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RELATION OF CESAREAN SECTIONS IN WOMEN WITH PREVIOUS CESAREAN DELIVERIES AND HYSTERECTOMIES IN A MATERNITY HOSPITAL IN RIGA

DIPLOMA THESIS

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Abstract

Background. The number of cesarean sections (CSs) increases worldwide. Consequently, women who have already had a cesarean delivery, decide for yet another CS in their future pregnancy, which is accompanied by a major complication, namely hysterectomy.

Objectives. To detect the incidence of hysterectomies associated with CSs in women with a history of previous CS, and to provide the best evidence available nowadays on that topic. To compare the risk factors (maternal age, gestational week, fetal weight, BMI, and number of previous births) in the groups "hysterectomy" and "no hysterectomy". To compare the fetal outcome via APGAR II scores in the groups "CS" and "vaginal delivery" (VD) in women with a prior CS.

Materials and Methods. 1620 patients were studied retrospectively from January 2015 until November 2017. All of the women had a history of previous CS. Number of hysterectomies, maternal age, gestational week, birth weight, maternal BMI before gestation, number of previous births, APGAR II score, and pregnancy complications (gestational diabetes mellitus, gestational hypertension, eclampsia, preeclampsia) were collected from each patient. Exclusion criteria were fetal retardation, twins, and cephalopelvic disproportion (CPD). 1513 of these patients further delivered with a repeated CS and 107 delivered vaginally (groups "CS" and "VD" for assessing the fetal outcome). In addition, the CS group was divided into two groups ("hysterectomy" and "no hysterectomy") for assessing the risk factors which might influence the occurrence of the hysterectomies. The incidence of hysterectomies was compared to international and national data by calculating p-values and confidence intervals (CI).

Results. 1620 patients with a history of previous CS were included in the study. 93.4% (n=1513) of those women gave birth by a repeated CS and 6.6% (n=107) performed a VD after prior cesarean. Further, the CS group was divided into hysterectomy and no hysterectomy group, and it was shown that 0.33% (n=5) (95%CI: 0.14…0.77) of those women had to undergo a hysterectomy. Compared with international data, there is no statistically significant difference between our findings and the findings in other countries (p-values >0,05), even though number of hysterectomies is less in some other European countries, namely Italy, Denmark, and the Netherlands (p-values >0,05). However, there is a statistically significant difference between our study and another study from a regional Hospital in Daugavpils, where 2,89% hysterectomies were associated with CSs (p-value <0.0001) in women with prior CSs. Furthermore, there was a statistically significant difference in the mean (M) maternal age in the groups hysterectomy (38±3.67) and no hysterectomy (33±4.54) (p-value=0.038). Another statistically significant difference was found in the mean gestational week at labor of the women in the groups hysterectomy (35.2±4.44) and no hysterectomy (38.5±1.65) (p-value <0.001). Birth weight, maternal BMI and number of previous births did not show a statistically significant association with the groups hysterectomy and no hysterectomy. Assessing fetal outcome in the groups CS and VD via APGAR II score, a statistically significant difference was found (p-value=0.039). The mean APGAR II score in the CS group was 8.83±0.57, while it was 8.94±0.41 in the VD group.

Conclusion. Even though there was no statistically significant difference between the incidence of hysterectomies in our study and international data, we must say, that the numbers of hysterectomies were lower in some other European countries (Italy, Denmark and the Netherlands). Nevertheless, our study showed significantly better results when comparing the data to a study conducted in a regional hospital in Daugavpils. Further, there was a significant difference in the maternal age and the gestational week among the groups hysterectomy and no hysterectomy. Maternal age was significantly higher, and the gestational week at labor was significantly lower in the hysterectomy group. No statistically significant differences were found in birth weight, BMI, and previous number of births among those groups. The rate of primary CSs is increasing progressively worldwide. Therefore, the number of repeated CSs, and thus, the risk for hysterectomies, increases, too. To escape this vicious cycle, women should be encouraged to do VDs and avoid unnecessary CSs. Guidelines and physicians should help decrease the numbers of primary and repeated CSs, and with that, the risk for hysterectomies for women in a reproductive age. The significantly better APGAR II scores in the VDs after prior CS should motivate women to try their deliveries vaginally rather than via repeated CS.

Key words: Cesarean section, hysterectomy, risk factors, newborns outcome.

