarean delivery itself, but the excess number cannot be calculated from the studies examined.

Cardiac arrest: Limited evidence suggests that a MODERATE excess number of healthy women may experience cardiac arrest in association with cesarean delivery compared with similar women planning vaginal birth.

Urgent hysterectomy: A SMALL to MODERATE excess number of women having initial cesarean delivery undergo unplanned hysterectomy compared with women having vaginal birth.

Thromboembolic events (blood clots): A SMALL to MODERATE excess number of healthy women having cesarean delivery experience a blood clot.

Anesthetic complications: Limited evidence suggests that a MODERATE excess number of healthy women having cesarean delivery may experience complications with anesthesia compared with similar women having spontaneous vaginal birth.

Major infection: Limited evidence suggests that a MODERATE to LARGE excess number of healthy women having planned cesarean delivery experience major puerperal infection compared with women having or planning vaginal birth.

Rare, life-threatening complications: Limited evidence suggests that more women experience amniotic fluid embolism or uterine artery pseudoaneurysm after cesarean than after vaginal birth, but the excess number cannot be calculated from the studies examined.

Wound infection (cesarean or genital): A LARGE excess number of healthy women having cesarean delivery have wound infections compared with women planning vaginal birth.

Hematoma (cesarean or genital): Limited evidence suggests that a LARGE excess number of healthy women having cesarean delivery have wound hematomas compared with women planning vaginal birth.

Wound disruption (cesarean or genital): Limited evidence suggests that a SMALL excess number of healthy women having cesarean delivery have wound disruption compared with women planning vaginal birth.

Length of hospital stay: Planned cesarean delivery increases length of hospital stay by at least 0.6 to 2 days compared with planned vaginal birth.

Hospital readmission: A MODERATE to LARGE excess number of healthy women having cesarean delivery require readmission to the hospital. →

Problems with physical recovery: With the exception of the presence of hemorrhoids, which are more common with vaginal birth, a LARGE to VERY LARGE excess number of women having cesarean delivery experience problems with physical recovery, including general health, bodily pain, extreme tiredness, sleep problems, bowel problems, ability to carry out daily activities, and ability to perform strenuous activities, compared with women having spontaneous vaginal birth.

Chronic pelvic pain: More women experience chronic pelvic pain after cesarean delivery than after vaginal birth, but the excess number cannot be calculated from the studies examined.

What physical effects may occur in babies more frequently with cesarean delivery?

Neonatal mortality: Limited evidence suggests that babies of women having elective first cesareans may be at greater risk of neonatal death compared with low-risk women planning vaginal birth, but the excess number of deaths cannot be calculated from the study examined.

Respiratory distress syndrome: When birth occurs before 39 weeks, more babies born by cesarean than by vaginal birth experience respiratory distress syndrome (RDS), but the excess number cannot be calculated from the studies examined.

Pulmonary hypertension: Limited evidence suggests that a MODERATE excess number of babies delivered by elective cesarean may develop pulmonary hypertension.

Not breastfeeding: Conflicting evidence suggests that babies delivered by cesarean may be at excess risk of not being breastfed.

What role may cesarean delivery play in the development of childhood chronic disease?

Asthma: Cesarean delivery increases the likelihood of developing asthma in childhood, but the excess number cannot be calculated from the studies examined.

Type 1 diabetes: Cesarean delivery increases the likelihood of developing Type 1 diabetes in childhood, but the excess number cannot be calculated from the studies examined.

Allergic rhinitis: Cesarean delivery increases the likelihood of developing childhood allergic rhinitis, but the excess number cannot be calculated from the studies examined.

Symptomatic food allergy: Limited and conflicting evidence suggests that cesarean delivery may increase the likelihood of developing food allergy in childhood, but the excess number, if any, cannot be calculated from the studies examined.

Obesity: Limited evidence suggests that a LARGE excess number of children delivered by cesarean may be obese at age 3.

What complications are unique to cesarean delivery?

Operative maternal injury: Among women having first delivery via cesarean, a MODERATE number of women experience bladder puncture, and a SMALL number experience bowel injury or injury to a ureter.

Surgical cuts to the baby: Limited evidence suggests that a MODERATE number of babies are cut during cesarean delivery.

Re-operation: Limited evidence suggests that a MODERATE number of women having cesarean delivery require re-operation.

Persistent pain at the site of the cesarean incision: Limited evidence suggests that a LARGE to VERY LARGE number of women still experience pain at the incision site 6-10 months or more after cesarean delivery.

Cesarean scar endometriosis: Limited evidence suggests that a SMALL to LARGE number of women having cesarean delivery develop cesarean scar endometriomas.

Cesarean scar ectopic pregnancy/early placenta accreta: Some women becoming pregnant after cesarean will experience a cesarean scar ectopic pregnancy or placental implantation within the uterine scar, but the number cannot be calculated from the studies examined.

Dense intra-abdominal adhesions: Limited evidence suggests that a VERY LARGE number of women develop dense adhesions after cesarean delivery.

What complications are unique to vaginal birth?

Anal sphincter injury: A LARGE number of women experience anal sphincter injury at vaginal birth.

Perineal or genital lacerations of any degree: Exclusive of episiotomy, a VERY LARGE number of women experience trauma to the perineum or genitals at vaginal birth that requires suturing.

Persistent perineal pain: Limited evidence suggests that a LARGE number of women experience persistent perineal pain lasting at least six months with spontaneous vaginal birth, and a VERY LARGE number of women experience perineal pain lasting at least six months after instrumental vaginal delivery.

What are potential psychosocial consequences of cesareans?

Adverse effect on maternal-child relationship: Data conflict about whether cesarean delivery has an adverse effect on the mother-child relationship.

Depression: Data conflict on whether cesarean delivery increases the likelihood of postpartum depression.

Posttraumatic distress: Data conflict but suggest that more women may experience PTSD or PTSD symptoms after cesarean delivery in general and unplanned cesareans in particular, but the excess number, if any, cannot be calculated from the studies examined.

What are potential effects of cesareans on women in future pregnancies and births?

Impaired fertility: More women experience impaired fertility after prior cesarean delivery compared with after prior vaginal birth, but the excess number cannot be calculated from the studies examined.

Voluntary infertility: A LARGE to VERY LARGE excess number of women choose not to conceive again after cesarean delivery.

Placenta previa: A SMALL excess number of women with first delivery by cesarean develop placenta previa in the next pregnancy, but the excess number cannot be calculated from the studies examined. A LARGE excess number of women develop placenta previa after two or more prior cesareans.

Placenta accreta: A SMALL excess number of women with first delivery via cesarean develop placenta accreta in the next pregnancy. A LARGE excess number of women develop placenta accreta after multiple prior cesareans.

Placental abruption: A MODERATE excess number of women with first delivery via cesarean have a placental abruption in subsequent pregnancies.

Hysterectomy: A MODERATE excess number of women with prior cesarean delivery require an urgent hysterectomy during the next delivery admission compared with women with only prior vaginal birth. Limited evidence suggests that the excess increases with subsequent pregnancies.

Uterine rupture: A MODERATE excess number of women will experience uterine rupture with prior cesarean delivery compared with prior vaginal birth.

Intensive care admission: Limited evidence suggests that a LARGE excess number of women with prior cesarean are admitted to intensive care at the next delivery compared with women with prior vaginal birth.

Hospital readmission: Limited evidence suggests that a MODERATE excess number of women with prior cesarean are readmitted to the hospital after discharge at the next delivery compared with women with prior vaginal birth.

What are potential effects of a scarred uterus on future babies?

Stillbirth: Data conflict, but suggest that a SMALL to MODERATE excess number of babies developing in a uterus with a cesarean scar are stillborn.

Perinatal or neonatal death: Data conflict, but suggest that more babies developing in a uterus with a cesarean scar may die late in pregnancy or during the first week after birth, but the excess number, if any, cannot be calculated from the studies examined.

Preterm birth and low birth weight: Data conflict on whether prior cesarean delivery imposes increased risk of preterm birth and concomitant low birth weight. →

Small for gestational age (SGA): Data conflict on whether prior cesarean delivery imposes increased risk of SGA in the next pregnancy compared with prior vaginal birth.

Need for ventilation at birth: Limited evidence suggests that a LARGE excess number of babies whose mothers had prior cesarean may require ventilation at birth compared with babies whose mothers had prior vaginal birth.

Hospital stay longer than 7 days: Limited evidence suggests that a LARGE excess number of babies whose mothers had prior cesarean have hospital stays of more than 7 days compared with babies whose mothers had prior vaginal birth.

Does cesarean delivery protect against sexual, bowel, urinary, or pelvic floor dysfunction?

Sexual dysfunction: Cesarean delivery provides minimal or no protection against sexual dysfunction.

Anal incontinence: Cesarean delivery provides no protection against anal incontinence in either the short term or up to 12 years after birth; planned cesarean provides no protection compared with cesareans during labor.

Urinary urge incontinence: Data conflict but suggest that cesarean delivery may provide some protection against urinary urge incontinence of any degree in the short term, but protective effect, if any, has disappeared by one year after birth, and similar percentages experience severe incontinence.

Urinary stress incontinence: A LARGE to VERY LARGE excess number of women having vaginal birth experience urinary stress incontinence of any degree at one year or more after birth compared with women having cesarean delivery, but rates of severe incontinence are low and similar between cesarean and vaginal birth groups.

Symptomatic pelvic organ prolapse: A LARGE excess number of women having vaginal birth experience symptomatic pelvic floor prolapse compared with women having only cesarean delivery. The excess increases as the number of vaginal births increases and with instrumental vaginal delivery compared with spontaneous vaginal birth.

Does cesarean delivery protect against injuries to babies?

Brachial plexus injury: Limited evidence suggests that a MODERATE excess number of babies born vaginally experience brachial plexus injury compared with babies delivered by cesarean, but the excess is influenced by whether delivery is spontaneous vaginal, instrumental vaginal, or cesarean after failed instrumental delivery.

Facial nerve injury: Limited evidence suggests that facial nerve injury rates do not differ by mode of birth.

Neonatal neurologic symptoms: Planned cesarean provides no protection against intracranial hemorrhage, neonatal seizure, or abnormal neurologic status compared with women planning vaginal birth.

Cerebral palsy: Limited evidence suggests that liberal use of cesarean delivery is not associated with a reduction in cerebral palsy rates.

Conclusion

The findings of this report overwhelmingly support striving for vaginal birth in general and spontaneous vaginal birth in particular in the absence of a compelling reason to do otherwise. To improve both the quality and value of maternity care in the United States and promote the optimal health of women and infants, clinicians, policy makers, and other stakeholders should prioritize identifying and promulgating practices that promote safe, spontaneous vaginal birth and reduce the use of cesarean delivery.

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Introduction and Background

Cesarean delivery is the most common operating room procedure in the United States, with about one in three babies born surgically. This rate is about 70% higher than the U.S. rate two decades ago,¹ and is more than twice the target rate recommended by the World Health Organization.⁸ The cesarean rate has increased among women with and without prior cesareans, in both preterm and term pregnancies, in women at low and high risk of complications, and across all ages, races, and ethnicities.^{1, 2} In addition, rates vary considerably across providers, facilities, and states.^{4, 9-12} These trends and variations suggest that cesarean rates reflect clinician practice patterns and are influenced by institutional and system factors in addition to medical factors and women's preferences.¹³⁻¹⁵

As cesarean rates increase, proportionally more low-risk women experience cesarean delivery.^{3, 4} While the expected benefits of cesarean delivery vary depending on the indication and would be minimal in low-risk women, the potential harms are generally intrinsic to surgical delivery. Of particular consequence are downstream effects including childhood chronic illness and placental complications in any subsequent pregnancies. These include life-threatening complications that occur more frequently with accumulating surgeries. Because many women lack access to vaginal birth after cesarean (VBAC), they will go on to have multiple cesareans. Thus safely preventing the first cesarean, especially in low-risk women, has become a national priority with growing multi-stakeholder consensus, including among prominent obstetric leaders.^{16, 17} In 2012, the National Priorities Partnership, a consortium of major national organizations facilitating coordinated action within targeted areas of health and healthcare improvement, convened a Maternity Action Team to address inappropriate and unsafe maternity care.⁵ A major goal of the Maternity Action Team is to reduce cesarean delivery in low-risk women to 15% or less.

