KCE REPORT 275Cs

Federaal Kenniscentrum voor de Gezondheidszorg
Centre Fédéral d'Expertise des Soins de Santé
Belgian Health Care Knowledge Centre

SYNTHESIS

ELECTIVE CAESAREAN SECTION IN LOW-RISK WOMEN AT TERM: CONSEQUENCES FOR MOTHER AND OFFSPRING

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HEALTH TECHNOLOGY ASSESSMENT

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ELECTIVE CAESAREAN SECTION IN LOW-RISK WOMEN AT TERM: CONSEQUENCES FOR MOTHER AND OFFSPRING

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FOREWORD

For the human species – as for any form of life – the birth of a descendant is a step crucial to survival. One would therefore expect that such an event would take place according to precise patterns, refined by millions of years of evolution, and without great room to manoeuvre. The human animal is the only species for which this expectation is not met. Depending on their history and their cultures, women have given birth in all sorts of ways, culminating with the advent of modern obstetrics. And the enormous drop in the infant and maternal mortality figures.

This progress was not made easily. Before the Hungarian physician Ignace Semmelweis discovered that these were the hands of obstetricians that carried deadly bacteria, puerperal fever caused such devastation that many women refused to give birth in a hospital. A story that should remind us that medicalisation also introduces potential risks. There is also another reason to cite Semmelweis here – and to grant him a place alongside Florence Nightingale and John Snow; he was one of the founders of what we now call Evidence-Based Medicine.

Today as in 1847, it remains essential to counter the individual beliefs of obstetricians – or the 'dominant obstetrical culture' – with the intransigence of the numbers, the only way to objectify risks and benefits. Opting for a caesarean in the event of transverse presentation or placenta praevia is a foregone conclusion; this is also the case for other indications for which there is no longer any hesitation today. But what do the statistics tell us when it comes to results of planned caesareans for pregnancies without particular risk?

Admittedly, our rate of 21% caesareans is very far from the worrisome rates of countries such as Greece, Turkey or Brazil, where over 50% of births take place by this method. In our country the trend is emerging, however, and raises a question, given that the rate of caesareans reaches 33% in some maternity clinics. Or when it is noted that inductions or planned caesareans are 33% more common among the least educated women.

Where does one stop? Why not, for example, perform a caesarean on all women? The question to be asked is: who bears the burden of proof? To the KCE, the answer is clear; anyone who opts for an invasive procedure instead of a natural birth must be able to produce figures that prove or at the very least make sufficiently plausible the benefit of the procedure.

Today, the WHO has dropped the idea of 'optimal' rates of caesareans. Of course, the influence of cultural factors can never be avoided, if only in the relative weight given to the various risks, but we believe that the minimum is that future parents be clearly and objectively informed so that they themselves can evaluate which is best. Best, it is understood, for the mother and the child.

Christian LÉONARD
Deputy general director

Raf MERTENS
General director

KEY MESSAGES

- Births by caesarean section have been increasing throughout the world for about thirty years. In 1985, the World Health Organisation (WHO) recommended that a rate of 10 to 15% caesarean sections not be exceeded. In 2010, some European countries approached a rate of 35%.
- In Belgium, the rate of caesarean sections currently fluctuates around 21% (20.6% in Flanders, 22.2% in Wallonia and 20.4% in the Brussels Region); in each Region, however, significant variations are observed between hospitals (from 11.8% to 32.9%).
- When a caesarean is not due to a medical indication, there is no proof that it provides any health benefit for mothers or children. More and more publications even report negative consequences in the short term and in the long term; some are clearly established, others remain more hypothetical. A significant share of the post-caesarean risk involves the progression of subsequent pregnancies.
- Scientific studies comparing the immediate or long-term effects of delivery methods (caesarean vs. vaginal) abound. But these studies, even when they are of high quality, often report contradictory results. To date, it therefore remains risky to draw unequivocal conclusions or to establish indisputable causal relationships for most of the issues of maternal and infant health.
- The main weakness of these studies is the inability to reliably report the reason for which a caesarean section was performed. It would be useful to record clearly in the future. In the same way, categories 2 and 4 of the Robson classification should be divided into a (induction) and b (elective caesarean section) to facilitate analysis and comparison of data.
- In 2015, the WHO adapted its recommendation formulated in 1985. The WHO acknowledges that the caesarean is effective in saving the lives of mothers and newborns, but only when it is justified by a medical indication. At a population level, caesarean section rates greater than 10% are not associated with a reduction in maternal and neonatal mortality rates. The priority should not be to achieve an “optimal” rate of caesareans, but to limit recourse to caesarean sections to clinically justified situations.
- A caesarean in a nulliparous woman is very often followed by other caesarean sections. An initial approach to preventing the progressive increase in the rate of caesarean sections observed in a number of countries would consist of avoiding the first caesarean section insofar as possible.
- Clear information on the consequences of the delivery method for the mother and child should be provided to future parents at the beginning of the third trimester, when the benefits and risks can be evaluated. This information should in particular involve the consequences of the delivery method for future pregnancies.

SYNTHESIS

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1. INTRODUCTION

Each year approximately 125 000 children are born in Belgium. Slightly more than 20% are born through a caesarean section (CS). This proportion is much higher than it was a few decades ago.

Caesarean sections are indicated only when a spontaneous vaginal delivery (VD) is foreseen as too risky for mother or child (elective CS) or following a failed VD (emergency CS). In particular, elective CS can be the preferred mode of delivery for specific indications such as abnormal fetal presentations (e.g. transverse or oblique lie, breech presentation) or when pregnancy duration is less than 37 weeks and the vital status of the foetus is compromised. When clinically justified, CS delivery can prevent maternal and neonatal mortality and morbidity. In general, experts largely agree on the absolute and relative clinical indications to perform a CS.

However, CS delivery is increasingly perceived as a routine intervention and harmless alternative for spontaneous VD by pregnant women and obstetricians, even in the absence of a clinical indication. Many non-medical reasons are put forward in the literature to opt for CS: hospital planning, the availability of obstetrician ensuing pregnancy, family organization at the time of birth (presence of spouse, care for other children) or the apprehension of labour-induced pain and risks of vaginal delivery. Such indications may be difficult to identify in historical birth databases. However, the 'maternal/obstetrician request' is recorded more often, in recent birth registries allowing to evaluate trends in the future. The medical literature also fails to clearly distinguish CS carried out for medical or personal reasons when comparing the outcomes of CS and VD.

Anyway, a CS remains a surgical intervention associated with short and long term risks which can extend many years beyond the delivery and affect the health of the mother and her child, as well as future pregnancies.

This report examines the clinical outcomes (physical and psychological) of each mode of delivery for both the mother and the offspring,[a] and does not include an economic analysis, an evaluation of organisational aspects such as length of stay nor an ethical reflection. No assessment of the initiatives adopted in Belgium or in other countries to curb the growing trend of CS was undertaken. However, the importance of objective counselling on delivery modes is discussed.

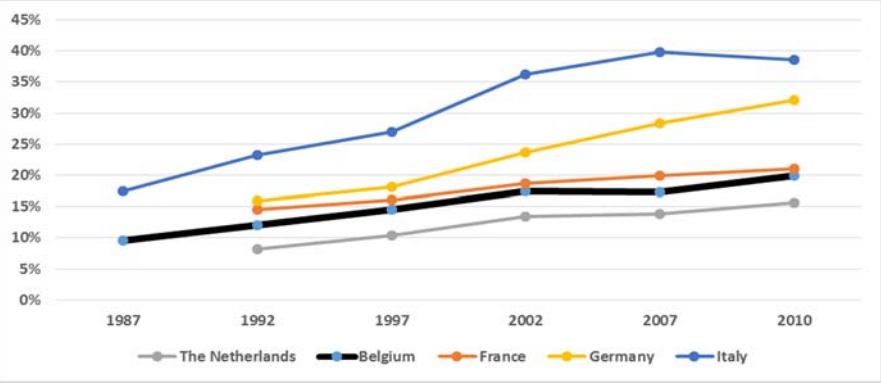
[a] The term 'offspring' is used on purpose rather than 'child' since some studies report offspring outcomes beyond the childhood period.