Kopsavilkums

Pamatojums. Pasaulē aizvien pieaug veikto ķeizargriezienu (ĶG) skaits. Arī sievietes, kurām jau ir bijis ķeizargrieziens iepriekšējā grūtniecībā, izvēlas to arī nākamajā grūtniecībā, kas var izraisīt smagas komplikācijas: histerektomiju.

Mērķi. Sniegt labākos šobrīd pieejamos pierādījumus par mātes saslimstību, kas rezultējas ar histerektomiju un ir saistīta ar ĶG veikšanu sievietēm, kurām jau bijis ĶG. Salīdzināt riska faktorus (mātes vecums, grūtniecības nedēļa, jaundzimušā svars, ĶMI, un iepriekšējo dzemdību skaits) grupās "histerektomija" un "ne histerektomija". Noteikt bērna stāvokli, izmantojot Apgares skalu, pēc ĶG un pēc vaginālām dzemdībām (VDz).

Materiāli un metodes. Pētījumā retrospektīvi analizēti dati par 1620 pacientēm, kas dzemdējušas no 2015. gada janvāra līdz 2017. gada novembrim. Visām sievietēm ir iepriekš bijis veikts ĶG, tātad: uz dzemdes bija rēta. No šīm pacientēm 1513 arī apskatītajās (sekojošās) dzemdībās tika veikts ĶG, bet 107 dzemdēja vagināli. Katrai pacientei tika reģistrēts vecums, grūtniecības nedēļa, iepriekšējo dzemdību skaits un veids, mātes ķermeņa masas indekss (BMI) pirms grūtniecības, grūtniecības komplikācijas (grūtniecības diabēts, grūtniecības hipertensija, eklampsija, preeklampsija), bērna svars (paredzētais un reālais), dzimums un Apgares skalas novērtējums (II). No pētījuma izslēgti augļi ar palēninātu attīstību, dvīņi un gadījumi ar cefalopelvisko disproporciju. Histerektomiju biežums tika salīdzināts ar starptautiskajiem un nacionālajiem datiem, aprēķinot p-vērtības un ticamības intervālus (TI).

Rezultāti. Pētījumā iekļautas 1620 pacientes, kurām iepriekš veikts ĶG, no tām 93.4% (n=1513) veikts atkārtots ĶG, bet 6.6% (n=107) pēc iepriekš piedzīvota ĶG dzemdēja vagināli. Abās grupās kopā sieviešu vidējais vecums bija 33±5, bet vidējais bērnu skaits: 2.3±0.6. ĶG grupā 0.33% (n=5) sieviešu tika veikta histerektomija. Salīdzinot ar starptautiskiem datiem, šis rezultāts nav statistiski nozīmīgi atšķirīgs no citu valstu rezultātiem, lai gan histerektomiju skaits ir mazāks citās Eiropas valstīs: Itālijā, Dānijā un Nīderlandē. Salīdzinot ar citu pētījumu, kas veikts Latvijā (reģionālajā slimnīcā Daugavpilī), pētījumu rezultātu atšķirība ir statistiski nozīmīga (p-value <0.001). Lielākā daļa histerektomiju (60%, n=3) tika indicēta dzemdes plīsuma dēļ. Histerektomiju incidence ir saistīta ar mātes vecumu. Vidējais vecums grupā, kurā tika veiktas histerektomijas, bija 38±3.67, bet grupā, kurā histerektomijas netika veiktas: 33±4.54. Vecumu atšķirība abās grupās ir statistiski nozīmīga (p-value=0.038). Vēl viena statistiski nozīmīga atšķirība tika konstatēta grūtniecības nedēļā, kad notika dzemdības starp sievietēm histerektomijas grupā un ne histerektomijas grupā (p-vērtība <0,001). Vidējā vērtība histerektomijas grupā bija 35,24,44, bet ne histerektomijas grupas vidējā vērtība - 38,51,65. Jaundzimušā svars, mātes ķermeņa masas indekss un iepriekšējo dzemdību skaits neuzrādīja statistiski nozīmīgu saistību starp histerektomijas un ne histerektomijas grupu. ĶG un VDz

grupās atšķīrās novērtējums pēc Apgares skalas (II): 8.83±0.57 ĶG grupā un 8.94±0.41 VDz grupā, arī šī atšķirība ir statistiski nozīmīga (p-value=0.039).