In 2004, Childbirth Connection (then named the Maternity Center Association) launched a Cesarean Alert Initiative to raise awareness of concerns about the rising cesarean rate, and issued a consumer booklet titled *What Every Pregnant Woman Needs to Know About Cesarean Section*.¹⁸ Endorsed by more than 30 organizations, this booklet summarized the findings of an extensive scientific review to identify and compare all harms that might differ in likelihood depending on how a woman gives birth. With escalating multi-stakeholder attention on cesarean overuse, an ever-growing body of evidence, and new opportunities for consumer education and shared decision making, Childbirth Connection recently determined the need to update the scientific review to summarize for all stakeholders the most current best evidence on the health consequences of cesarean delivery. This report presents the methods, findings, and implications of this best evidence review. Companion consumer-oriented materials, including a downloadable booklet, are available at <http://www.childbirthconnection.org/cesarean>.

Methods

This report intends to present the best available evidence for the direction and size of the excess likelihood of the harms associated with cesarean delivery versus vaginal birth measured within contemporary maternity practice in high-resource countries. To accomplish this goal, we searched PubMed by various techniques: constructing MeSH terms searches either de novo or using MeSH terms from relevant studies, inserting terms into PubMed's search box, and reviewing studies proposed by PubMed's "related citations" function. To be included in this best evidence review, systematic reviews or studies had to have been published in English since 2000, been conducted in high income countries (as defined by the World Bank⁶) and compare outcomes with cesarean delivery versus either actual or planned vaginal birth. To examine outcomes unique to surgery (e.g. cesarean scar ectopic pregnancy, operative injury to internal organs) or vaginal birth (i.e.. perineal or genital injury), however, we relied on studies without comparison groups. Studies specifically of planned repeat cesarean versus planned VBAC were excluded, as the aim of this review was to illuminate the short- and long-term consequences of primary cesarean delivery. Studies published only as abstracts were also excluded.

The strength of the evidence varied greatly across outcomes. To determine the best available evidence, we therefore applied a hierarchy that likewise varied across outcomes. Where an eligible systematic review was available—that is, a review of studies on a defined question or questions that described its search methods, specified inclusion and exclusion criteria, and used meta-analysis when appropriate—we used it as our exclusive source. If more than one eligible systematic review was identified covering the same topic, we chose the most recent, unless including multiple systematic reviews enabled reporting of additional outcomes. The next step down in the hierarchy would normally be randomized controlled trials (RCTs), but the only RCT of which we are aware that allocated women to planned cesarean delivery versus planned vaginal birth was a trial of breech delivery.¹⁹ We excluded it and its follow-up studies because breech presentation is a potent confounding factor. It is associated with adverse perinatal outcomes, and high rates of obstetric interventions and injuries with planned vaginal birth, which means results cannot be generalized to *cephalic* (head-down) presentation. If no eligible systematic review could be identified, we resorted to observational studies of any design including cohort, cross sectional, or case-control. In the case of rare adverse outcomes, electronic databases have enabled a growing number of population analyses of sufficient size to detect differences according to mode of birth and effects of mode of birth on outcomes of subsequent pregnancies. For inclusion, we required that these database studies take into account confounding and correlating factors that could both lead to cesarean delivery and predispose to adverse outcome. Evidence for some outcomes was only available in case series and reports. In this situation, we included only the largest of the case series, excluding single case reports or series of only a few cases.

In some studies, the vaginal birth group consisted of women who *planned* vaginal birth but might ultimately have given birth by cesarean ("intent-to-treat" studies). In others, the vaginal birth group was comprised of women who *had* vaginal births. Each method has limitations: with planned vaginal birth, adverse outcomes are concentrated in the subset of women who deliver by cesarean or instrumental vaginal birth. This proportion is greatly impacted by local practice patterns and obstetric culture, and thus the magnitude of harm varies widely across study settings,⁹ limiting external validity of intent-to-treat study findings. Studies of women who *have* vaginal births, however, provide an incomplete picture of the likelihood of various outcomes for a woman planning vaginal birth. Because both bodies of literature can inform our understanding of the harms and benefits of cesarean versus vaginal birth, and together enable a fuller understanding of the range of outcomes that differs by mode of birth, we have included studies of both planned and actual vaginal birth. Where the planned vaginal birth group includes women giving birth by cesarean, we have reported that cesarean rate in the research summaries.

We have confined our results to person-centered outcomes—that is, outcomes that have an important impact on the woman’s or her child’s condition. Many studies measure *surrogate outcomes*, i.e., laboratory measurements, physical signs, or intermediate outcomes used as a substitute for a direct measurement of how a patient feels, functions or survives. This is often done because they occur more frequently and closer to the time of the exposure than outcomes of greater consequence, making it easier to measure differences, but surrogate outcomes are often poor predictors of clinically important outcomes.²⁰ Therefore, we have not reported on such outcomes, including Apgar scores or cord blood pH.

Another strategy for increasing a study’s power to detect difference in uncommon outcomes is to combine them into a composite. We have chosen not to report composite outcomes because they often encompass a range of severity, and occurrence rates of the component outcomes may vary widely.

Results for each outcome are presented as an italicized outcome summary with estimation of absolute differences (when quantifiable), followed by a research summary. Some of these outcome summaries address the overall strength and consistency of the body of literature, although no standard quality framework was applied. In general, “limited evidence” refers to a single more substantial observational study or a small number of small observational studies, and “data conflict” indicates that some studies found significant differences while others found no significant difference or found a significant difference in the opposite direction. For some outcomes, additional information is provided before the outcome summary to provide appropriate context and define terms. These explanatory passages may reference studies or reports that did not meet inclusion criteria. Included studies, i.e., those cited in research summaries, are denoted with an asterisk (*) in the reference list.

Where differences between modes of birth could be quantified, we reported the size of those differences (“absolute risk difference”) on a scale of “very small” to “very large” according to orders of magnitude standardized to a denominator of 10,000.⁷ (See Table 1.) The standardized scale allows readers to make comparisons at a glance, and 10,000 was chosen as the common denominator to capture the wide variation in rates of various outcomes. In some cases, studies reported only odds or risk ratios, which meant that differences could not be quantified. These have been so noted. Unless stated otherwise, all differences are *statistically significant*, that is, unlikely to be due to chance.

Table 1: Magnitude of Absolute Risk Difference in Reported Outcome

Excess number of women or babies having a specific problem	Compared with the safer form of care, the care with more risk may cause problems for an additional	
VERY LARGE	1,000 to 10,000	} of every 10,000 women or babies
LARGE	100 to 999	
MODERATE	10 to 99	
SMALL	1 to 9	
VERY SMALL	less than 1	

Results

1. What physical effects occur in women more frequently with cesarean delivery?

Maternal death

Excess risk of maternal death with cesarean delivery is biologically plausible in that surgery introduces the possibility of surgical complications, including life-threatening complications.

More women appear to die as a result of cesarean delivery itself, but the excess number cannot be calculated from the studies examined.

Two studies, one in North Carolina and one in France, have attempted to determine whether cesarean delivery directly contributes to an excess of maternal deaths. The death rate associated with live birth according to birth mode in North Carolina was 3.6 per 10,000 with cesarean delivery compared with 0.9 per 10,000 with vaginal birth or an excess 2.7 women per 10,000.²¹ After taking into account medical complications, maternal age, and preterm birth, women were 3.9 times more likely to die in conjunction with cesarean delivery than with vaginal birth. The French study excluded all deaths that did not result in a live birth (e.g., ectopic pregnancy) and all pregnancy conditions that would both increase the risk of death and the likelihood of cesarean delivery such as placental attachment abnormalities.²² After adjusting for age, nationality, parity, and preterm birth, women were 3.6 times more likely to die in conjunction with cesarean delivery than with vaginal birth. Both studies may have underestimated the true cesarean-related mortality rate because they excluded deaths related to complications that are associated with prior cesarean and that would not (cesarean scar ectopic pregnancy) or might not (placenta previa) result in a live birth. (See below.)

A third study analyzed deaths occurring at Hospital Corporation of America hospitals, a for-profit hospital chain, between 2000 and 2006.²³ It reported 0.2 deaths per 10,000 causally related to cesarean delivery compared with 0.02 deaths per 10,000 causally related to vaginal birth, much lower rates in both categories than the North Carolina study.

Cardiac arrest

Limited evidence suggests that a MODERATE excess number of healthy women may experience cardiac arrest in association with cesarean delivery compared with similar women planning vaginal birth.

A large study compared healthy women having planned primary cesarean for breech with similar women with a head-down fetus planning vaginal birth of whom 8% had cesareans.²⁴ Fifteen more women per 10,000 having planned cesarean experienced cardiac arrest before hospital discharge.

Urgent hysterectomy

A SMALL to MODERATE excess number of women having initial cesarean delivery undergo unplanned hysterectomy compared with women having vaginal birth.

Three studies accounted for the fact that abnormal placental attachment and antepartum bleeding can lead both to cesarean delivery and to hysterectomy, and all found that primary cesarean delivery was an independent risk factor for hysterectomy during or after delivery.²⁴⁻²⁶ Excess rates varied from 4 to 11 more hysterectomies per 10,000 women having primary cesarean.

Thromboembolic events (blood clots)

If deep venous clots become dislodged, they can lead to *pulmonary embolism* (blockage of a blood vessel in the lung) or stroke. These blood clots occur more frequently with cesarean delivery compared with planned or actual vaginal birth. This excess can be reduced with routine prophylactic measures—for example, use of pneumatic compression devices after surgery.²⁷

A SMALL to MODERATE excess number of healthy women having cesarean delivery experience a blood clot.

Two studies reported increased likelihood of thromboembolic events with cesarean delivery compared with vaginal birth. One study compared women having elective cesarean with women having spontaneous vaginal birth and reported 12 more thromboembolic events (deep venous clot, embolism, or stroke) per 10,000 women having elective cesareans.²⁸ The other compared healthy women having planned cesarean for breech with healthy women with a head-down baby planning vaginal birth (of whom 8% had a cesarean).²⁴ Investigators reported 3 more deep venous clots per 10,000 women having planned cesarean.

Anesthetic complications

Limited evidence suggests that a MODERATE excess number of healthy women having cesarean delivery may experience complications with anesthesia compared with similar women having spontaneous vaginal birth.

A large study of women with no documented maternal risk factors or complications reported that 30 more women per 10,000 having elective cesareans had anesthetic complications (not defined) compared with women having spontaneous vaginal birth.²⁸

Major infection

Cesarean delivery in healthy women imposes excess risk of major puerperal infection (endometritis, fever, peritonitis, pyemia, salpingitis, septicemia) compared with vaginal birth. Antibiotic prophylaxis can reduce infection rates after cesarean delivery, with pre-incision administration more effective than intrapartum administration. The studies finding excess infection with cesarean were conducted in developed countries during periods when routine antibiotic prophylaxis was likely to be the norm, but timing of administration is unknown. It is possible that some of the excess is reducible with pre-incision administration.^{29, 30}

Limited evidence suggests that a MODERATE to LARGE excess number of healthy women having planned cesarean delivery experience major puerperal infection compared with women having or planning vaginal birth.

A large study compared maternal outcomes within 60 days after birth between healthy women having elective cesarean delivery and women having spontaneous vaginal births and found that 197 more women per 10,000 having planned cesarean delivery had major puerperal infections.²⁸ A second study compared healthy women having planned primary cesarean for breech with similar women with a head-down fetus planning vaginal birth of whom 8% had unplanned cesarean and found that 39 more women per 10,000 having planned cesarean delivery had major puerperal infections.²⁴

Rare, life-threatening complications

*Limited evidence suggests that more women experience **amniotic fluid embolism** or **uterine artery pseudoaneurysm** after cesarean than after vaginal birth, but the excess number cannot be calculated from the studies examined.*

A study of amniotic fluid embolism (AFE) analyzed a subgroup of cases occurring after birth in order to determine the cause and effect relationship between AFE and cesarean delivery and found that women having cesarean delivery were nine times more likely to experience postpartum AFE compared with women having vaginal birth.³¹ The maternal mortality rate among all cases was 20%. A systematic review of cases of uterine artery pseudoaneurysm, a complication that can result in life-threatening hemorrhage, reported that among the cases associated with childbirth, 75% occurred after cesarean delivery.³²

Problems with the cesarean or genital wound

Healthy women having cesarean delivery are more likely to experience problems with the abdominal wound than women having vaginal birth are to experience problems with a genital wound. Problems include infection, wound disruption (the wound reopens), and *hematoma* (a blood-filled swelling). Furthermore, with avoidance of episiotomy and patience during the second stage of labor, a substantial percentage of women having vaginal births do not experience any genital wound, and thus they are not at risk for wound complications.³³

- **Wound infection**

*A LARGE excess number of healthy women having cesarean delivery have **wound infections** compared with women planning vaginal birth.*

A study reported on wound infection in women having planned primary cesarean compared with women planning vaginal birth among whom 8% had a cesarean during labor.³⁴ It found that 790 more women per 10,000 having planned cesarean developed wound infection. A second large study reported that 552 more women per 10,000 having cesarean during labor and 382 per 10,000 more women having planned cesarean had a wound infection within 30 days postpartum than women having vaginal birth.³⁵ Investigators only performed statistical analysis on infection rate differences between cesareans during labor (560 per 10,000) and planned cesareans (390 per 10,000), finding a significant difference, but had they compared rates with vaginal birth (8 per 10,000), it seems probable they would have found a significant difference as well.