2. CAESAREAN SECTION RATES IN BELGIUM AND WORLDWIDE

In 1985, the WHO considered the ideal rate for caesarean sections to be between 10% and 15%. Such rate was adopted as ideal cut-off based on a review of the limited data available at the time, mainly from northern European countries that demonstrated good maternal and perinatal outcomes with that rate of caesarean sections. Twenty-five years later, European rates were far above this rate and varied by country between 15.6% in The Netherlands and 50% in Greece (2010). Elsewhere, the phenomenon is equally marked, for example with a caesarean section rate of 33% in the USA and 35% in Korea.

In Belgium, CS rates have also risen in the last decades from around 10% in 1987 to around 21% in 2014 (for 125 000 births per year). In comparison to other European countries, the CS rates in Belgium remain relatively low (see Figure 1).

Figure 1 – Caesarean section rates in six selected European countries



Sources: Declercq et al. (2011) for data 1987-2007 and Xie et al. (2015) for the 2010 data

The CS rates in the different Belgian regions differ only slightly, with somewhat higher rates in Wallonia (2014). However, large variations between Belgian healthcare facilities are observed, ranging from 11.8% to 32.9% in 2014 (IMA data, 2014). Different rates can be explained by institutional guidelines but can also reflect different case-mixes between healthcare facilities, regions or countries. In order to compare those rates more objectively, the WHO recommends using the Robson classification, originally published in 2001 and endorsed by the WHO since 2015. This classification stratifies women into ten mutually exclusive categories according to their obstetric characteristics: parity (nulliparous, multiparous with and without previous CS); onset of labour (spontaneous, induced or pre-labour CS); gestational age (preterm or term); fetal presentation (cephalic, breech or transverse); and number of foetuses (single or multiple).

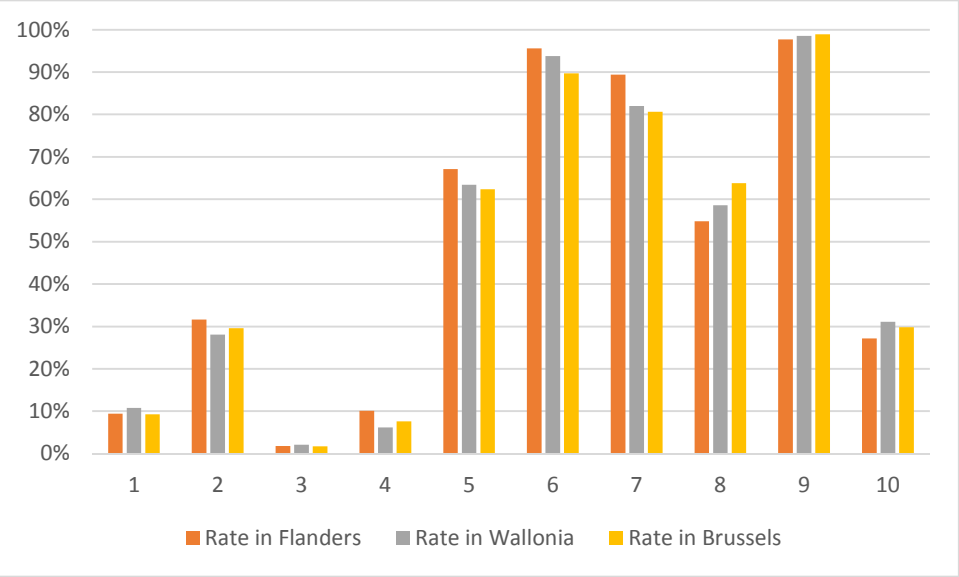
The Robson classification is a simple and easy system to implement. The categories are based on relevant criteria, mutually exclusive and totally inclusive. Ideally, categories 2 and 4 should be divided into a (induction) and b (elective caesarean section) to facilitate analysis and comparison of data.

This classification is now widely used in many countries, including the three regions in Belgium.

Figure 2 shows the CS rates in the three Belgian regions based on the Robson classification. No major differences between regions are noted. It is clear from this figure that all abnormal (transverse or oblique) lies, nulliparous/multiparous breeches and multiple pregnancies are mainly delivered by caesarean section. Globally, these four groups represent about 6% of all pregnancies.

According to the SPE and CEpiP, we observe these recent years an increase in CS in primiparous women and in multiparous women with previous CS.

Figure 2 – Caesarean section rate using the Robson classification in the three Belgian regions



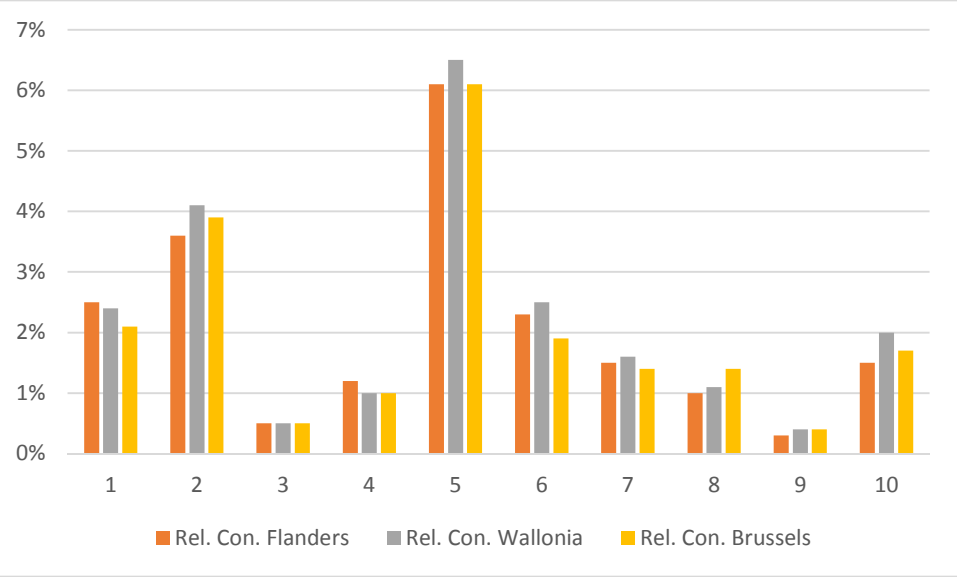
Legend: The 10 categories of the Robson classification

1. Nulliparous, single cephalic, ≥37 weeks, in spontaneous labour
2. Nulliparous, single cephalic, ≥37 weeks, induced or CS before labour
3. Multiparous (excluding prev. CS), single cephalic,≥37 weeks, in spontaneous labour
4. Multiparous (excluding prev. CS), single cephalic, ≥37 weeks, induced or CS before labour
5. Multiparous with previous CS, single cephalic, ≥37 weeks gestation
6. All nulliparous with a single breech pregnancy
7. All multiparous with a single breech pregnancy (including prev. CS)
8. All multiple pregnancies (including prev. CS)
9. All women with a single pregnancy with a transverse or oblique lie (including prev. CS)
10. All single cephalic, <37 weeks (including prev. CS)

Data from 'Studiecentrum voor Perinatale Epidemiologie' and 'Centre d'Epidémiologie Périnatale' for 2014

However, not all of these Robson categories are equally frequent. Therefore some of the groups contribute more than other categories to the total number of CS. Figure 3 shows the contribution of each category to the total proportion of CS performed. Group 5 (women with previous CS, but with at-term single cephalic presentations) constitute the largest proportion of the CS deliveries in all regions of this country. So an important part of CS deliveries is really driven by having had a previous CS. Second in the order is all breech pregnancies (categories 6 and 7) followed by at-term primiparous women with labour induction or planned CS.