Secinājumi. Lai gan netika atrastas statistiski nozīmīgas atšķirības starp histerektomiju skaitu šajā pētījumā salīdzinot ar starptautiskajiem datiem, jāatzīst, ka histerektomiju skaits ir mazāks citās Eiropas valstīs (Itālijā, Dānijā un Nīderlandē). Tomēr šis pētījums uzrādīja ievērojami labākus rezultātus, salīdzinot histerektomiju skaitu ar nacionāla mēroga pētījumu, kas tika veikts Daugavpils reģionālajā slimnīcā. Visbiežākā indikācija histerektomijai šajā pētījumā bija dzemdes plīsums, ko var skaidrot ar iepriekš veikta ĶG ietekmi: dzemdes sieniņas integritātes mazināšanās. Salīdzinot ar grupu, kurai netika veikta himterektomija, histerektomijas grupā mātes vecums bija ievērojami lielāks un grūtniecības nedēļa bija ievērojami zemāka. Jaundzimušā svars, mātes ķermeņa masas indekss un iepriekšējo dzemdību skaits neuzrādīja statistiski nozīmīgu saistību ne ar histerektomijas grupu, kā arī ne histerektomijas grupu. Primāro ĶG skaits pasaulē aizvien pieaug. Līdz ar to pieaug arī atkārtoto ĶG skaits un, līdz ar to, arī šīs manipulācijas komplikāciju risks, ieskaitot histerektomiju. Lai izlauztos no šī apburtā loka, nepieciešams sekmēt sieviešu izvēli dzemdēt dabiskā veidā (vagināli) un izvairīties no nevajadzīga ĶG. Vadlīnijām un ārstiem jāpalīdz samazināt primāru un atkārtotu ĶG skaitu, un, līdz ar to, arī samazināt histerektomiju risku sievietēm reproduktīvā vecumā. Arī labākajiem novērtējumiem pēc Apgares skalas būtu jāmotivē sievietes izvēlēties dzemdēt vagināli, nevis veikt ĶG.

Atslēgvārdi: Ķeizargrieziens, histerektomija, riska faktori, jaundzimušais stāvokli.

List of abbreviations

CS	Cesarean section
CSs	Cesarean sections
VD	Vaginal delivery
VDs	Vaginal deliveries
DM	Diabetes Mellitus
T1DM	Type 1 Diabetes Mellitus
Gest. DM	Gestational Diabetes Mellitus
Gest. week	Gestational week
CPD	Cephalopelvic disproportion
CTG	Cardiotocography
ECV	External cephalic version
VBAC	Vaginal birth after cesarean
ERC	Elective repeat cesarean section
TOL	Trial of Labor
EPH	Emergency peripartum hysterectomy
BMI	Body Mass Index
HDI	Human development Index
WHO	World Health Organization
NICE	National Institute for Health and Care Excellence
UK	United Kingdom
US	United States
M	Mean
SD	Standard deviation
MD	Mean difference
CI	Confidence interval
n	Number
kg	Kilogram
g	Grams
cm	Centimeters

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1 Introduction

CSs are a surgical, life-saving procedures when specific complications arise during the pregnancy and the labor. However, it is surgery which is accompanied with significant risks for the mother, and the child, as well as for future pregnancies. The number of cesarean deliveries, especially medically not indicated CSs, has increased dramatically during the last years, especially in middle- and high-income countries. Several causes are leading to this trend, including economic, organizational, social and cultural factors (Khan, Ghani, Rahim, & Rahman, 2014).

One of the main reasons for these numbers is the elective repeated CS. For women, who already underwent a CS, typically, their choices for the route of childbirth is either an elective repeated CS or a trial of vaginal birth. However, the number of women choosing the vaginal delivery has declined in the previous years in many countries due to the anxiety of pain, or of an unsuccessful vaginal birth. On the other hand, the rates of repeated CSs have risen remarkably, and account for almost 90% in the United States (Crowther et al., 2012). This, in turn, is associated with major risks, namely hysterectomies. Emergency peripartum hysterectomy (EPH) is one of the complications of cesarean deliveries. It is a surgical procedure invariably performed in the setting of life-threatening hemorrhage during, or immediately after birth. The incidence of EPH is ranged from 0.24 to 8.7 per 1000 births, and is found to be more common following CSs than VDs. The most common indications for this procedure nowadays are abnormal placentation and uterine atony. Both conditions might be explained by the prior CSs, which predispose for the abnormal placentation and the uterine atony. Despite great advances in the medical, as well as in the surgical field, postpartum hemorrhage is still a leading cause of maternal morbidity and mortality. Hysterectomies are performed when all of the conservative measures have failed to control bleedings. Of course, both, the VD after previous CS and the repeated cesarean delivery have their risks and benefits. However, there must be a healthy balance to avoid unnecessary CSs and the risk for hysterectomies associated with them (Machado, 2011).