- **Hematoma**

*Limited evidence suggests that a **LARGE** excess number of healthy women having cesarean delivery have **wound hematomas** compared with women planning vaginal birth.*

A study compared healthy women having planned primary cesarean for breech with similar women with a head-down fetus planning vaginal birth of whom 8% had unplanned cesarean and found that 103 more women per 10,000 having planned cesarean delivery had hematomas.²⁴

- **Wound disruption**

*Limited evidence suggests that a **SMALL** excess number of healthy women having cesarean delivery have **wound disruption** compared with women planning vaginal birth.*

A study compared healthy women having planned primary cesarean for breech with similar women with a head-down fetus planning vaginal birth of whom 8% had unplanned cesarean and found that 4 more women per 10,000 had the wound reopen.²⁴

Longer hospital stay

*Planned cesarean delivery increases **length of hospital stay** by at least 0.6 to 2 days compared with planned vaginal birth.*

Three studies compared length of hospital stay after planned cesarean versus planned vaginal birth. All three had high cesarean rates in the planned vaginal birth groups (25-43%), which would reduce observed differences. Two of the studies were of outcomes related to planned mode of birth with breech presentation. Median hospital stay in one was 4.0 days with planned cesarean versus 2.8 days with planned vaginal birth, and the cesarean rate with planned vaginal birth was 43%.¹⁹ In the other, median length of stay was 4 days with planned cesarean versus 2 days with planned vaginal birth, and the cesarean rate with planned vaginal birth was 25%.³⁶ The third study was of healthy first-time mothers at term planning cesarean for breech or elective cesarean versus similar women with a head-down fetus planning vaginal birth.³⁷ The mean length of stay was 3.2 days with planned cesarean versus 2.6 days with planned vaginal birth, and the cesarean rate with planned vaginal birth was 35%.

Hospital readmission

*A **MODERATE** to **LARGE** excess number of healthy women having cesarean delivery require **readmission to the hospital**.*

Three studies looked at hospital readmission rates according to actual or planned mode of birth. One study compared hospital readmission rates in low-risk women *having* a primary cesarean delivery with women *having* a spontaneous vaginal birth and found that 120 more women per 10,000 having cesareans were readmitted to the hospital within the first 60 days after delivery.³⁸ Women having no medical or obstetric complications who had cesareans were just as likely to be readmitted as women in the cesarean delivery population overall, which suggests that factors inherent

to surgery are the reasons for the readmissions. A second study compared hospital readmission rates in women with no reported risk factors *having* primary cesarean with similar women *planning* vaginal birth among whom 9% had a cesarean during labor and found that 40 more women per 10,000 were readmitted to the hospital within the first 30 days after birth.³⁹ Most hospital readmissions in the planned vaginal birth group were in women who had cesareans during labor, which suggests that reducing the currently liberal use of cesarean delivery will reduce rehospitalization rates. The third study compared rates between low-risk women *planning* primary cesarean delivery with similar women *planning* vaginal birth among whom 8% had a cesarean during labor.³⁴ It found that 220 women per 10,000 having planned cesarean were readmitted after hospital discharge compared with 0 women planning vaginal birth. The difference did not achieve statistical significance, but the study may have enrolled too few women (178 women in each group) to detect a true difference.

Problems with physical recovery

Women who have cesarean delivery face greater challenges than women having vaginal birth in physical and social functioning and carrying out daily activities in the early weeks and months after birth. Differences in physical functioning are also influenced by the proportion of women having instrumental vaginal delivery. Women having vaginal birth with vacuum extraction or forceps, a modifiable factor, have increased problems with physical functioning (pain; limitations on activity; and sexual, bowel, and possibly urinary problems) compared with spontaneous vaginal birth.^{40, 41} (See below for studies specifically of the effect of mode of birth on sexual problems and urinary and bowel incontinence.)

*With the exception of the presence of hemorrhoids, which are more common with vaginal birth, a LARGE to VERY LARGE excess number of women having cesarean delivery experience **problems with physical recovery**, including general health, bodily pain, extreme tiredness, sleep problems, bowel problems, ability to carry out daily activities, and ability to perform strenuous activities, compared with women having spontaneous vaginal birth.*

Three studies of postpartum health in the weeks and months after childbirth all report worse physical functioning with cesarean delivery. One study surveyed first-time mothers at seven weeks postpartum to assess general health according to mode of birth.⁴¹ Compared with spontaneous vaginal birth, women with cesarean delivery scored lower in physical functioning, general health perception, bodily pain, social functioning, and ability to carry out daily activities. In specific areas of physical functioning, fewer women with cesareans reported no limitation in performing vigorous activities such as running or lifting heavy objects (2000 fewer per 10,000), participating in less vigorous activities such as vacuuming (1500 fewer per 10,000), lifting and carrying groceries (1000 fewer per 10,000), or climbing several flights of stairs (900 fewer per 10,000). Fewer women evaluated their overall health as excellent (1200 fewer per 10,000) or agreed that pain did not interfere at all with usual activities in the prior four weeks (1800 fewer per 10,000) or that their health had not limited their social activities in the prior four weeks (1100 fewer per 10,000). Finally, 1600 fewer women per 10,000 with cesarean delivery agreed that they had no difficulty at all when doing their usual daily activities and tasks inside and outside their home.

A second study surveyed women at 8, 16, and 24 weeks postpartum.⁴⁰ Compared with spontaneous vaginal birth, at 8 weeks women with cesarean delivery were more likely to report extreme tiredness (900 more per 10,000), to be troubled by lack of sleep due to their baby crying (1000 more per 10,000), and to be experiencing bowel problems (e.g., constipation or diarrhea)

(1100 more per 10,000). More women with cesarean delivery also reported bowel problems at 16 weeks (600 more per 10,000, not statistically significant) and 24 weeks (700 more per 10,000, statistically significant).

The third study surveyed first-time mothers and reported differences by mode of birth at 3, 6, and 12 months postpartum.⁴² At 3 months postpartum, 1020 fewer women per 10,000 complained of hemorrhoids after cesarean delivery than women after spontaneous vaginal birth. At 6 months postpartum, 770 more women per 10,000 complained of extreme tiredness and 930 more women per 10,000 reported lower back pain after cesarean delivery than after spontaneous vaginal birth. At 12 months postpartum, 920 more women per 10,000 women complained of extreme tiredness and 780 more women per 10,000 complained of upper back pain with cesarean delivery than after spontaneous vaginal birth.

Finally, a fourth study reported on pain alone.⁴³ When first-time mothers were asked how much pain had interfered with routine activity in the first two months after birth, 1300 more women per 10,000 with cesarean delivery responded “quite a bit” or “extremely” compared with women having spontaneous vaginal birth.

Chronic pelvic pain

*More women experience **chronic pelvic pain** after cesarean delivery than after vaginal birth, but the excess number cannot be calculated from the studies examined.*

Two studies in a systematic review analyzing factors correlated with chronic pelvic pain evaluated the relationship with cesarean delivery, and a meta-analysis pooling their data found that women were more than three times as likely to report chronic pelvic pain after cesarean delivery compared with women who birthed vaginally.⁴⁴

2. What physical effects occur in babies more frequently with cesarean delivery?

When women experience physical or emotional problems as a result of a cesarean delivery, it may interfere with their ability to care for their babies. In addition, cesarean delivery rather than vaginal birth is associated with increased likelihood of babies experiencing the following problems:

Neonatal mortality

*Limited evidence suggests that babies of women having elective first cesareans may be at greater risk of **neonatal death** compared with low-risk women planning vaginal birth, but the excess number of deaths cannot be calculated from the study examined.*

A national U.S. study of 8 million women at “no indicated risk” for cesarean (singleton, term, vertex, no medical risk factors reported on the birth certificate, no prior cesarean) compared neonatal mortality rates between women having planned cesarean delivery and women planning vaginal birth among whom 8% had cesareans during labor.⁴⁵ Investigators adjusted for birth weight, gestational age, maternal age, race or ethnicity, parity, education, and smoking. They further excluded all infants with congenital anomalies because this could affect both choice of birth route and mortality risk and all infants with Apgar scores less than 4 as a proxy for fetal distress, which, as with anomalies, could affect both mode of birth and mortality. Nevertheless, the risk of neonatal death was 70% greater with planned cesarean than with planned vaginal birth.

Respiratory problems

Elective cesarean delivery is associated with increased risk of newborn breathing complications compared with vaginal birth or cesarean during labor; however, the magnitude of the risk decreases as gestational age advances past 37 weeks.

- **Respiratory Distress Syndrome**

*When birth occurs before 39 weeks, more babies born by cesarean than by vaginal birth experience **respiratory distress syndrome (RDS)**, but the excess number cannot be calculated from the studies examined.*

A systematic review without meta-analysis analyzed nine studies comparing respiratory complications after elective cesarean versus after vaginal or planned vaginal birth at or near full term.⁴⁶ Four studies evaluated RDS (oxygen supplementation longer than 24 h plus x-ray findings typical of RDS). Two of the four reported a statistically significant increase, and a third reported an increase that did not achieve statistical significance. The fourth study was small and had too few cases to perform a statistical analysis. Rates ranged from 20 to 70 per 10,000 with elective cesarean vs. 10 to 20 per 10,000 with vaginal or planned vaginal birth; however, intra-study differences were not reported, which prevents calculation of absolute differences. The association disappeared after 39 weeks' gestation.

- **Pulmonary hypertension**

*Limited evidence suggests that a **MODERATE** excess number of babies delivered by elective cesarean may develop **pulmonary hypertension**.*

One study included in the systematic review evaluated pulmonary hypertension (continued fetal circulation requiring 100% oxygen supplementation to maintain adequate oxygenation).⁴⁶ It reported an excess of 29 cases per 10,000 with elective cesarean compared with vaginal birth.

Not breastfeeding

*Conflicting evidence suggests that babies delivered by cesarean may be at excess risk of **not being breastfed**.*

A systematic review examined the association between breastfeeding and cesarean delivery versus vaginal birth and found that prelabor cesarean negatively affected early breastfeeding rates (any initiation or breastfeeding at hospital discharge), but cesareans during labor did not.⁴⁷ Only two of its component 53 studies, however, controlled for breastfeeding intent, an important potential confounding factor. Both of the studies adjusting for breastfeeding intent were conducted in England. One of the two studies was of first-time mothers and reported a statistically significant reduction in breastfeeding at hospital discharge among women delivered by cesarean, 28 of whom had planned cesareans and 72 had cesareans in labor. The other compared women having instrumental vaginal deliveries with women having cesarean delivery during the pushing phase of labor. It found a reduction in breastfeeding rates in the cesarean group that did not achieve statistical significance.

3. What role may cesarean delivery play in the development of childhood chronic disease?

Autoimmune diseases

Children delivered by cesarean are more likely to develop autoimmune diseases, including asthma, Type 1 diabetes, and allergies. Investigators have theories as to why this may be so. One is that differences in gut flora, which mediate immune intolerance, explain the excess.⁴⁸⁻⁵² Babies delivered by cesarean are not exposed to vaginal bacteria, and their mothers are usually given prophylactic peripartum antibiotics to reduce risk of infection. Antibiotics cross the placenta and are found in breast milk, thereby also affecting gut flora colonization. Another theory is that cesarean-born infants are more prone to *transient tachypnea of the newborn* (abnormally rapid breathing) and RDS, both of which are associated with increased risk of asthma.⁴⁸

- **Asthma**

Cesarean delivery increases the likelihood of developing asthma in childhood, but the excess number cannot be calculated from the studies examined.