Figure 3 – Relative contribution of caesarean sections by the Robson classification in the Belgian regions



Data from 'Studiecentrum voor Perinatale Epidemiologie' and 'Centre d'Epidémiologie Périnatale' for 2014

Overall percentage of deliveries by C-section:
- Flanders 20.6%
- Wallonia: 22.2%
- Brussels: 20.4%

Legend: The 10 categories of the Robson classification

1. Nulliparous, single cephalic, ≥37 weeks, in spontaneous labour
2. Nulliparous, single cephalic, ≥37 weeks, induced or CS before labour
3. Multiparous (excluding prev. CS), single cephalic,≥37 weeks, in spontaneous labour
4. Multiparous (excluding prev. CS), single cephalic, ≥37 weeks, induced or CS before labour
5. Previous CS, single cephalic, ≥37 weeks
6. All nulliparous with a single breech pregnancy
7. All multiparous with a single breech pregnancy (including prev. CS)
8. All multiple pregnancies (including prev. CS)
9. All women with a single pregnancy with a transverse or oblique lie (including prev. CS)
10. All single cephalic, <37 weeks (including prev. CS)

Overall, recent CS rates are comparable in the three Belgian regions. In 2014 they varied from 20.4% in the Brussels Region to 22.2% in Wallonia, with Flanders with 20.6% in between. Remarkable is the large difference across healthcare facilities in all regions ranging from 11.8% to 32.9%. The real reason is not clear, but this may represent different case mixes or different practices in each healthcare facility.

Across the three regions also the relative contribution of the different indications or situations, using the Robson classification, is comparable. **In all three regions, a previous caesarean section is the major indication for a next CS.** Second in the order is the group of breech presentations (composed of categories 6 and 7).

Also remarkable is the relation between elective and emergency CS. While in Flanders the majority of CS is elective, the proportion of elective and emergency CS in Wallonia and the Brussels region is almost equal.

3. LITERATURE REVIEW

3.1. Objectives and methods

In this report we performed a systematic literature search on maternal and offspring outcomes after CS delivery (elective or emergency CS) compared to a VD (spontaneous, induced or assisted) in women with a low-risk pregnancy at term (≥37 weeks gestation). Low-risk births were singleton, term (37-41 weeks' gestation), vertex births, with no reported medical risk factors or placenta praevia and with no prior caesarean section.

A search for recently published (from 2011 onwards) systematic reviews and meta-analyses (SR/MA) was performed in The Cochrane Library, Medline, CENTRAL and Embase. Reference lists from selected articles were browsed to find additional relevant papers. In a second step, we searched for primary studies to update selected evidence syntheses. If no systematic review was available, a search for publications (systematic reviews and primary studies) was performed on a larger period (15 years). The reference lists of included studies were checked for relevant publications that may have been missed through the database search. Experts in the field were also consulted to identify additional relevant publications that may have been missed.

No study design was excluded a priori. Randomised controlled trials (RCTs), observational studies (prospective or retrospective cohort studies and case-control studies) conducted in high-income countries were included. Studies conducted in countries where pregnancy related mortality is very high (e.g. specific African or Asian countries), letters to editors, case series and congress abstracts were excluded. Only studies published in English, Dutch or French were included.

Together with a group of clinical experts (see colophon), we chose to include all outcomes reported in the literature, provided they were reported for both groups (CS vs. VD) and the research methodology is of sufficient quality.

The selection processes led to retain 61 publications. Each study was appraised for methodological quality using validated instruments (AMSTAR tool for systematic reviews (SRs), the Cochrane Collaboration's tool for RCTs and comparative observational studies).

Whenever possible, results are reported for planned/elective CS. However, the literature does not always clearly distinguish between CS performed for medical reasons or for non-medical reasons. Studies that have used data from regional or national registers mention the very recent recording (after 2010) of an option 'at the request of the obstetrician / mother' from the list of indications. This record should help in the future to better differentiate between planned CS for medical reason from personal or organisational reasons.

Mortality and morbidity associated with CS delivery are difficult to define due to many confounding factors. The evidence found in the literature is mainly observational. The few available RCTs were conducted in narrowly defined populations (e.g., breech presentation). In the International Breech Trial, many women randomized to have a VD (trial of labour) ended up with CS and many women randomized to a planned CS had eventually a VD, leading to a high degree of unplanned cross-over between groups.

Long-term complications and those associated with subsequent pregnancies were difficult to ascertain. Most data regarding mortality and morbidity in mother and offspring associated with CS delivery or VD were derived from observational studies and subject to potential bias and unmeasured confounding. Therefore, causality is difficult to prove and we can only describe associations.

Findings are presented as short- and long-term maternal outcomes including the impact on future pregnancies followed by short- and long-term outcomes for the offspring.

3.2. Mortality and morbidity in mother

3.2.1. Short-term maternal outcomes

Short-term maternal morbidity can be conceptualized as a spectrum ranging from non-life-threatening minor morbidity to the near death of a woman who has survived a complication occurring during pregnancy or childbirth or within 42 days of the termination of pregnancy. Definitions of non-severe or non-life-threatening maternal morbidity may include discomfort such as nausea.

The Maternal Morbidity Working Group of the WHO has agreed on the following definition of short-term maternal morbidity as: "…any health condition attributed to and/or aggravated by pregnancy and childbirth that has a negative impact on the woman's wellbeing…"

Reported maternal complications include haemorrhage requiring hysterectomy, haemorrhage requiring blood transfusion, hysterectomy, uterine rupture, anaesthetic complications, obstetric shock, cardiac arrest, acute renal failure, assisted ventilation or intubation, puerperal venous thromboembolism, major puerperal infection, in-hospital wound disruption and haematoma.

A NICE clinical guideline (2011) based on a systematic literature review (search date 2011) found evidence for low-risk women in five studies, comparing outcomes for planned CS with planned VD (based on planned antenatal intention, not on the actual mode of delivery). For each outcome of interest, NICE reported a low to very low level of evidence using the GRADE methodology.

These studies suggest that, compared to vaginal delivery, a caesarean delivery leads to:

- **A lower incidence** of perineal and abdominal pain occurring during birth and persisting three days post-partum (but no more four months post-partum);
- **A moderately increased risk** for cardiac arrest and peripartum hysterectomy;
- **No differences** for injury to the vagina, injury to the cervix, injury to bladder or ureter, iatrogenic surgical injury, post-partum haemorrhage and blood transfusion, pulmonary embolism, intraoperative trauma, assisted ventilation or intubation, acute renal failure and obstetric shock.
- **Inconsistent findings** are reported for wound and post-partum infection, deep vein thrombosis and anaesthetic complications.

3.2.2. Maternal mortality

Maternal mortality in most European and other industrialized countries is nowadays a rare event and therefore difficult to investigate, especially in observational studies. Experimental (for breech presentations) and observational evidence regarding the relationship between mode of delivery and maternal mortality were analysed by one systematic review (2014). No significant difference in risk of maternal mortality between the two groups was reported.