Two systematic reviews published in the same year report on the relationship between mode of birth and asthma. Included studies largely overlapped, but differences in which outcomes reviewers chose to report make it worthwhile to summarize both. Pooling data from 23 studies, one review reported that birth by cesarean increased the odds of developing asthma by 20%; however, studies were significantly heterogeneous.⁵³ Restricting analysis to studies ascertaining asthma onset before age 18 reduced heterogeneity without altering excess risk. Reviewers could not adjust for confounding factors but observed that studies that adjusted for breastfeeding (2 studies) and for maternal smoking (6 studies) did not find that this reduced the effect of cesarean delivery, nor did the “majority” of studies that adjusted for low birth weight (7 studies). The other review, which pooled data from 26 studies, also reported a 20% increase in odds of asthma with cesarean delivery (13 studies), which would be expected given the overlap.⁴⁸ The review also found a 20% increased likelihood of hospitalization for asthma (7 studies).

- **Type 1 diabetes**

Cesarean delivery increases the likelihood of developing Type 1 diabetes in childhood, but the excess number cannot be calculated from the studies examined.

A systematic review of 20 studies found that cesarean conferred a 20% increase in the likelihood of developing Type 1 diabetes in childhood compared with control populations.⁴⁹ Adjustment for potential confounders (gestational age, birth weight, maternal age, birth order, breastfeeding, maternal diabetes) did not affect the relationship.

- **Allergic rhinitis**

Cesarean delivery increases the likelihood of developing childhood allergic rhinitis, but the excess number cannot be calculated from the studies examined.

A systematic review of 7 studies reported a 23% to 24% increased likelihood of allergic rhinitis with cesarean delivery, depending on the statistical technique used to pool data.⁴⁸

- **Symptomatic food allergy**

*Limited and conflicting evidence suggests that cesarean delivery may increase the likelihood of developing **food allergy in childhood**, but the excess number, if any, cannot be calculated from the studies examined.*

A systematic review identified only two studies of development of symptomatic food allergy according to mode of birth.⁵² One study reported no difference according to mode of birth but did not adjust estimates for confounding factors. The other, adjusting for factors such as birth weight, preeclampsia, restricted fetal growth, maternal smoking, and maternal education, found that parent-reported food allergy was three times more prevalent by age two in children delivered by cesarean. Stratification according to whether the child's mother had allergies revealed that the adverse effect of cesarean delivery was confined to children of allergic mothers. Reviewers further note that parent report of food allergy is likely to overestimate its prevalence.

Obesity

As with autoimmune diseases, differences in gut flora in infants delivered by cesarean provide a plausible explanation for the possibility of increased risk of subsequent obesity.⁵⁴ Other effects of mode of birth on inflammation, immune, or endocrine function independent of intestinal colonization might also influence future obesity.⁵⁴

*Limited evidence suggests that a **LARGE** excess number of children delivered by cesarean may be **obese at age 3**.*

A study adjusting for maternal age, education, race/ethnicity, child's age and sex, maternal prepregnancy body mass index (BMI), and birth weight reported that 820 more children per 10,000 delivered by cesarean were obese at age 3.⁵⁴ (Household income, paternal BMI, maternal smoking, pregnancy weight gain, birth order, maternal glucose tolerance during pregnancy, child's gestational age at birth, initiation and duration of breastfeeding, timing of solid food introduction, energy intake and television viewing at age 2, and height at age 3 did not change effect estimates and were not included in the adjusted model.) When analysis was stratified according to maternal prepregnant BMI, children of women with BMI less than 25 kg/m² were at triple the risk of obesity whereas children of women with BMI of 25 kg/m² or more were only at a 60% increased risk, which further supports that high maternal BMI, which is associated with increased likelihood of cesarean delivery and increased likelihood of high BMI children, was not the mediating factor.

4. What complications are unique to cesarean delivery?

Certain complications are unique to surgical delivery; thus vaginal birth eliminates the risk of their occurrence.

Operative maternal injury

*Among women having first delivery via cesarean, a **MODERATE** number of women experience bladder puncture, and a **SMALL** number experience **bowel injury or injury to a ureter**.*

Three cohort analyses report on operative injury during primary cesarean.⁵⁵⁻⁵⁷ Cumulative incidence rates are 11 per 10,000 for bladder puncture, 9 per 10,000 for bowel injury, and 4 per 10,000 for ureteral injury. Injury rates would be lower with planned cesarean delivery than with cesarean during labor.

Surgical cuts to the baby

Limited evidence suggests that a MODERATE number of babies are cut during cesarean delivery.

A large case series (272 cases) reported rates of surgical cuts of 40 per 10,000 with planned cesarean versus 70 per 10,000 among cesareans overall.⁵⁸ This study did not report on seriousness of injury, but other, smaller studies reported that some infants required suturing or wound closure with staples.^{59, 60} Injury rates would likely be lower with planned cesarean delivery than with cesarean during labor.

Re-operation

Limited evidence suggests that a MODERATE number of women having cesarean delivery require re-operation.

A study reported that 53 per 10,000 women having cesarean delivery required re-operation for hemorrhage, protrusion of the intestines through the abdominal wound, or intra-abdominal abscess.⁶¹

Persistent pain at the site of the cesarean incision:

Limited evidence suggests that a LARGE to VERY LARGE number of women still experience pain at the incision site 6-10 months or more after cesarean delivery.

A survey of U.S. women revealed that among women having cesarean delivery, 1800 per 10,000 reported pain at the site of the cesarean incision lasting 6 months or more.⁴³ Among women with cesareans who responded to the survey 10 months or more after delivery, 600 per 10,000 reported continuing pain at the incision site. A survey of Australian women reported that among women having cesarean delivery, incision pain was reported “occasionally” or “often” by 1900 per 10,000 at 6 months postpartum, 700 per 10,000 at 12 months postpartum, and 600 per 10,000 at 18 months postpartum.⁴²

Cesarean scar endometriosis

Cesarean scar endometriosis is a painful condition caused by iatrogenic seeding of endometrial cells into the abdominal wall or uterine wound during surgery. It is also called *cesarean scar endometrioma* to indicate that it is a defined mass.

Limited evidence suggests that a SMALL to LARGE number of women having cesarean delivery develop cesarean scar endometriomas.

A systematic review of case series of five or more cases of abdominal wall endometriomas reported that 57% of cases were associated with cesarean scars.⁶² Only 13% of women with abdominal wall endometriomas had a history of or subsequently diagnosed pelvic endometriosis, the same as the background population, which suggests that scar-related endometriomas are a de novo phenomenon arising from the surgical procedure. This complication has serious consequences. For almost all women, pain was a presenting symptom, and the treatment of choice is wide excision of the tumor sometimes requiring abdominal wall reconstruction. The incidence after cesarean delivery ranged from 3 to 100 per 10,000, but there is a high probability that true rates of cesarean scar endometrioma are higher. The case series were of surgically treated cases, which would limit them to women who seek and obtain treatment for severe symptoms. The review also reported a 4.3% recurrence rate.

Cesarean scar ectopic pregnancy/early placenta accreta

Either the embryo (ectopic pregnancy) or the placenta (early placenta accreta) may implant within the uterine scar. These complications are fatal to the embryo and life-threatening for the woman.

Some women becoming pregnant after cesarean will experience a cesarean scar ectopic pregnancy or placental implantation within the uterine scar, but the number cannot be calculated from the studies examined.

A systematic review of the literature on early placenta accreta and cesarean scar ectopic pregnancy asserts that most placenta accretas are a manifestation of the same underlying pathology as cesarean scar ectopic pregnancy, i.e., implantation within the prior cesarean scar.⁶³ Among 47 cases of placenta accreta detected and treated before the third trimester, 79% required hysterectomies. Among 751 cases of cesarean scar ectopic pregnancy, 5% ended in hysterectomy. Reviewers believe that cesarean scar pregnancy is underreported. Based on frequency estimates, they estimate that there should have been 557-696 cases in 2007 in the U.S. alone, but their review of the U.S. literature published in the last 20 years only identified 44 cases.

Dense intra-abdominal adhesions

Dense adhesions (internal scar tissue) make any future pelvic surgery more difficult and more likely to result in operative injury and may cause chronic pain and in rare cases, bowel obstruction.

Limited evidence suggests that a VERY LARGE number of women develop dense adhesions after cesarean delivery.

Data come from a study evaluating adhesions at second cesarean according to whether the parietal peritoneum was sutured closed at the initial cesarean or left open (the more usual practice).⁶⁴ Overall, 3900 per 10,000 women had dense adhesions, 3000 per 10,000 with peritoneal closure, and 4500 per 10,000 without.

5. What complications are unique to vaginal birth?

The complications unique to vaginal birth are perineal and genital trauma and consequent persistent local pain. The greatest concern is anal sphincter laceration because it increases the likelihood of experiencing perineal pain in the short term and continued pain up to six weeks after the birth, and it predisposes to fecal incontinence.^{65, 66}

The proportion of women experiencing trauma at vaginal birth depends on modifiable factors, including whether they have an instrumental vaginal delivery, whether the instrument is a vacuum extractor or forceps, whether *fundal pressure* (pressing on the woman's abdomen) is applied to help expel the baby, whether they have an episiotomy, whether the episiotomy is median or mediolateral (median episiotomy, commonly used in the United States and Canada, predisposes to anal sphincter laceration; mediolateral much less so or not at all), their pushing position at birth, and whether the woman pushes forcefully when delivering the head.⁶⁷

Perineal and genital trauma

A LARGE number of women experience anal sphincter injury with optimal care at vaginal birth.

A VERY LARGE number of women experience trauma to the perineum or genitals at vaginal birth that requires suturing.

No systematic review was identified to estimate overall incidence of genital tract trauma in vaginal birth. Because episiotomy and instrumental vaginal delivery markedly increase genital tract trauma, a study was identified that reported very low rates of these interventions in order to estimate the incidence attributable to vaginal birth itself. The study was a single-center U.S. randomized controlled trial of perineal management at birth in 1202 women having vaginal birth attended by experienced midwives. It reported that 110 women per 10,000 experienced an anal laceration, and excluding episiotomy, 1960 women per 10,000 had genital or perineal trauma that required suturing.³³ Overall, 1.3% had instrumental vaginal delivery and 0.8% had an episiotomy. No episiotomy extended into the anal sphincter.

Persistent perineal pain

Limited evidence suggests that a LARGE number of women experience persistent perineal pain lasting at least six months with spontaneous vaginal birth, and a VERY LARGE number of women experience perineal pain lasting at least six months after instrumental vaginal delivery.

A U.S. survey reported that 100 women per 10,000 reported perineal pain 6 months or more after spontaneous vaginal birth, and 1700 women per 10,000 women reported pain as a problem persisting 6 months or more after instrumental vaginal delivery.⁴³

6. What are potential psychosocial consequences of cesareans?

Postpartum psychological morbidities such as depressive mood or posttraumatic distress symptoms not only can have profound adverse effects on women, impairing their functioning at home and work and increasing their risk of suicide, but also can have adverse impact on both caretaking and responsiveness to their children, resulting in behavioral and emotional problems in the child, and their relationship with their intimate partner.^{68, 69} It is difficult, however, to determine the degree to which psychological morbidity relates to mode of birth because of weaknesses and limitations of the research. These include small sample sizes, possible selection biases (who agrees to participate, who drops out), lack of prospective assessment, and inadequate and diverse

assessment measures.⁶⁸⁻⁷¹ Studies may also fail to control for confounding factors.^{69, 70} These include negative or traumatic experience in prior pregnancy and delivery, complications such as preterm birth that predispose both to cesarean delivery and to maternal psychological morbidity, and labor management factors such as instrumental vaginal delivery or labor induction, which also predispose to adverse psychological outcome. In addition, timing of data collection can influence outcomes.⁶⁹ With the passage of time, a positive experience of motherhood may soften a negative perception of the childbirth experience, or societal pressure to view cesarean delivery to a healthy baby positively may make it difficult for women to acknowledge negative feelings.

Adverse effect on maternal-child relationship

Data conflict about whether cesarean delivery has an adverse effect on the mother-child relationship.

According to a systematic review, some studies reported that women delivering by cesarean evaluated their children less favorably than women having vaginal birth, and one study found that they exhibited less tactile stimulation, caretaking, and intimate play in the first five months.⁶⁹ Other studies included in the review, however, found no effect on mother-child interaction.

Depression

Data conflict on whether cesarean delivery increases the likelihood of postpartum depression.

A systematic review of studies evaluating the link between postpartum depression and cesarean delivery reported disagreement about its effects.⁷⁰ Studies made their evaluation between 10 days and 1 year after birth. Among 24 studies, 5 reported a statistically significant adverse association, 15 reported no significant association, and 4 reported mixed results, meaning results were adverse or neutral depending on which measure was used and when depression was assessed. Eight studies were sufficiently homogenous (all used the Edinburgh Postnatal Depression Scale and were conducted within 6 to 20 weeks after birth) that their data could be pooled in a meta-analysis. This resulted in an 8% increased likelihood of depression after cesarean delivery compared with vaginal birth that did not achieve statistical significance. Four of the studies were stronger than the others by virtue of large sample size; prospective assessment; use of a standardized, generally accepted measure; and control of at least some confounding factors. Meta-analysis of these four strengthened the association to a 15% near-significant increased likelihood of depression after cesarean delivery. The review did not distinguish between instrumental and spontaneous vaginal birth or between planned versus unplanned cesarean, which is likely to confound results, and one of the larger studies was a randomized controlled trial of breech birth. The specialized concerns around breech presentation and the high rate of instrumental vaginal delivery with a breech presentation raise doubts as to whether results can be generalized to women with head-down babies.

Posttraumatic distress

Data conflict but suggest that more women may experience PTSD or PTSD symptoms after cesarean delivery in general and unplanned cesareans in particular, but the excess number, if any, cannot be calculated from the studies examined.

A systematic review of studies published between 1977 and 2003 assessed prevalence and risk factors for childbirth-related posttraumatic stress symptoms.⁷¹ Only four studies, all conducted by the same group, specifically evaluated the impact of cesarean delivery on posttraumatic stress symptoms. While an association was found, reviewers noted the small size of these studies as a limitation. In addition, two other studies included in the review reported an association between posttraumatic distress and, respectively, “level of obstetric interventions” and unplanned cesarean. Posttraumatic distress symptoms were also associated with instrumental vaginal delivery, which would be a confounding factor in studies that did not distinguish between modes of vaginal birth.

A subsequent systematic review that explicitly built on the earlier one included studies published after the earlier review through October 2010.⁶⁸ Study heterogeneity did not permit meta-analysis, but reviewers addressed this problem by developing a quality rating system that weighted included studies according to bias and reliability of results. Risk factors significantly associated with PTSD were then given a point score based on the ranking of the study reporting them. Factors reported as not associated or not achieving a statistically significant association were given negative points. Reviewers clustered risk factors where individual concepts or events were similar or would be perceived as such by study participants. The top rated factors were “subjective distress in labor” (54 points) followed by “obstetrical emergencies” (47 points), a category that included “emergency” cesarean (20 points) and instrumental vaginal delivery (26 points). (*Note:* “Emergency cesarean” is usually used in the obstetric literature merely to mean an unplanned “cesarean during labor,” as opposed to planned or elective cesarean, and cannot be assumed to connote urgent cesarean.) Twelve studies reported on “emergency” cesarean of which nine reported a positive association with PTSD or PTSD symptoms. Eight studies reported on “elective cesarean” (7 points) of which five found an association with PTSD.

7. What are potential effects of cesareans on women in future pregnancies and births?

The consequences of cesarean delivery for future pregnancies and births must be taken into account when considering the first cesarean regardless of the woman’s plans for future children because many women who do not plan to have more children change their minds or decide to continue with unplanned pregnancies. One-third of U.S. women have three or more children.⁷² Cesarean at the first delivery increases the risk of complications in future childbearing, some of which, as noted below, increase in likelihood as the number of cesarean surgeries goes up. The increasing risk of serious complications with accumulating cesarean surgeries is a crucial concern because many women have limited or no access to planned VBAC in the United States.

Reduced fertility

Lower fertility rates may be involuntary (difficulty conceiving again) or voluntary (choosing not to conceive again). Prior cesarean delivery appears to be associated with both.

- **Impaired fertility**

More women experience impaired fertility after prior cesarean delivery compared with after prior vaginal birth, but the excess number cannot be calculated from the studies examined.

A systematic review reports on two studies, one finding fewer pregnancies with prior cesarean than with prior instrumental vaginal delivery and the other finding increased likelihood of conception taking more than one year with prior cesarean compared with prior vaginal birth. Both studies adjusted for confounding factors including parity and age.⁷³

- **Voluntary infertility**

A LARGE to VERY LARGE excess number of women choose not to conceive again after cesarean delivery.

Three studies provide evidence for voluntary infertility. One surveyed women three years after either cesarean delivery during the pushing phase of labor or instrumental vaginal delivery and found that 900 more women per 10,000 having cesarean delivery cited fear of childbirth as the reason why they had not had further children.⁷⁴ A second study investigating why women had not had a second child reported that more women with a first cesarean “found aspects of the birth particularly distressing” than women with first spontaneous vaginal birth (42% versus 36%), but distress was related to whether the cesarean was planned or during labor (31% versus 45%).⁷⁵ Compared with women having first spontaneous vaginal birth, women with first cesarean were more likely to give the following as reasons for voluntary infertility: that they were “unwilling to experience pregnancy/childbirth again” (38% versus 16%), “relationship with child” (13% versus 9%), “recovery period in hospital and at home” (67% versus 37%), and “initial bonding with child” (33% versus 21%). The third study looked at the effect of mode of birth at first birth according to whether the baby was alive or was stillborn or died before one year. If the first baby lived, 920 per 10,000 fewer women had a second child if the first delivery was cesarean compared with a first vaginal birth, but if the first baby died, the same number of women had a second child regardless of mode of first birth.⁷⁶ Furthermore, if an initial cesarean was followed by a VBAC, a similar percentage of women went on to have a third child (4000 per 10,000) as those whose first two births were vaginal (3200 per 10,000), but if the first two deliveries were cesareans, only 1900 per 10,000 women had a third child.

Problems with placental attachment

A woman with a prior cesarean is more likely than a woman with an unscarred uterus to have *placenta previa* (placenta overlays the cervix partially or completely), *placenta accreta* (the placenta grows into or even through the uterine muscle), or *placental abruption* (placenta detaches partially or completely before the birth) in the next pregnancy. Placenta previa, placenta accreta, and placental abruption increase the likelihood of severe maternal morbidity, including severe hemorrhage, hysterectomy, injury to other organs or blood vessels during urgent cesarean delivery, abnormal clotting, clots in the deep veins of the legs, or fluid in the lungs, and they increase the likelihood of preterm birth and therefore its consequences, all of which put women and their babies at increased risk of death.^{55, 73, 77-81} The likelihood of placenta previa and placenta accreta rises with increasing numbers of prior cesareans, but the likelihood of placental abruption does not.⁷³

- **Placenta previa**

A SMALL excess number of women with first delivery by cesarean develop placenta previa in the next pregnancy, but the excess number cannot be calculated from the studies examined. A LARGE excess number of women develop placenta previa after two or more prior cesareans.

Investigators conducted a systematic review of 37 studies evaluating the risk of placenta previa with first vaginal birth compared with first delivery via cesarean.⁸² The review included seven studies looking only at the next pregnancy. Among these seven studies, prior cesarean was associated with a 50% increase in placenta previa; however, investigators did not report sufficient details to determine whether those studies adjusted for factors in the first pregnancy likely both to lead to cesarean delivery and to recur in the next pregnancy. The investigators also included results from their own study, which adjusted for multiple factors associated with an increased risk of placenta previa, including placenta previa in the first pregnancy, and reported a 60% increase in risk. This suggests that failure to adjust for confounding factors among the reviewed studies had little effect on the finding of increased risk.

A different systematic review of eight studies examined the risk of placenta previa with increasing numbers of prior cesareans.⁷³ Reviewers reported a rate of 90 per 10,000 with one prior cesarean, 170 per 10,000 with two prior cesareans, 260 per 10,000 with two or more prior cesareans, and 300 per 10,000 with three or more prior cesareans. The likelihood of placenta previa resulting in hysterectomy also rose with the number of prior cesareans.

- **Placenta accreta**

*A SMALL excess number of women with first delivery via cesarean develop **placenta accreta** in the next pregnancy. A LARGE excess number of women develop placenta accreta after multiple prior cesareans.*

A study found that 3 per 10,000 women with first birth vaginal experienced placenta accreta in the next pregnancy compared with 6 per 10,000 with first delivery via cesarean.⁸³ A systematic review of four studies provides information about accumulating risk as the number of cesareans rises. The review reported a rate of 30 to 60 per 10,000 with one prior cesarean, 57 per 10,000 with two prior cesareans, 1400 per 10,000 with two or more prior cesareans, 213 with three prior cesareans, 233 per 10,000 with four prior cesareans, 470 with four or more prior cesareans, and 674 with five or more prior cesareans.⁷³

- **Placental abruption**

*A MODERATE excess number of women with first delivery via cesarean have a **placental abruption** in subsequent pregnancies.*

Three studies reported on placental abruption rates in the next pregnancy with first delivery via cesarean compared with first birth vaginal. Excesses with first delivery via cesarean varied from 20 to 36 per 10,000.⁸³⁻⁸⁵ A systematic review of six studies provides information about accumulating risk as the number of cesareans rises. The review reported that, unlike placenta previa and placenta accreta, incidence of placental abruption did not increase with increasing numbers of cesareans.⁷³

Hysterectomy

*A MODERATE excess number of women with prior cesarean delivery require an **urgent hysterectomy during the next delivery admission** compared with women with only prior vaginal birth. Limited evidence suggests that the excess increases with subsequent pregnancies.*

Seven studies of varying designs all agree that prior cesarean increases the risk of urgent hysterectomy during a subsequent delivery admission. Three studies analyzed population-based hysterectomy rates, finding that 13 to 85 more women per 10,000 with prior cesarean had an unplanned hysterectomy than women with only prior vaginal birth.^{26, 86, 87} Two analyses reported on prevalence of prior cesarean among women having hysterectomies at an individual hospital, finding that 64% of women having hysterectomy around the time of birth had prior cesareans at one hospital and 79% at the other.^{88, 89} Two studies compared women having childbirth-related hysterectomies with control women and found that cases were much more likely to have had prior cesareans: 66% versus 30% in one study and 52% versus 15% in the other.^{80, 90} A systematic review noted that two studies suggested that the likelihood of hysterectomy increased with multiple cesareans but that a dose-dependent relationship could not be established.⁷³ In one of the studies, the rate was 42 per 10,000 after two cesareans versus 900 per 10,000 after six or more.

Uterine rupture

Uterine rupture is more common in women with prior cesarean delivery. Rates in subsequent pregnancy in women with prior cesarean delivery will depend on the proportion of the population who plan VBAC and may be modified by management during the prior cesarean delivery (single-versus double-layer uterine closure⁷³) and the VBAC labor (oxytocin use for induction or labor augmentation⁷³). Differences in rates between women with prior cesarean and women without prior cesarean also will be affected by labor management practices in women with only prior vaginal births (use of oxytocin and other agents for induction).

Planned repeat cesarean does not eliminate the possibility of uterine rupture. A systematic review reported a uterine rupture rate with planned repeat cesarean of 3 per 10,000.⁷³ Moreover, some uterine ruptures cannot be averted by planning repeat cesarean because they occur in the first or second trimester as a result of the embryo or placenta implanting within the cesarean scar.⁶³ (See above.)

A MODERATE excess number of women will experience uterine rupture with prior cesarean delivery compared with prior vaginal birth.

A study compared uterine rupture rates in the next pregnancy with first delivery via cesarean versus first vaginal birth and found that 19 more women per 10,000 experienced uterine rupture with first delivery cesarean.⁸³ A second study reported uterine rupture rates in women with prior cesarean or cesareans versus only vaginal births and found that 25 more women per 10,000 experienced uterine rupture with prior cesarean delivery.⁹¹ Neither study reported what proportion of women with prior cesarean planned VBACs or what percentage of VBAC labors resulted in scar rupture.

Intensive care admission

Limited evidence suggests that a LARGE excess number of women with prior cesarean are admitted to intensive care at the next delivery compared with women with prior vaginal birth.

A study compared outcomes in women with prior vaginal birth with outcomes in women with prior cesarean delivery.⁹² Among women with prior cesarean, 21% planned VBAC in the current pregnancy, of whom 80% had a vaginal birth. The study found that 120 more women per 10,000 with prior cesarean were admitted to intensive care. Controlling for maternal Type 1 and Type 2 diabetes and hypertension did not affect results.

Hospital readmission

*Limited evidence suggests that a MODERATE excess number of women with prior cesarean are **readmitted to the hospital after discharge at the next delivery** compared with women with prior vaginal birth.*

The same study as immediately above found that 40 more women per 10,000 with prior cesarean were readmitted to the hospital after discharge at their next delivery compared with women with prior vaginal birth.⁹²

What about maternal death in a next pregnancy?