3.2.3. Breastfeeding

It has been hypothesized that the mode of delivery impacts on breastfeeding. Two biological mechanisms could explain this association. The first is associated with surgery itself. Following a CS complications may occur such as pain, haemorrhage and infections, all susceptible to delay the mothers holding their infants and disrupt the mother-infant interaction. Moreover, in-labour (emergency) CS may be performed after a long and difficult labour and implies confinement to bed, fasting, analgesia and/or anaesthetics for pain, anxiety and stress, all potentially having an adverse impact on breastfeeding. For elective CS performed before the onset of labour such complications are more limited but postoperative care routines may also hamper bonding. The first postnatal hours are crucial for establishing mother-infant interaction, thereby increasing the chances for successful breastfeeding. Therefore, mothers with VD have a greater opportunity for early and effective breastfeeding.

The second mechanism is related to the magnitude of oxytocin and prolactin responses. These differ between modes of delivery and play an important mediating role in milk ejection and in establishing mother–infant interaction. Blood concentrations of appetite-regulating hormones in infants born by CS or VD may also differ and hamper successful breastfeeding.

One systematic review of moderate quality (2012) includes 48 studies. Additionally we identified 2 cohort studies. Studies that evaluated the impact of the mode of delivery on breastfeeding initiation and continuation produced inconsistent results. In some studies, negative associations were found between elective CS and breastfeeding initiation whereas in other studies, such association was not confirmed. Once initiated, breastfeeding at six months was no longer affected.

It is important to point that methodologies used by the primary studies were diverse and mostly based on questionnaire-based interviews. Lots of countries, either developed or developing countries, were involved and no study investigated the association between mode of delivery and breastfeeding in ‘Baby friendly hospitals’ where a high level of breastfeeding support is provided (UNICEF and WHO initiative; see http://www.unicef.org/programme/breastfeeding/baby.htm).

It is argued that in such hospitals, the encouragement and support received from healthcare providers motivates all mothers to initiate and maintain breastfeeding, regardless of delivery mode.

3.2.4. Long-term maternal outcomes

3.2.4.1. Urinary incontinence

Pregnancy itself is a recognised risk factor for urinary incontinence. Childbearing may cause hormonal fluctuations, mechanical changes or both that may lead to urinary incontinence. The mode of delivery can also be related to postpartum urinary incontinence, especially VD. Elective CS is assumed to protect against pelvic floor trauma. In contrast, spontaneous VD or instrumental VD with vacuum or forceps delivery is believed to be associated with increased risks of trauma leading to urinary incontinence.

To assess the association between mode of delivery and urinary incontinence we used one high quality systematic review with meta-analysis (2016) that examined the association between delivery mode and the presence of Stress urinary incontinence (SUI) and Urgency urinary incontinence (UUI) more than one year after delivery. SUI is defined as the involuntary loss of urine on effort or physical exertion, or on sneezing or coughing while UUI is defined as involuntary loss of urine associated with a sudden and compelling desire to pass urine. A statistically significant three-fold higher risk for SUI was associated with spontaneous (non-instrumental) VD compared to elective CS. For UUI, the risk increase was 30% for VD compared to all forms of CS, still statistically significant. Women were followed on a five- to ten-years period.

3.2.4.2. Faecal incontinence

Faecal incontinence is defined as involuntary loss of faeces while anal incontinence is involuntary loss of faeces or flatus. It is considered as a consequence of labour and VD and may occur in women during the immediate postpartum period and persist throughout life. Some obstetricians argue that VD affects both urinary and anal incontinence and therefore advocate CS to protect the pelvic floor and continence mechanisms.

Our assessment was based on a Cochrane review (2010) and a subsequent longitudinal cohort study (2011). The Cochrane review found no association between faecal incontinence and mode of delivery. None of the included studies showed a significant benefit of CS over VD regarding faecal incontinence or flatus. In addition, the more recent longitudinal study failed to show statistical differences up to 12 years post-partum.

3.2.4.3. Post-natal depression

Complicated labour and emergency CS can be stressful for the mother. Therefore there might be an association between emergency CS and post-natal depression.

Three primary studies specifically assessed this outcome. None of these studies showed a clear association between mode of delivery and post-natal depression.

3.2.5. Impact on future pregnancies: maternal outcomes

The main question when a CS is planned is its potential impact on the future pregnancies and deliveries. As illustrated in Figure 3, a CS is often planned after previous CS.

3.2.5.1. Subsequent fertility

Compared to VD, CS has long been suspected to lead to a reduction in subsequent birth rates and a longer time to next pregnancy. However, this association may be biased due to confounding by indication. Because it is difficult to evaluate fertility of women after a first birth, rate and time to subsequent live birth are frequently used as surrogate markers for fertility.

Our assessment is based on two high quality systematic reviews (2013) and three additional cohort studies (2014 and 2015). All of these studies failed to demonstrate a clear association between mode of delivery and subsequent fertility.

Other social and educational factors may play a role in delaying or avoiding further childbirth including the choice for a small family, the women's desire to work or to pursue education. Because fertility declines with age, regardless of mode of delivery, the older the woman is at the birth of her first baby, the lesser is the probability to have other children.

3.2.5.2. Subsequent ectopic pregnancy

An ectopic pregnancy occurs when an embryo implants outside the uterine cavity, for example in the fallopian tube. This primary cause of morbidity and mortality in pregnant women occurs in 1% to 2% of all pregnancies. Several risk factors for ectopic pregnancy have been identified, including a history of pelvic inflammatory disease, previous ectopic pregnancy, previous pelvic surgery and the use of intrauterine devices. Despite conflicting evidence, a previous CS has also been considered a risk factor for subsequent ectopic pregnancy without clear mechanisms explaining such association.

Our assessment of the risk associated with mode of delivery is based on a very large cohort study with registry data in Denmark (2014). For all CS, there was a slight but statistically significant 9% risk increase. For elective CS, the risk increase was 12%, also statistically significant. However, for elective CS on maternal request the association disappeared. Therefore, the underlying reason to perform an elective CS may play a role in this association. Overall, the association between elective CS and subsequent ectopic pregnancy remains inconclusive.

3.2.5.3. Placenta praevia, placenta accreta, placental abruption and uterine rupture in subsequent pregnancies

The mode of delivery can have implications for subsequent pregnancies. Some consequences specifically occur after uterine surgery (e.g. presence of uterine scar and abdominal scar). Placental complications such as placenta praevia, placenta accreta, and placental abruption often are reported to be associated with previous CS. Placenta accreta is a severe obstetric complication characterized by abnormally deep attachment of the placenta, with adherence to the myometrium rather than the endometrium. In women with placenta accreta, the tight adherence of the placenta to the uterine wall hampers the normal separation of the placenta from the uterus after delivery, leading to maternal haemorrhage. Placenta accreta is possibly the most clinically significant long-term maternal morbidity after a CS and is associated with a life-threatening haemorrhage that frequently results in peripartum hysterectomy.

Uterine rupture is a rare obstetric complication (0.07%) associated with severe maternal and perinatal morbidity and mortality. Uterine rupture rarely occurs in women with a native unscarred uterus but mainly in women with a uterus with a surgical scar from previous surgery, most often due to a previous CS. Uterine rupture occurs when a full-thickness disruption of the uterine wall that also involves the overlying visceral peritoneum (uterine serosa) is present.

The search strategy failed to identify a SR on these outcomes. Our assessment is largely based on a very large Norwegian registry study (2008) and on large cohort studies conducted in the USA.

American studies reported that the risk for placenta accreta and uterine rupture increased with the number of previous CS.

In a large American cohort study (> 30 000 women), the rate of placenta accreta was 0.24% in women having their first CS. The rate increased to 0.31%, 0.57%, 2.13%, 2.33% and 6.74% in women having their second, third, fourth, fifth, and sixth CS deliveries, respectively.