We were unable to find an eligible study comparing maternal mortality rates with prior cesarean compared with prior vaginal birth, and, moreover, validity of such a study would depend on controlling for complications in the first pregnancy that might lead to cesarean and also increase risk of death in subsequent pregnancies. However, prior cesarean increases the likelihood of several life-threatening complications in subsequent pregnancies. These include placental attachment complications, uterine rupture, and ectopic pregnancy.

In addition, repeat cesarean delivery, the norm in the United States where many women have limited or no access to planned VBAC, is associated with a small risk of mortality, which is thus indirectly related to the prior cesarean. Analysis of a large U.S. cohort reported a maternal death rate with true elective repeat cesarean, that is, repeat cesarean delivery with no medical indication, of 2.8 per 10,000 women with prior cesarean.⁹³ The background U.S. maternal mortality rate in recent decades has varied from 0.7 to 1.2 per 10,000,⁷³ which calculates to 2.1 to 1.6 more women per 10,000 dying of causes directly related to repeat surgery.

8. What are potential effects of a scarred uterus on future babies?

Most studies that have attempted to control for maternal and fetal health problems potentially leading both to cesarean and to repeating in a subsequent pregnancy still report an association between adverse perinatal outcomes in the next pregnancy and prior cesarean delivery compared with prior vaginal birth. One explanation is the increased risk of abnormal placental attachment (summarized above), but other possibilities are that a scarred uterus may not provide oxygen and nutrients to the developing fetus as effectively compared with a fetus developing in an unscarred uterus or that maternal major blood vessels serving the uterus may have been cut either intentionally or accidentally during the first cesarean, which could affect placental perfusion in future pregnancies.^{94, 95}

Death

The preponderance of evidence suggests that a baby who develops in a uterus with a cesarean scar has an increased risk of dying before birth or during labor (*stillbirth*) compared with a baby who develops in an unscarred uterus. The evidence for an effect on deaths during the time period before and shortly after birth (*perinatal deaths*) is much weaker, but suggests a possible effect as well. The excess number of stillbirths and perinatal deaths may be greater than appears because some studies excluded women with life-threatening complications that are more common with prior cesarean such as placenta previa, placenta accreta, and placental abruption. (See above for relationship between placental complications and prior cesarean.)

- **Stillbirth**

Data conflict, but suggest that a SMALL to MODERATE excess number of babies developing in a uterus with a cesarean scar are stillborn.

Ten studies have evaluated stillbirth rates in women with a prior cesarean versus women with no prior cesarean: one in Scotland,⁹⁵ two in different states in Australia,^{96, 97} one in England,⁹⁸ one in Germany,⁹⁹ one in Canada,¹⁰⁰ and four in the U.S. Of the studies in the U.S., one used national data,¹⁰¹ one used Missouri state data,¹⁰² another was conducted in a single Massachusetts hospital,¹⁰³ and the fourth used data from a consortium of hospitals.¹⁰⁴

Studies varied in whether they reported on antepartum demise alone or whether stillbirth also encompassed deaths during labor. This could affect results because prior cesarean could lead to intrapartum death consequent to scar rupture during VBAC labor. Studies also varied in what confounding factors they controlled for that might lead both to cesarean delivery in the preceding pregnancy and increased risk of stillbirth in succeeding pregnancies. Some factors were demographic and social (e.g., maternal age, BMI, social class, tobacco use), some related to adverse obstetric history (e.g., prior preterm birth, small-for-gestational-age infant, or stillbirth), and some were chronic health problems (e.g., hypertension, cardiac disease, renal disease).

Eight of the ten studies reported an excess of stillbirths in women with a prior cesarean in the population overall,^{95-100, 103, 104} and a ninth, from Missouri, reported an excess among black women but not white women.¹⁰² Six of the studies finding excess stillbirths reported that the difference was statistically significant (unlikely to be due to chance).^{95, 96, 99, 102-104} In two of the three studies not finding a statistically significant excess,^{98, 100} the number of women having a primary cesarean was too small to detect a difference reliably, and the third did not perform a statistical analysis.⁹⁷ Among the eight studies allowing calculation of excess rates with prior cesarean, rates ranged from 5 more stillbirths per 10,000 to 25 more per 10,000. The ninth study reported a 30% increase in risk.¹⁰⁴ The tenth study, a national study from the U.S., reported no difference in women with one prior birth, no underlying medical conditions (not specified), and a fetus with no structural or chromosomal abnormalities; however, the authors of the study from a consortium of U.S. hospitals speculate that the national study may have differed from their study because of underreporting or misclassification, both of which are known problems in vital statistics databases.¹⁰⁴ The study also, unlike any of the others, was confined to stillbirth in term pregnancies.

- **Perinatal or neonatal death**

Data conflict, but suggest that more babies developing in a uterus with a cesarean scar may die late in pregnancy or during the first week after birth, but the excess number, if any, cannot be calculated from the studies examined.

The data on the effect of first cesarean on *perinatal death* (stillbirth plus early neonatal death) are much weaker than those for stillbirth but do not rule out an effect. Five studies reported on perinatal death with prior cesarean versus prior vaginal birth. Among the studies reporting on stillbirth, the German study reported a significant increase: 18 more women per 10,000 with prior cesarean compared with prior vaginal birth.⁹⁹ Differences in perinatal mortality rates can be calculated from data in the Australian studies: 9 per 10,000 more women with prior cesarean in New South Wales and 14 per 10,000 in South Australia,^{96, 97} but we do not know whether these differences would achieve statistical significance or the degree to which adjusting for correlating factors would affect them. In addition, a Swedish study reported 20 more perinatal deaths per 10,000 in the next pregnancy with first delivery cesarean compared with first birth vaginal after adjustment for maternal age, smoking, height, BMI, multiple birth, preterm birth (< 37 w), breech presentation, and birth weight, a difference that just missed achieving statistical significance.¹⁰⁵ By contrast, a Finnish study reported an excess of 5 more perinatal deaths per 10,000 with prior vaginal birth that was not significant.¹⁰⁶ Finally, a study using U.S. national data reports on *neonatal deaths* (death of a live birth within 28 d).⁹⁴ Among healthy women without a previous preterm birth or SGA infant, neonatal deaths from all causes did not differ significantly according to mode of prior birth, but asphyxia-related deaths did: 0.8 more per 10,000 with prior cesarean. Investigators explain that this could be because women are more likely to have placental dysfunction with prior cesarean. (See above summary of problems with placental attachment.)

Preterm birth and low birth weight

Preterm birth and low birth weight (less than 2500 grams) are necessarily intertwined because babies born early will weigh less. Preterm birth puts babies at risk for experiencing its associated serious and life-threatening complications such as respiratory distress syndrome, *necrotizing enterocolitis* (death of portions of the baby's intestines), seizure, or bleeding within the brain.⁷⁹

Data conflict on whether prior cesarean delivery imposes increased risk of preterm birth and concomitant low birth weight.

Among the four studies that control or adjust for preterm birth in the prior pregnancy, one reports a statistically significant excess of preterm births with prior cesarean (69 more per 10,000);⁹⁷ one reports a 15% increase in deliveries between 33 and 36 weeks with prior cesarean, but data do not permit calculation of the excess;⁹⁵ one reports a nonsignificant excess with prior cesarean (12 more per 10,000);¹⁰⁶ and one reports a nonsignificant excess with prior vaginal birth (24 more per 10,000).⁹⁴ The study reporting a nonsignificant excess of preterm birth with prior cesarean also reports a nonsignificant excess of low-birth-weight babies (18 more per 10,000).¹⁰⁶

Small for gestational age (SGA)

*Data conflict on whether prior cesarean delivery imposes increased risk of **SGA** in the next pregnancy compared with prior vaginal birth.*

Of the four studies that controlled or adjusted for SGA in the prior pregnancy, one reports a significant excess with prior cesarean (116 more per 10,000);⁸³ one reports a 15% increase with prior cesarean, but data do not permit calculation of the excess;⁹⁵ one reports a nonsignificant excess in women with prior vaginal birth (74 more per 10,000);⁹⁴ and the fourth also reports a nonsignificant excess in women with prior vaginal birth (20 more per 10,000).⁹⁷

Need for ventilation at birth

*Limited evidence suggests that a **LARGE** excess number of babies whose mothers had prior cesarean may require **ventilation at birth** compared with babies whose mothers had prior vaginal birth.*

A study compared neonatal outcomes in women with prior vaginal birth with outcomes in women with prior cesarean delivery.⁹² Among women with prior cesarean, 21% planned VBAC in the current pregnancy, of whom 80% had a vaginal birth. The study found that 100 more newborns per 10,000 whose mothers had prior cesarean required ventilation at birth. Controlling for maternal Type 1 and Type 2 diabetes or hypertension did not affect results.

Hospital stay longer than 7 days

*Limited evidence suggests that a **LARGE** excess number of babies whose mothers had prior cesarean have **hospital stays of more than 7 days** compared with babies whose mothers had prior vaginal birth.*

The same study as the one immediately above found that 140 more newborns per 10,000 whose mothers had prior cesarean had hospital stays of more than 7 days.⁹²

9. Does cesarean delivery protect against sexual, bowel, urinary, or pelvic floor dysfunction?

Sexual dysfunction

Studies of sexual dysfunction may not take into account modifiable confounding factors associated with vaginal birth that can affect perineal and vaginal pain. These include instrumental vaginal delivery and whether the delivery is by vacuum extraction or forceps, episiotomy, and whether episiotomy is median, the usual type in the United States and Canada, or mediolateral, the usual type in most other countries. No study considers the effects of pushing position and technique, which could affect pelvic floor muscle tone (and therefore sexual satisfaction), or cesarean wound pain. Breastfeeding is also associated with painful intercourse,¹⁰⁷ a problem attributed to hormonal status during lactation, and cesarean delivery may be associated with decreased likelihood of breastfeeding. (See above.) Even so, studies show cesarean delivery confers little or no protection against sexual dysfunction.

*Cesarean delivery provides minimal or no protection against **sexual dysfunction**.*

A systematic review of studies of sexual function during pregnancy and after birth included data from studies reporting outcomes according to mode of birth.¹⁰⁷ Among these eight studies, five reported no protective effect for cesarean and three found a protective effect. Reviewers do not quantify results but describe the effect as small in one study, limited to the early recovery period in another, and state only that sexual function improved after planned cesarean delivery (compared with before delivery) in the third.

Bowel, bladder, and pelvic floor dysfunction

As with sexual dysfunction, the relationship between vaginal birth and bowel, bladder, and pelvic floor function is difficult to determine. Factors that increase likelihood of dysfunction include:

- use of episiotomy and whether episiotomy was median or mediolateral
- use of vacuum extraction or forceps to deliver the baby
- use of fundal pressure
- using caregiver-directed pushing, which is often more forceful than having the woman and her own reflexes guide pushing
- high maternal BMI
- smoking

In addition to avoiding the previous practices, engaging in exercises to strengthen the pelvic floor relieves or improves symptoms of pelvic floor dysfunction as does losing weight, making the use (or not) of ameliorative strategies such as these another confounding factor.^{108, 109}

No study has controlled for all factors relevant to pelvic floor strength, and some may not have controlled for any. None has compared women with optimally conducted vaginal birth to women with cesarean delivery. Even so, cesarean delivery offers no protection against *anal incontinence* (spontaneous leakage of solid or liquid fecal material, often including mucoid discharge, or gas) in the short or medium term or severe urinary incontinence, whether this be *stress incontinence* (incontinence associated with exercise, laughing, sneezing, or coughing) or *urge incontinence* (sudden need to void followed by involuntary loss). Studies disagree on whether cesarean delivery protects against urge incontinence of any degree. While it provides protection against urinary stress incontinence of any degree and pelvic floor prolapse, the degree to which vaginal birth per se, as opposed to specific vaginal birth practices, is responsible for excess incidence of these problems remains unclear.

• Anal incontinence

Cesarean delivery provides no protection against anal incontinence in either the short term or up to 12 years after birth; planned cesarean provides no protection compared with cesareans during labor.