A large registry based retrospective cohort analysis in the US (> 20 000 women) focused on uterine rupture during VD among women with a prior CS delivery. Approximately 60% of women with a previous CS tried labour in a subsequent pregnancy. Uterine rupture occurred at a rate of 5 per 1000 among women with spontaneous onset of labour, around 8 per 1000 among women whose labour was induced without prostaglandins and 25 per 1000 among women with prostaglandin-induced labour. For women with one prior CS, the risk of uterine rupture is higher among those with a VD, especially when labour is induced. Labour induced with a prostaglandin confers the highest risk. In comparison, uterine rupture occurred in less than 2 per 1000 among women with repeated CS.

3.3. Mortality and morbidity in offspring

3.3.1. Short-term offspring outcomes

3.3.1.1. Neonatal mortality

Neonatal mortality is defined as death occurring during the first 28 days of life (0-27 days).

Our assessment of neonatal mortality in relation to mode of delivery is based on a systematic review conducted by NICE (2012) including two observational studies and on an ecological study in 31 high-income industrialized countries (2015). Again, all these studies were observational preventing causal conclusions to be drawn.

The first population-based cohort study compared 1046 healthy nulliparous women who had undergone elective pre-labour CS (using breech presentation as a surrogate) with 38 021 women who had spontaneous labour with anticipated vaginal delivery (VD) at full term. This study showed no significant difference in mortality but was grossly underpowered.

In **the second registry study** on more than 8 million births, an intention to treat approach was chosen. Low-risk births were defined as singleton, term, vertex births, with no reported medical risk factors or placenta praevia and with no prior CS. The unadjusted neonatal mortality rate for CS with no labour complications or procedures was 2.4 times greater than for the group with planned VD (which also included those ending up with unplanned CS for labour complications). The adjusted ratio for neonatal mortality was 1.7 deaths per 1000 live births for CS compared to 0.7 deaths for 1000 live births for planned VD.

The ecological study reported no significant correlation between planned CS and infant mortality after adjustment for a number of risk factors. But since infant mortality figures are overwhelmingly dominated by preterm births and specific causes (malformations, intrauterine infections…), any effect on low-risk, term births is masked.

In conclusion, only the large registry study is useful for our research question. Still, despite the adjustments for a number of relevant risk factors, there remains a risk of residual confounding and selection bias, as an unknown percentage of the planned CS may have been carried out for indications linked to the risk of neonatal mortality.

3.3.1.2. Neonatal respiratory problems

It has long been suspected that infants delivered by elective CS may be at increased risk of neonatal respiratory morbidity and that this risk is related to gestational age at birth. Possible consequences of respiratory morbidity are admission to neonatal intensive care units, separation of mother and child (hampering bonding and the onset of breastfeeding), need for respiratory support, painful procedures, treatment with antibiotics and mechanical ventilation and severe complications.

Our assessment of neonatal respiratory problems is based on one systematic review (2007) and a subsequent cohort study (2008). These studies report a two- to seven-fold increased risk for neonatal respiratory problems associated with elective CS compared to VD. The magnitude of this relative risk seemed dependent on gestational age even after 37 completed weeks of gestation. Babies delivered by elective CS at 37 to 39 weeks' gestation are at two- to four-fold increased risk of respiratory morbidity compared with babies delivered by intended VD. The authors therefore recommend to postpone an elective CS until 39 completed weeks of gestation.

3.3.1.3. Cerebral palsy

Cerebral palsy (CP) is a group of clinical syndromes more or less severe, including abnormal muscle tone (spasticity or weak muscles), poor members' coordination, tremors as well as problems with vision, hearing, swallowing, sensation and speaking. These conditions are due to abnormal development or damage to the parts of the brain that control movement, balance, and posture. There is some evidence that intrapartum factors may cause CP, i.e. intrapartum hypoxia or brain damages caused by antenatal infection (e.g. toxoplasmosis or rubella). Cerebral palsy may also have its origin in postnatal events, especially Hypoxic Ischemic Encephalopathy (HIE) and prematurity (very low birth weight and very preterm infants, i.e., gestational age < 28 weeks or <25 weeks).

The prevalence of cerebral palsy has been remarkably stable for decades (around 1.5-2.5/1000 live births, and 1.0-1.5/1000 births at term), with little or no variation among western nations. This has not been the case among very low birth weight and very preterm infants, among whom prevalence increased after the introduction of neonatal intensive care that allow extremely low gestational age neonates to survive.

Fear of cerebral palsy litigation has a major influence on the defensive decision-making of the obstetrician to perform a CS, convinced this will offer a protective effect.

Our assessment is based on a systematic review with meta-analysis (2013) and one ecological study (2015). No information was given on the indication of the CS, and no distinction was made between elective and emergency CSs, making these results uninterpretable.

The evidence does not support an overall increase or decrease in the risk of cerebral palsy with CS. The literature review does not support the use of CS to prevent cerebral palsy in uncomplicated, term pregnancies with babies in cephalic presentation.

3.3.2. Long-term offspring outcomes

3.3.2.1. Immune disorders

CS delivery has long been suspected to influence the development and function of both innate and acquired immunity and the ensuing risk of disease. The association between CS and immune diseases was explored in many observational studies. Outcomes related to immune disorders include later risk for asthma, diabetes mellitus type 1, atopy and gastrointestinal diseases.

The mechanisms through which CS could impact the development of the immune system are largely hypothetical but may be at the level of the intestine by (1) altering bacterial colonization of the neonatal gut; (2) mounting poor and maladaptive stress response; and (3) altering epigenetic regulation of gene expression through DNA methylation on cytosine-phosphate-guanine (CpG) dinucleotides. Stress is also thought to influence the epigenome.

However, these outcomes were investigated in observational studies that have a high risk of bias since adjusting can only be performed for measured confounding factors. Most studies do not differentiate between elective CS for medical or non-medical reasons and emergency CS. Therefore, the observed associations may be spurious.

Asthma

Previous literature suggested that CS increased the risk of asthma in the offspring.

Our assessment is based on a large systematic review with meta-analysis (2015) with a distinction between elective and emergency CS and on five cohort studies (2015 and 2016).

The meta-analysis and the more recent large retrospective cohort studies showed around 20% higher risk for asthma in children born following CS compared to VD. However, note that CS was performed in a significantly higher number of mothers with immune disorders (i.e. asthma, systemic connective tissue disorders, juvenile arthritis, inflammatory bowel disease, diabetes type 1, immune deficiencies, psoriasis, and coeliac disease). Therefore, CS may be a confounding factor, with asthma in children being more related to maternal history. Children born prematurely are more likely to develop asthma. In the same way, when the CS was performed before rupture of membranes, the risk of asthma in children also increased.

A smaller Dutch prospective study based on questionnaires did not find any statistically significant association. The observational studies indicated that the risk may increase following elective surgery compared to non-elective surgery. However, the term elective CS is ill-defined and is used in various manners.

The causal nature of this association is difficult to prove based on observational studies, so there is low quality evidence that (elective) CS increases the risk for later development of asthma in the offspring.

Atopy

Previously, studies showed that CS was associated with a moderate risk increase for specific atopic syndromes such as allergic rhinitis, asthma, or food allergy.

Our assessment is based on a systematic review and meta-analysis (2008). Those observational data did not differentiate between elective or emergency CS and showed a modest increased risk associated with CS delivery for food allergy/food atopy and for allergic rhinitis, but not for inhalant atopy or eczema and atopic dermatitis. For each significant association with an allergic outcome, only 1–4% of cases could be attributed to CS.