A systematic review of 21 studies failed to find that cesarean delivery had a protective effect against anal incontinence.¹¹⁰ The same was true of the seven studies that assessed incontinence after four months postpartum, adjusted for maternal age, and categorized women as having only cesarean deliveries. Nor did rates differ between elective cesarean and cesarean during labor in the six studies making this comparison. A 12-year follow-up survey likewise found that neither exclusive cesarean delivery nor planned cesareans protected against fecal incontinence (involuntary loss of fecal material).¹¹¹

- **Urinary incontinence**

*Data conflict but suggest that cesarean delivery may provide some protection against urinary **urge incontinence** of any degree in the short term, but protective effect, if any, has disappeared by one year after birth, and similar percentages experience severe incontinence.*

*A **LARGE** to **VERY LARGE** excess number of women having vaginal birth experience urinary **stress incontinence** of any degree at one year or more after birth compared with women having cesarean delivery, but rates of severe incontinence are low and similar between cesarean and vaginal birth groups.*

A systematic review evaluated the relationship between mode of birth and urinary incontinence.¹¹² Data were analyzed according to whether the source study was a population analysis or a prospective cohort study, and results were pooled among study types. Reviewers used study investigators' definitions of severity.

With respect to urge incontinence, when results were pooled in the population studies (3 studies), rates were similar after cesarean delivery compared with vaginal birth for both urge incontinence of any degree (330 versus 360 per 10,000) and severe urge incontinence (40 per 10,000 versus 80 per 10,000). By contrast, when results were pooled in the cohort studies, at 3 months after birth 800 more women per 10,000 experienced urge incontinence of any degree (4 studies), but rates of severe incontinence were similar (80 versus 90 per 10,000). In the sole cohort study reporting rates at more than one year's follow-up, neither rates of urge incontinence overall (1900 per 10,000 versus 2100 per 10,000) nor rates of severe urge incontinence (650 per 10,000 versus 180 per 10,000) differed significantly. In the subset of elective cesareans, rates were higher than the total rate with cesarean delivery in the one population study and the two cohort studies reporting this outcome. While this is probably an artifact due to small numbers, it suggests that non-labor cesareans provide no additional protection.

With respect to stress incontinence, among the population studies, 620 more women per 10,000 experienced stress incontinence of any degree (4 studies) compared with vaginal birth, and 80 more women per 10,000 experienced severe stress incontinence (3 studies). Among cohort studies, 1200 more women per 10,000 with vaginal birth experienced stress incontinence of any degree (9 studies), but rates of severe incontinence were similar (150 per 10,000 versus 310 per 10,000) (4 studies). Among studies reporting rates at more than 1 year after birth, 1320 more women per 10,000 with vaginal birth were experiencing stress incontinence of any degree (3 studies), but as before, rates of severe incontinence were similar (170 per 10,000 versus 200 per 10,000) (2 studies). In the subset of elective cesareans, rates were higher than the total rate in the one population study reporting this outcome and similar in the five cohort studies reporting this outcome (870 per 10,000 versus 1000 per 10,000), again suggesting that non-labor cesarean provides no additional protection.

- **Symptomatic pelvic floor prolapse**

*A **LARGE** excess number of women having vaginal birth experience symptomatic **pelvic floor prolapse** compared with women having only cesarean delivery. The excess increases as the number of vaginal births increases and with instrumental vaginal delivery compared with spontaneous vaginal birth.*

Studies consistently find that cesarean delivery reduces incidence of symptomatic pelvic floor prolapse compared with vaginal birth. One study reported 100 more women per 10,000 younger than age 60 with vaginal births experienced symptomatic prolapse compared with women only having cesarean deliveries.¹¹³ Another reported that in women older than age 40, compared with women having only cesarean deliveries, 200 more women per 10,000 with one vaginal birth, 400 more per 10,000 with two vaginal births, and 600 more per 10,000 with three or more vaginal births experienced symptomatic prolapse.¹¹⁴ A third study compared surgery rates for pelvic organ prolapse in a population of women having only cesarean deliveries with an age-matched sample having vaginal births.¹¹⁵ Investigators found that 190 more women per 10,000 having spontaneous vaginal births, 230 more women per 10,000 having vacuum extraction, and 470 more women per 10,000 having forceps delivery had surgery for pelvic organ prolapse, pointing to the significance of mode of vaginal birth. A fourth study of pelvic floor disorders 5 to 10 years after first birth similarly found that 200 more women per 10,000 with at least one spontaneous vaginal birth and 500 more women per 10,000 with at least one instrumental vaginal delivery experienced pelvic floor symptoms compared with women having only cesarean surgeries occurring prior to labor.¹¹⁶ Whether women had their cesarean prior to labor, during labor before full dilation, or during labor during the pushing phase had no effect on symptom prevalence (100-200 per 10,000).

10. Does cesarean delivery protect against injuries to babies?

Brachial plexus or facial nerve injury

Nerve injury rates during vaginal birth are modifiable because they depend largely on the proportion of women having instrumental delivery, which in turn is related to factors such as use of epidural analgesia and continuous electronic fetal monitoring.^{117, 118} Furthermore, use of instruments to deliver babies through the cesarean incision, which has become common in some institutions, may increase injury rates in cesarean deliveries.¹¹⁹ Most injuries resolve on their own or with treatment.¹²⁰

*Limited evidence suggests that a MODERATE excess number of babies born vaginally experience **brachial plexus injury** compared with babies delivered by cesarean, but the excess is influenced by whether delivery is spontaneous vaginal, instrumental vaginal, or cesarean after failed instrumental delivery.*

*Limited evidence suggests that **facial nerve injury** rates do not differ by mode of birth.*

One study compared nerve injury rates according to mode of birth but did not distinguish between modes of vaginal birth or timing of cesarean delivery.¹²¹ Investigators found that facial nerve injury rates did not differ significantly between babies delivered by cesarean and babies born vaginally, but 13 fewer babies per 10,000 delivered by cesarean experienced brachial plexus injury compared with babies born vaginally.

Other neurologic injury

- **Neonatal neurologic symptoms**

*Planned cesarean provides no protection against **intracranial hemorrhage, neonatal seizure, or abnormal neurologic status** compared with women planning vaginal birth.*

Two studies evaluated early symptoms of neurologic injury according to mode of birth. A study compared women who were carrying full-term normally formed fetuses and were planning vaginal birth (of whom 6% had unplanned cesareans) with women having planned cesarean delivery for reasons other than fetal condition.¹²² Rates of abnormal neurologic status, neonatal seizure, and intracranial hemorrhage were similar between groups. A second study reported that intra- and epi-cranial hemorrhage rates did not differ between babies delivered by cesarean and babies born vaginally.¹²¹ Neither study stratified results according to spontaneous vaginal birth versus instrumental vaginal delivery.

- **Cerebral palsy**

*Limited evidence suggests that liberal use of cesarean delivery is not associated with a reduction in **cerebral palsy** rates.*

One study suggests that liberal use of cesarean delivery is not associated with a decrease in prevalence of cerebral palsy. A systematic review found that cerebral palsy rates in the early 1980s were virtually identical in Sweden, Australia, England, Ireland, and the United States while cesarean rates ranged from 7% to 12% in the first four countries versus 22% in the United States.¹²³

Discussion

Our comprehensive assessment reveals the following: Of 14 maternal adverse outcomes in the current pregnancy, sufficient evidence demonstrates that 8 favor vaginal or planned vaginal birth, and limited evidence suggests the remaining 6 favor vaginal or planned vaginal birth. Of 4 neonatal adverse outcomes, sufficient evidence demonstrates that 1 favors vaginal or planned vaginal birth, limited evidence suggests that 2 favor vaginal or planned vaginal birth and evidence is conflicting for the remaining 1 outcome. Of 4 childhood chronic diseases, sufficient evidence demonstrates that 3 favor vaginal or planned vaginal birth and evidence is limited and conflicting for the remaining 1. Seven adverse outcomes are unique to cesarean delivery while 3 are unique to vaginal birth. Of 3 psychosocial outcomes examined, evidence conflicts but suggests a possible association with cesarean delivery for all 3. In subsequent pregnancies, of 9 adverse maternal outcomes, sufficient evidence demonstrates that 6 favor vaginal birth in the prior delivery and limited evidence suggests the remaining 3 also favor prior vaginal birth. Of 6 perinatal adverse outcomes in subsequent pregnancies, limited evidence suggests that 2 favor prior vaginal birth, and data conflict for the remaining 4. Of 5 outcomes related to pelvic floor dysfunction, none favors vaginal birth, mode of birth makes no difference for 2, and 3 favor cesarean delivery, but of these 3, 2 favor cesarean only in the short term or only with respect to mild or moderate symptoms. Of 4 outcomes related to delivery injury of the baby, mode of birth appears to make no difference for 3, none favor vaginal birth, and limited evidence suggests that 1 favors cesarean. (See Table 2.)

Table 2: Summary of Outcomes (pgs. 40 - 42)

Outcome	May be more common with cesarean delivery	May be more common with vaginal birth	No difference
Maternal adverse outcomes related to the current pregnancy			
Maternal death	●		
Cardiac arrest	L		
Urgent hysterectomy	●		
Thromboembolic event (blood clot)	●		
Anesthetic complications	L		
Major infection	L		
Rare, life-threatening complications	L		
Wound infection	●		
Hematoma	L		
Wound disruption	L		
Longer hospital stay	●		
Hospital readmission	●		
Problems with physical recovery	●		
Chronic pelvic pain	●		
● = evidence is sufficient / L = evidence is limited / C = evidence conflicts but suggests an association is possible			

Table 2 cont'd

Neonatal adverse outcomes			
Neonatal mortality	L		
Respiratory distress syndrome	●		
Pulmonary hypertension	L		
Not breastfeeding	C		
Childhood chronic disease			
Asthma	●		
Type 1 diabetes	●		
Allergic rhinitis	●		
Symptomatic food allergy	L, C		
Complications unique to cesarean delivery			
Operative maternal injury	●		
Surgical cuts to the baby	L		
Re-operation	L		
Persistent pain at the cesarean incision site	L		
Cesarean scar endometriomas	L		
Cesarean scar ectopic pregnancy/early placenta accreta	●		
Dense intra-abdominal adhesions	L		
Complications unique to vaginal birth			
Anal sphincter injury		●	
Perineal or genital lacerations of any degree		●	
Persistent perineal pain		L	
Psychosocial outcomes			
Adverse effect on maternal-child relationship	C		
Depression	C		
Post-traumatic distress	C		
Maternal and placental complications in future pregnancies			
Reduced fertility	●		
Voluntary infertility	●		
Placenta previa	●		
Placenta accreta	●		
Placental abruption	●		
Hysterectomy	●		
Uterine rupture	●		
Maternal intensive care unit admission	L		
Hospital readmission	L		
● = evidence is sufficient / L = evidence is limited / C = evidence conflicts but suggests an association is possible			

Table 2 cont'd

Fetal/neonatal complications in future pregnancies			
Stillbirth	C		
Perinatal or neonatal death	C		
Preterm birth or low birthweight	C		
Small for gestational age infant	C		
Need for ventilation at birth	L		
Infant hospital stay > 7 days	L		
Stillbirth	C		
Perinatal or neonatal death	C		
Preterm birth or low birthweight	C		
Small for gestational age infant	C		
Pelvic floor outcomes			
Sexual dysfunction			●
Anal incontinence			●
Urinary incontinence – urge		C	
Urinary incontinence – stress		●	
Symptomatic pelvic floor prolapse		●	
Delivery injury to baby			
Brachial plexus injury		L	
Facial nerve injury			L
Neonatal neurologic symptoms			●
Cerebral palsy			●
● = evidence is sufficient / L = evidence is limited / C = evidence conflicts but suggests an association is possible			

These findings contrast with those of the 2006 National Institutes of Health State of the Science Conference: “Cesarean Delivery on Maternal Request,” which concluded, “[O]ur comprehensive assessment, across many different outcomes, suggests that no major differences exist between primary [elective cesarean delivery] and planned vaginal birth, but the evidence is too weak to conclude definitively that differences are completely absent” (p. v).¹²⁴ The major difference in findings stems from the narrow scope of the NIH review, limitations in the resulting body of literature, and inclusion of results from inappropriate studies such as vaginal breech trial data and studies that were underpowered for measuring less common outcomes. Authors of the commissioned evidence report underpinning the conference searched for research comparing “maternal request” cesarean with planned vaginal birth. Since no trials make this comparison, they used a small assortment of “proxy” studies to identify benefits and harms. The current broader review considers a more comprehensive list of relevant outcomes and encompasses both planned and unplanned cesareans. In addition, unlike the NIH report, the current analysis excludes studies of planned vaginal breech birth (a potent confounder, as discussed previously), and benefits from additional studies and systematic reviews published since the NIH review.