Respiratory infections

No meta-analysis or systematic review for respiratory infection outcomes was found. A large Danish registry study (2016) showed around 20% increased risk for laryngitis and for 'pneumonia and lower respiratory tract infection' when comparing elective CS with VD. For emergency CS, this association was smaller for laryngitis and not significant for pneumonia and lower respiratory tract infection.

Another Danish registry study (2015) focused on hospitalization for Respiratory Syncytial Virus infection (RSV). Again the associated risk was higher for elective CS (27%) than for emergency CS (9%).

A Norwegian cohort study (2015) however, found no association between all CS or elective CS vs. VD for lower respiratory tract infections before the age of 36 months. Finally a large Australian registry study (2012) found an association for admissions for bronchiolitis after elective CS before the age of 12 months, but not during the second year of life. No association between elective CS and admissions for pneumonia was observed.

The causal nature of this association is difficult to prove based on observational studies. We conclude that there is low quality evidence that (elective) CS increases the risk for the later development of respiratory infections from some studies, while other studies do not confirm this.

Diabetes mellitus type 1

Our assessment is based on a systematic review and meta-analysis (2008) and five additional primary studies (2014 to 2016). The authors of the SR concluded that CS overall (elective and emergency) was associated with an approximately 20% risk increase for childhood-onset type 1 diabetes that cannot be explained by the measured confounders. However, five large and more recent studies (four registry based and one case-control) did not find such association. In particular, as for asthma, it appeared that CS were performed more frequently in diabetic mothers. When maternal diabetes was considered a confounding factor in the analysis, no association remained between mode of delivery and childhood diabetes.

Based on a cohort of 2.6 million children, the Swedish study (2014) found an association between elective CS and type 1 diabetes. The added-value of this study is the comparison of siblings with discordant mode of delivery. The sibling analysis suggested that the association was not causal, but may be due to familial confounders such as genetic susceptibility and environmental factors.

Inflammatory bowel diseases

Inflammatory bowel diseases (IBD) include Crohn Disease (CD) and Ulcerative Colitis (UC). Underlying pathophysiology includes inappropriate immune responses and the composition of the intestinal commensal bacterial flora or microbiome. Because neonatal intestinal colonization differs between children born through CS or VD, it has been hypothesised that the mode of delivery can modify the risk of IBD.

Our assessment is based on two systematic reviews with meta-analyses (2014) and on three cohort studies (2015 and 2016). One of the SR made the distinction between Crohn disease, ulcerative colitis and IBD and found a statistically significant association between CS and Crohn Disease but not Ulcerative Colitis or overall IBD. In the other meta-analysis, most of the results were not statistically significant except for one subgroup of studies based on questionnaires. Other studies showed conflicting results.

Gastro-enteritis

According to some authors, intestinal colonization patterns play important roles in tolerance induction, mucosa-associated barrier defences against pathogens, and in the development and homeostasis of innate and adaptive immunity to pathogens. Increasing CS practices may therefore impact on the susceptibility for intestinal bacterial infection.

Our assessment is based solely on two cohort studies because no systematic review was identified for this topic. One large registry-based cohort study (2010) showed a small but statistically significant association with an increased risk (laboratory-confirmed) in children born through CS (both elective and emergency) between the ages of 1-5 years compared to VD. Overall adjusted risk increase was 5%, but after age 5 years, there was no significant association. Mode of delivery appears thus not to be a clinically relevant determinant of risk for intestinal bacterial infections. Another cohort (2016) reported a statistically significant risk increase of clinically diagnosed gastro-enteritis of around 20% in children aged 0-14 years.

Coeliac disease

The assumption that the microbiome of the newborn may play a role in the development of coeliac disease was often quoted in the literature.

Our assessment is based on four cohort studies (2012-2016) and no recent systematic reviews were identified. The findings regarding a possible association between CS and coeliac disease are conflicting and no conclusions can be drawn.

3.3.2.2. BMI, overweight and obesity

A relation between CS and later-life obesity has been postulated because both CS rates and obesity prevalence in children and adults are steadily increasing worldwide. To explain a potential association between CS and later-life obesity, several biological mechanisms were proposed, including the microbiome.

Our assessment is based on three recent systematic reviews (2013-2015) and three cohort studies (2013-2015). Some of these studies reported an increased BMI associated with CS, while others did not. The best meta-analysis reported an increased risk for all CS, but not statistically significant for elective CS. The large cohort studies also reported inconsistent results up to the age of 21.

Childhood overweight and obesity is a multifactorial health issue. The main reasons of excess weight in childhood and adolescence are similar to those in adults, including individual causes such as behaviours (dietary patterns, level and frequency of physical activity, medication use), underlying disorders and genetics. None of these factors were investigated in epidemiological studies that explored the association between delivery mode and increased BMI in later-life. The mode of delivery (or caesarean) could act like a confounder, rather than a causal factor, in the development of overweight and obesity in adolescence.

3.3.2.3. Childhood cancer

CS delivery is also suspected to impact on subsequent cancer risk. Three potential mechanisms have been reported by which the mode of delivery may disturb the immune system and influence subsequent cancer risk. Firstly, the microbiome of the newborn is impacted by the mode of delivery: infants born by CS were not exposed to maternal vaginal and intestinal microbiota and harbour less Bifidobacterium species; their intestinal flora may be altered for months or even years after birth. Secondly, the absence of labour in planned CS, abolishes the stress response that initiates cortisol release and hypothalamic–pituitary–adrenal axis activation, needed for intestinal and immune system maturation. Thirdly, epigenetic regulation of genetic expression are affected: leucocytes in cord blood of offspring delivered by planned CS demonstrate higher levels of DNA methylation. These diverse proposed mechanisms imply that the risks for childhood cancers may differ by type of CS.

Our assessment is based on three primary cohort studies (2014-2016), no systematic review was identified.

Since CS rates are increasing in most European countries, even a very small rise in childhood cancer risk resulting from CS would have a public health impact. However, the results from three large, population-based studies across four European countries (Scotland, Denmark, Sweden and Finland) suggested no association between delivery by CS and childhood cancer in general and for the most common types of childhood cancer (including leukaemia, cancers of the central and sympathetic nervous systems, renal tumours and non-Hodgkin's lymphoma). For less common types of childhood cancer, the numbers of cases were too small to provide any strong conclusions.

It seems unlikely that delivery by CS is an important contributor to individual risk of childhood cancer, despite the reported associations between CS and specific immune diseases.

3.3.2.4. Developmental and behavioural outcomes

Birth by CS has been linked to psychological development through adulthood in animal models. Some studies have linked birth by CS to an increased risk of autism spectrum disorder, attention-deficit/hyperactivity disorder and other behavioural difficulties but results are inconsistent. One of the reasons for this inconsistency is the difficulty to objectively measure this outcome and the different tools that are used. Another problem is that the age of assessment of the children differs widely between studies making results difficult to compare.

Our assessment is based on two cohort studies (2015-2016) and no systematic review was identified. The conclusion was that there was no evidence for an association between mode of delivery and the development

of autism spectrum disorder, attention-deficit/hyperactivity disorder or other behavioural difficulties.

3.3.2.5. Long-term child mortality

This outcome was studied in only one large population-based retrospective cohort study (2015) in Scotland (1993–2007) aiming to examine the relationship between elective CS delivery and offspring health problems or death. Different outcomes were explored including death up to age 21 years. The study sample included data on 321 287 term first-born singletons followed until February 2015.

The study concluded that in comparison with children born by VD, offspring born by elective CS are at increased risk of all cause death by the age of 21: 0.40% vs 0.32% with a difference of 0.08% (statistically significant). After adjustment for confounders the associated risk increase was 41% (statistically significant). However, important unmeasured confounders such as maternal education, ethnicity, and in particular the primary indication for CS delivery may still confound the relationships studied.

3.3.3. Impact on future pregnancies: offspring outcomes

3.3.3.1. Stillbirth in subsequent pregnancies

There are different classification systems to define stillbirth and none is universally accepted. Stillbirth can be defined according to gestational age at birth, typically into early stillbirth (20–28 weeks gestation) and late stillbirth (>28 weeks) or according to foetus weight (e.g. any foetus born weighing more than 400 grams in Australia). Additionally stillbirths are classified into antepartum (death occurring before the onset of labour) or intrapartum (death during or after labour). Moreover, many registration systems include both stillbirths and neonatal deaths. The main causes or risk factors of stillbirth are well-known. They include, non-exhaustively, placental insufficiency with fetal growth restriction, infection, pre-eclampsia, congenital abnormalities, placental abruption and umbilical cord accidents, advanced maternal age, high maternal BMI and other maternal conditions such as diabetes and hypertension.

Our assessment of the association between previous CS and stillbirth in subsequent pregnancies is based on a systematic review with meta-analysis (2013) and a large Danish registry study (2014). In these studies there appeared to be an association between previous CS and stillbirth of about 15 to 20% increased risk compared to previous VD (statistically significant). However, the heterogeneity between trials in the meta-analysis is extremely high. The causal nature of this association is difficult to prove in those observational studies because of the high risk of residual confounding.

Overall, compared to vaginal delivery, CS is associated with a small increased rate of subsequent stillbirth. Underlying medical conditions, however, and confounding by indication for the primary CS account for at least part of this increased rate.

4. OVERALL CONCLUSION

4.1. Caesarean section: national and international trends

In Europe, CS rates constantly increased over time and in 2010 they varied between 15.6% in The Netherlands and 50% in Greece. In 2014, the CS rate in Belgium was around 21%.

Data over a 20-years period (1987-2007) from 22 industrialised countries are particularly striking. In 2007, 11 of those countries reported overall CS rates of more than 25%, led by Italy (39%), Portugal (35%), the United States (32%), and Switzerland (32%) (Greece was not included in this overview).

In Belgium, CS rates are comparable in the three regions. In 2014 they ranged from 20.4% in the Brussels Region to 22.2% in Wallonia, with 20.6% in Flanders. Remarkable is the large difference across maternity services in all regions, with CS rates ranging from 11.8% to 32.9%. The real reason is not clear, but this may represent differences in case mix or, more likely, differences in practice.

The Robson classification uses ten mutually exclusive categories to group pregnancies. Across the three regions both the global CS rate and the relative contribution of each Robson category is comparable.

Abnormal (transverse or oblique) lies, nulliparous/multiparous breeches and multiple pregnancies are mainly delivered by caesarean section. Globally, these four groups represent about 6% of all pregnancies. **In all three regions, a previous caesarean section is the major indication for a next CS.**

Also notable is the relation between elective and emergency CS. While in Flanders the majority of CS is elective, the proportion of elective and emergency CS in Wallonia and the Brussels region is almost equal. In all Regions, the proportion of elective CS is much higher in multiple births compared to singletons.

4.2. Towards an ideal rate of caesarean deliveries?

In 1985, the World Health Organisation (WHO) and the Pan-American Health Organisation (PAHO) held a shared conference on the appropriate technology for birth in Fortaleza, Brazil. The optimal rate for caesarean section (CS) was considered by this international healthcare community to be between 10% and 15%.

In 2015, the WHO issued a statement on CS rates, based on the observation that over the last 30 years CS rates gradually increased worldwide, both in developed and in developing countries. Many authorities and clinicians expressed their concerns about this increase and its potential negative consequences. On the other hand, the international healthcare community asked to reconsider the optimal rate proposed in 1985.

At a population level (ecological studies) an increase in CS rate up to 10-15% is associated with a decrease in maternal, neonatal and infant mortality. However, this association weakens or even disappears in studies that control for socioeconomic factors. Above the level of 10-15%, a further increase in CS rate is no longer associated with reduced mortality.

In its statement the WHO concludes that **there is no optimal rate**. But, rather than striving to achieve a specific rate every effort should be made to provide CS to women who really need it. It further concludes that CS is effective in saving maternal and infant lives, but only when it is justified by medical indication.

4.3. Association between delivery modes and outcomes: level of evidence

In 2012, Lavender et al. attempted to compare the effects on perinatal and maternal morbidity and mortality of planned CS versus planned VD when there is no clear clinical indication for CS, i.e. in singleton pregnancies with cephalic presentation at term and with no conventional medical indication for caesarean section. Their attempt was unsuccessful and they had to conclude that "there are no RCTs of planned CS vs. planned VD for non-medical reasons at term. Performing such a RCT not only raises methodological concerns but also arouses substantial moral issues about the ethics of undertaking a trial where women randomised to the intervention arm would receive surgery in the absence of a medical indication".

RCTs were conducted in other situations: in term breech deliveries or in women with a previous CS. Still, the conclusions of trials on planned CS for medical indications versus planned VD are not applicable to situations where there are no medical reasons, because caesarean mortality and morbidity is confounded by pre-existing obstetric or general medical conditions.

Therefore, researchers have no other option than to rely on observational studies to formulate recommendations to pregnant women and healthcare practitioners. Observational studies comparing the immediate or long-term effects of delivery methods (caesarean vs. vaginal) abound. To eliminate potential bias, most of them adjust their results by taking into account known confounders, such as maternal age, maternal BMI, maternal smoking behaviour, pre-pregnancy maternal diseases, previous delivery by CS, marital status, parity... In general, paternal potential confounders are not taken into account in those studies. Unfortunately, many other potentially relevant but harder to ascertain confounders are usually not taken into account (e.g. dietary patterns, physical activity, medication use in the studies on overweight and obesity).

Very broad studies involving tens of thousands of women and children and providing very long-term follow-up lead to the conclusion of associations, sometimes very strong, between the delivery method and the health issue studied (maternal or infant morbidity). The most recent and most thorough studies even extend their analysis to siblings and thus compare health issues between brothers and sisters according to their method of birth. Other studies with the same methodological characteristics conclude, on the contrary, that there is no association between the delivery method and the health issues studied. The main weakness of these studies is the inability to reliably report the reason for which a caesarean was performed, thus confusing the delivery procedure with the reason for which it was necessary (health problem of the mother or the child complicating or preventing vaginal delivery).

To date, it therefore remains risky to draw unequivocal conclusions or to establish indisputable causal relationships for most of the issues of maternal and infant health.

4.4. Caesarean section: Maternal and offspring outcomes

A CS is a surgical intervention that can prevent mortality and morbidity in both mother and child when performed in justified clinical situations. These last years, CS have become safe interventions in industrialised countries owing to mastered surgical techniques, improved anaesthesia and the routine use of infection and thrombosis prophylaxis. However, CS remains a surgical procedure with abdominal and uterine incisions, and subsequent scarring and risk of adhesions. Table 1 summarizes the results of our literature review: some of the clinical consequences are manifest, e.g. the increased risk of future uterine rupture.

Most other effects on the short- and long-term are less clear cut and therefore less certain.