Strengths and Limitations

This review addresses the broadest set of outcomes of any review of cesarean versus vaginal birth of which we are aware. The purpose of the review was to provide the best available evidence to inform all stakeholders concerned with decisions about mode of birth and guide policy makers concerned with maternity care quality and value. To improve relevance to decision making, the review is confined to outcomes having a significant impact on the woman or her child rather than surrogate outcomes or other proxy measures. Where information was available from the source studies or systematic reviews, the review provides absolute differences in outcomes rather than odds ratios or relative risk, which avoids inflating perceived differences. To facilitate understanding of risks, we reported risk differences with a standard denominator of 10,000, and grouped differences by orders of magnitude.

The limitations of this review primarily originate in weaknesses in the body of relevant research. In many areas of concern, the evidence is conflicting, inadequate, or nonexistent. In particular, more research is needed into rare but serious outcomes (e.g., death), long-term outcomes in both women and children, subsequent reproductive complications after primary cesarean, quality of life in the postpartum period, breastfeeding outcomes, and psychological morbidity. The review addresses these limitations by applying a flexible hierarchy of evidence to identify the best available evidence for each outcome.

Another weakness is that the research does not permit analysis of harms intrinsic to mode of birth versus those that are modifiable by improvements in obstetric and midwifery practice, and in fact, many studies included in this review were conducted in the context of suboptimal labor management. Strong, consistent evidence identifies significant overuse of harmful or ineffective practices and underuse of other practices shown to improve outcomes.¹²⁵ Poor quality care for planned vaginal birth results in excess neonatal injury, genital tract trauma, and pelvic floor dysfunction and leads to a higher proportion of labors that end in cesarean delivery, thus exposing women and babies to surgical risks.⁶⁷ Suboptimal practices with cesarean delivery (e.g., inadequate prophylaxis against infection or blood clots) affect rates of certain adverse outcomes as well, but the problem is more pronounced and affects far more outcomes with planned vaginal birth. Thus, available studies may find a benefit for cesarean that could lessen or disappear with more optimal vaginal birth care, no difference that may favor vaginal birth with more optimal care, or a benefit for vaginal birth that may increase with more optimal care. To mitigate this limitation and provide context for readers, this review includes studies of both planned and actual vaginal birth, reports intrapartum cesarean rates for studies of planned vaginal birth, and reports information about labor care practices in the study settings where relevant and available.

This review is also limited by the scope and resources of the review process. Because of the large scope and number of potentially eligible studies, we limited our review to systematic reviews where available. However, as there are no randomized controlled trials of planned vaginal birth versus planned primary cesarean delivery (other than with breech presentation), systematic reviews were limited to observational or descriptive studies, which in most cases did not permit meta-analysis. We did not have the resources to assess independently the studies included in systematic reviews or to search for subsequently published studies that might have augmented or conflicted with systematic review findings. A single reviewer (H.G.) conducted searches and prepared the research summaries. Additional reviewers (A.R. and C.S.) assisted with identifying studies from Childbirth Connection's databases and reviewed source studies as needed to help prepare and edit research summaries. Thus, it is possible that eligible studies were not identified or were analyzed inadequately.

Priorities for Future Research

As noted above, more research is needed into many of the outcomes addressed in this report. A more robust evidence base for these outcomes will help clarify and quantify the association between cesarean delivery and individual adverse outcomes and facilitate informed decision making.

There is also an urgent need for more and better research on strategies for safely preventing cesarean delivery. A recent systematic review issued by the Effective Health Care Program at the Agency for Healthcare Research and Quality evaluated strategies to reduce the use of cesarean in low-risk women.¹²⁶ The reviewers evaluated the quality of individual studies and the strength of the body of evidence for each strategy. Of the 97 studies included, 16 were good quality, 28 fair, and 53 poor, and the strength of the evidence was low or insufficient for all strategies examined. Of note, the review was limited to randomized controlled trials and, for health system strategies, pre-post studies of changes in policies or procedures. While the review identified no single strategy that was uniformly successful in reducing cesarean delivery, documented variation in cesarean rates across providers, settings, and geographic regions suggests that certain approaches to organizing and delivering maternity care yield more conservative use of cesarean delivery than others. Future research should examine the characteristics of settings and providers with low cesarean delivery rates and good maternal and newborn outcomes to identify approaches to care that may be effective.

One approach to care that should be closely examined is care that promotes, supports, and protects physiologic labor and birth.¹²⁷ Elements of physiologic care in childbirth include awaiting spontaneous onset of labor unless there is a medical indication to do otherwise; encouraging freedom of movement throughout labor including the second stage; providing continuous emotional support and comfort care to the laboring woman; offering the full range of non-pharmacologic pain relief and comfort strategies in addition to pharmacologic options; avoiding artificial means of hastening labor, such as artificial oxytocin or rupture of the membranes, unless medically indicated; using intermittent rather than continuous monitoring of the fetal heart rate in low-risk women; supporting spontaneous maternal bearing down efforts rather than using directed pushing; and avoiding episiotomy. While some of these approaches have been individually assessed for their impact on mode of birth, no study has looked at a “package” of physiologic care as a strategy to reduce cesarean delivery. Studies of midwifery care, especially those conducted in home-like alternative hospital settings, freestanding birth centers, and the home environment, demonstrate very low utilization of cesarean delivery with physiologic care, suggesting that such a package of care is a promising strategy for reducing cesarean delivery, and may be associated with other benefits including higher breastfeeding rates and less genital tract trauma in vaginal births.¹²⁸⁻¹³⁰

Another priority area for future research is the examination of practices that may mitigate harms of cesarean. Recent research has evaluated the impact of various surgical techniques on healing and adhesion formation and the impact of prophylactic measures against wound infection and thromboembolism,^{27, 29, 131} but more research is needed.¹³² In addition, evidence shows that performing planned cesareans after 39 weeks can prevent iatrogenic neonatal harm from early elective deliveries and reduce utilization of neonatal intensive care.^{27, 133} Other promising lines of inquiry based on pilot studies include practices that reduce maternal-infant separation after surgery, including skin-to-skin contact in the operating room to improve breastfeeding, maternal-infant attachment, and neonatal thermoregulation;¹³⁴ and other innovations to make cesarean delivery more woman- and family-centered.¹³⁵

Emerging evidence that cesarean delivery increases the risk of childhood chronic diseases and obesity creates an imperative to clarify the pathophysiological mechanism(s) responsible for the association. Researchers hypothesize that a primary mechanism is the disruption of neonatal gut flora, which have a key role in establishing healthy immunity, metabolism, and digestion.¹³⁶ Research is urgently needed to explore this and other hypotheses and seek strategies to reduce the risk of chronic disease arising from alterations in physiologic processes around the time of birth.

Also, effects of cesarean delivery may differ by the timing and planning status of the procedure, and co-interventions such as labor induction, due to physiologic, psychologic, or other mechanisms. Future research should endeavor to understand whether such differences exist and, if so, implications for maternity care practice. Such research may help to disentangle bodies of literature with conflicting results.

Implications for Policy and Practice

The findings of this report overwhelmingly support striving for vaginal birth in general and spontaneous vaginal birth in particular in the absence of a compelling reason to do otherwise. However, the current cesarean delivery rate in the United States is 32.8% and has risen most dramatically in the past decade among women least likely to benefit from surgical delivery.³ Although cost and resource utilization were outside of the scope of this review, the cost of a cesarean delivery exceeds that of a vaginal birth by about 50%.¹³⁷ To improve both the quality and value of maternity care in the United States and promote the optimal health of women and infants, clinicians, policy makers, and other stakeholders should prioritize identifying and promulgating practices that promote safe, spontaneous vaginal birth and reduce the use of cesarean delivery.

Promising policy strategies include:

- Measuring performance and leveraging results to improve quality, including broader use of endorsed performance measures for facilities and providers (e.g., nulliparous, term, singleton, vertex cesarean and healthy term newborn) and evaluation and endorsement of additional relevant measures to fill measure gaps (e.g., spontaneous labor and birth, patient-reported outcome measures, decision quality measures);
- Developing and evaluating innovative models of service delivery and payment that foster and reward high-quality, high-value care;
- Increasing access to midwives and family physicians who can provide primary maternity care in collaboration with obstetricians and other members of the maternity care team;
- Developing, promoting, and evaluating the use of shared decision making tools to help women and health professionals make informed decisions about mode of birth;
- Engaging maternal and perinatal quality care collaboratives in quality improvement initiatives related to intrapartum care and mode of birth;
- Implementing effective strategies to improve the liability environment in maternity care;¹³⁸
- Supporting health professionals through educational programs imparting needed knowledge and skills for physiologic birth and reversing loss of skills for vaginal breech birth, vaginal twin birth, and assisted vaginal delivery;
- Increasing access to planned vaginal birth after cesarean and evaluating strategies to improving vaginal birth rates and maternal and fetal/newborn safety in VBAC labors.

Promising clinical strategies include:

- Offering external cephalic version for women with breech or transverse fetuses close to term;¹³⁹
- Following evidence-based policies for induction of labor, including avoiding use for indications that are not supported by research, (e.g. suspected fetal macrosomia);¹⁴⁰
- Working with women to await active labor before hospital admission for planned vaginal birth;¹⁴¹
- Providing intrapartum care to appropriately selected women in low-technology settings such as midwife-led hospital units, freestanding birth centers, and homes;¹²⁸⁻¹³⁰
- Providing continuous labor support, optimally from a doula;¹⁴²
- Avoiding time limits on labor progress, especially in early labor and during induced labor;^{143, 144}
- Using intermittent auscultation of the fetal heart rate during labor in low-risk women;¹⁴⁵
- Avoiding practices that might precipitate non-reassuring fetal heart rate patterns, including maternal supine positioning, routine amniotomy, and routine administration of artificial oxytocin, and implementing intrauterine resuscitation measures when such heart rate patterns occur;¹⁴⁶
- Judiciously using skillful instrumental vaginal delivery for prolonged or complicated second stage labor;¹⁴⁷
- Manually rotating ultrasound-confirmed occiput-posterior or occiput-transverse fetuses;¹⁴⁸
- Offering planned vaginal birth after one or two prior low-transverse cesareans and using evidence-based decision support tools to enable shared decision making.⁷³

Recommended Additional Resources

From Childbirth Connection

Transforming Maternity Care Web Site (<http://transform.childbirthconnection.org>) - provides access to direction-setting reports, *2020 Vision for a High-Quality, High-Value Maternity Care System* and *Blueprint for Action: Steps Toward a High-Quality, High-Value Maternity Care System*, as well as a regularly updated inventory of maternity care quality improvement tools.

Consumer resources (<http://www.childbirthconnection.org/cesarean>) - includes consumer-friendly summary of these report findings and other tips and tools, including downloadable booklet, *What Every Pregnant Woman Needs to Know About Cesarean Section*.

Forthcoming Reports:

The following will be available in 2013 at <http://transform.childbirthconnection.org/reports/>

- *The Cost of Having a Baby in the United States* (December 2012)
- *Maternity Care and Liability: Pressing Problems, Substantive Solutions* (January 2013)
- *Listening to Mothers III: Pregnancy and Childbirth* (February 2013)
- *Listening to Mothers III: New Mothers Speak Out* (May 2013)
- *Hormonal Physiology of Childbearing* (2013)

Other Recommended Resources

Hartmann KE, Andrews JC, Jerome RN, Lewis RM, Likis FE, McKoy JN, Surawicz TS, Walker SH. *Strategies To Reduce Cesarean Birth in Low-Risk Women*. Comparative Effectiveness Review No. 80. AHRQ Publication No. 12(13)-EHC128-EF. Rockville, MD: Agency for Healthcare Research and Quality. October 2012. (Available at <http://www.effectivehealthcare.ahrq.gov/reports/final.cfm>.)

National Priorities Partnership. Improving Maternity Care. Washington DC, National Quality Forum. 2012. (Available at <http://www.qualityforum.org/WorkArea/linkit.aspx?LinkIdentifier=id&ItemID=72393>)

National Quality Forum. Action Registry. (Available at <http://public.qualityforum.org/action-registry/Site%20Pages/Home.aspx>)

Main EK, Morton CH, Hopkins D, Giuliani G, Melsop K and Gould JB. *Cesarean Deliveries, Outcomes, and Opportunities for Change in California: Toward a Public Agenda for Maternity Care Safety and Quality*. Palo Alto, CA: CMQCC, 2011. (Available at <http://www.cmqcc.org>)

Chaillet N, Dumont A. Evidence-based strategies for reducing cesarean section rates: a meta-analysis. *Birth* 2007, 34(1): 53-64.

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Note: An asterisk () denotes studies included in research summaries. Others are cited in the introduction/background, methods, conclusion, and explanatory notes within the results.*

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