Table 1 – Planned caesarean section compared with vaginal birth in low-risk pregnant women at term

PLANNED CAESAREAN SECTION COMPARED WITH VAGINAL BIRTH IN LOW-RISK PREGNANT WOMEN AT TERM			
Short-term maternal outcomes			
Planned CS may reduce the risk of:	Planned CS may increase the risk of:	No difference in risk demonstrated:	Inconclusive evidence about increased risk from CS:
Perineal and abdominal pain during birth and 3 days post-partum	Cardiac arrest	Perineal and abdominal pain four months post-partum	Deep vein thrombosis
	Peripartum hysterectomy (after haemorrhage or other complication)	Post-partum haemorrhage and blood transfusion	Wound and postpartum infection
		Injury to bladder/ureter	Anaesthetic complications
		Injury to cervix	Breastfeeding problems
		Injury to vagina	
		Iatrogenic surgical injury	
		Pulmonary embolism	
		Intraoperative trauma	
		Assisted ventilation or intubation	
		Acute renal failure	
		Obstetric shock	
		Maternal mortality	
Long-term maternal outcomes			
Planned CS may reduce the risk of:	Planned CS may increase the risk of:	No difference in risk demonstrated:	Inconclusive evidence about increased risk from CS:
Urinary incontinence		Faecal incontinence	
		Post-natal depression	
Short-term offspring outcomes			
Planned CS may reduce the risk of:	Planned CS may increase the risk of:	No difference in risk demonstrated:	Inconclusive evidence about increased risk from CS:
	Neonatal respiratory problems	Cerebral palsy	Neonatal mortality
Long-term offspring outcomes			
Planned CS may reduce the risk of:	Planned CS may increase the risk of:	No difference in risk demonstrated:	Inconclusive evidence about increased risk from CS:
		Childhood cancer	Respiratory infections
		Developmental and behavioural outcomes	Diabetes mellitus type 1
			Inflammatory bowel disease
			Coeliac disease
			Overweight and obesity
			Asthma
			Atopy
			Gastro-enteritis
			Long-term child mortality
Impact on subsequent pregnancies: maternal and offspring outcomes			
Planned CS may reduce the risk of:	Planned CS may increase the risk of:	No difference in risk demonstrated:	Inconclusive evidence about increased risk from CS:
	Placenta praevia in subsequent pregnancies	Subsequent fertility	Subsequent ectopic pregnancy
	Placenta accreta in subsequent pregnancies		
	Placental abruption in subsequent pregnancies		
	Uterine rupture in subsequent pregnancies		
	Stillbirth in subsequent pregnancies		

4.5. Counselling women on the mode of delivery

During the meetings with the expert group, it was repeatedly stressed that women need to be fully, clearly and objectively informed about benefits and consequences of all modes of delivery. Especially the consequences for subsequent pregnancies and future deliveries need to be discussed.

It is clear that in some circumstances a CS is fully justified, but when it comes to CS 'on maternal request or obstetrician demand' patient information and consent and objective counselling are important. This is also a legal requirement under the law on patient's rights from August 22nd 2002. This implies that clear and complete information concerning the entire proposed procedure and its consequences should be delivered to the patient in a clear language understandable by a layperson.

More specifically, the consequences of a first CS should be clearly explained. Although there are a few advantages (less perineal and abdominal pain, lower risk of urinary incontinence) there is also an increased risk of negative consequences for mother and child, including the risk of uterine rupture during a subsequent pregnancy, a very dramatic and life-threatening event for both mother and child.

The international and Belgian data show that a previous CS is the most important driver for a repeat CS in subsequent pregnancies. Clinical experts who participated in the preparation of this report have also stressed on the impact of each CS on future pregnancies. In 2011, the College of Physicians for the mother and the newborn already stressed the need to avoid performing a first C-section in the absence of strict indications, to prevent the following deliveries are also made by CS[b]. Future parents should also be made aware of this impact of their current decision.

5. EXISTING INITIATIVES

In Belgium, when a child is born, the health care practitioner who performed the delivery has to notify the birth and complete medical data for the Communities and, ultimately, the FPS Economy. These notifications are made either via a paper form or via an electronic application, i.e. e-Birth (since 2010). The e-Birth form allows to record several medical variables very useful for epidemiological studies on previous pregnancies, current pregnancy, delivery (e.g. position at birth, induction, epidural analgesia, fetal monitoring, delivery mode, episiotomy...) or the baby's health status. This form allows to differentiate indications of caesarean section by recording detailed data (maternal indication without additional specification; CS required by the pregnant woman without medical indication; placenta praevia; multiple pregnancy; fetal indication such as dystocia, fetal distress, abnormal position; further indication to be specified). Data related to the hospital (INAMI/RIZIV code of the hospital and of the campus) and the health care practitioner (name, first name, INAMI/RIZIV code) who performed the delivery are also recorded.

Each year the Centre d'Épidémiologie périnatale (CEpiP) and the Studiecentrum voor Perinatale Epidemiologie (SPE) sent to all maternity centers a confidential report containing a feedback related to all obstetric indicators recorded on birth certificates, their evolution since 2008 or 2009 and their positioning relative to other maternity hospitals. This annual report is sent concomitantly with the report by region. These reports are not commented but healthcare professionals who are interested may request a presentation of the results by the research teams, or an electronic version to ensure in-house presentations. It is not an audit of maternity and leaves freedom for practitioners to adapt their practices.

[b] Absil G, Van Parijs A-S, Bednarek S. et al. Determinants of high and low rates of Caesarean deliveries in Belgium. Recommendations to avoid unnecessary Caesarean sections. A Report of the College Mother and New Born, 2011. Accessed on http://overlegorganen.gezondheid.belgie.be/sites/default/files/documents/college_van_geneesheren_voor_de_moeder_en_de_pasgeborene/19074153.pdf

In 2011, the College of Physicians for the mother and the newborn has published a report on the determinants of caesarean rates in Belgium. This report formulated a series of clinical and organizational recommendations to reduce the number of unnecessary CS. We refer the interested reader to this publication (http://overlegorganen.gezondheid.belgie.be/sites/default/files/documents/college_van_geneesheren_voor_de_moeder_en_de_pas geborene/19074153.pdf). Authors mentioned that these recommendations have been followed by hospital and private practitioners having an obstetric activity in an academic hospital in 2010, dropping the caesarean rate from 26% to 20.2%. Caesarean section rates related to admission in maternal intensive care (MIC) was unchanged. This illustrates that the observed decrease was almost exclusively due to the reduction of caesarean sections performed on low-risk pregnant women.

RECOMMENDATIONS[c]

To the health practitioners involved in the birth process:

- **Clear information about the consequences of mode of delivery on mother and offspring should be given to future parents at the beginning of the third trimester when benefits and risks can be assessed. This information should include the consequences for future pregnancies.**

To the College of Physicians for the mother and the newborn:

- **To heighten obstetricians' awareness of the consequences of opting for a caesarean section without a clear clinical indication, particularly for primiparous women with a singleton vertex, beyond 37 weeks of pregnancy.**

To the monitoring bodies for perinatal epidemiology:

- **A feedback on the statistics of *each practitioner* using the Robson Classification could be considered in addition to annual reports on hospital statistics.**
- **Use data from the birth registration form (e-Birth) allowing to differentiate and report CS indications:**
  - **Distinguish both in category 2 and 4 of the Robson classification between induction and elective CS**
  - **Integrate the category 'non-medical indications' in the data analysis and feedback.**

[c] The KCE has sole responsibility for the recommendations.

COLOPHON

Title:	Elective caesarean section in low-risk women at term: consequences for mother and offspring – Synthesis
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Disclaimer:	• **The external experts were consulted about a (preliminary) version of the scientific report. Their comments were discussed during meetings. They did not co-author the scientific report and did not necessarily agree with its content.** • **Subsequently, a (final) version was submitted to the validators. The validation of the report results from a consensus or a voting process between the validators. The validators did not co-author the scientific report and did not necessarily all three agree with its content.** • **Finally, this report has been approved by common assent by the Executive Board (see http://kce.fgov.be/content/the-board).** • **Only the KCE is responsible for errors or omissions that could persist. The policy recommendations are also under the full responsibility of the KCE.**

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