The fetal outcome might be associated with the delivery mode. A major complication, which is estimated to increase 2-3x after the elective surgery, is the fetal respiratory problem (van den Berg, van Elburg, van Geijn, & Fetter, 2001). Hypoglycemia and hypothermia are associated with CSs, too. Besides, it is proven that CSs may lead to delayed breastfeeding, shorter periods of breastfeeding, and difficulties of the newborn bonding with the mother. Furthermore, the APGAR scores are found to be negatively affected after CSs rather than after VDs

(Christensson et al., 1993; Hagnevik et al., 1984; Makoha, Felimban, Fathuddien, Roomi, & Ghabra, 2004).

1.1 Objectives

1) To detect the incidence of hysterectomies in women delivering via CS who have a history of previous CSs and to compare them with national and international data.
2) To determine risk factors which might affect hysterectomies.
3) To assess fetal outcomes in both groups: repeated CS and VD.

1.2 Tasks

1) To analyze the rate of hysterectomies associated with CS in women with previous CSs in the maternity hospital in Riga and compare the rate with international and national data.
2) To analyze the differences of the risk factors (maternal age, gestational week, fetal weight, BMI, and number of previous births) in patients who had to undergo a hysterectomy and in those where a hysterectomy was not needed.
3) To compare the fetal outcomes via APGAR II scores in the two groups: CS after previous cesarean delivery and VD after previous cesarean delivery.

2 Literature review

2.1 Cesarean Section

CS is defined as the delivery of a fetus by incisions in the abdominal wall (laparotomy) and the uterine wall (hysterotomy). In case of an emergent complication (such as intractable hemorrhage) abdominal hysterectomy is indicated following the fetuses' birth. This type of operation is then termed a cesarean hysterectomy (McGraw-Hill, 2009).

2.1.1 History

CS has been reported in both, western and non-western literature, since ancient times. The term CS first appeared during the seventeenth century, but it's early history and mythology are uncertain (Todman, 2007).

According to the first explanation, Julius Caesar was born in this manner which led to the operation being called a "cesarean operation". But this theory has its weak spots. For example, the operation was highly fatal in that time but the mother of Julius Caesar lived for many years after his birth. Also, this operation was not mentioned by any medical writer before the Middle Ages.

The second explanation seems the most logical, but it is uncertain when precisely it was applied to the operation. It says that the word cesarean was derived from the Latin verb "caedere", to cut, and that the word section is derived from "seco", which also means cut. As both of the verbs have the same meaning which makes them tautological, the term cesarean delivery is used to describe this operation method (McGraw-Hill, 2009).

The third explanation states that in ancient times, this procedure was only performed when the woman was either dead or about to die in order to save the fetus. This was the pattern of CS's until the era of anesthesia in the nineteenth century. The procedure was further refined from the later nineteenth century and through the twentieth century with the development of surgical techniques, resulting in low morbidities and mortalities. Consequently, there was a shift in the objectives of a CS: from saving the fetus or for cultural or religious reasons towards concerns for the health and safety of the mother and fetus as well as considering the preferences of mothers (Todman, 2007).

2.1.2 Frequency of CSs

Currently, the WHO recommended the ideal rate for CSs to be between 10% and 15%. Besides, they should be performed only under specific circumstances, when the life of the child or the mother is at danger. This conclusion was derived from data collected mainly from northern

European countries (as there was limited access to data at that time), that showed excellent maternal and perinatal outcomes with the specific rate of CSs. This procedure can prevent maternal and perinatal morbidity and mortality if there is a medical indication for it. Nevertheless, it does not show any benefit to the mother, or the fetus, if the procedure is medically not required. (WHO, 2015)

Since that time, CSs have increasingly become more common in both developed and developing countries. Betran et al. conducted a study involving 150 countries, where rates of CSs were calculated from 1990 until 2014, show that 18.6% of all births occur by CSs. The highest rates account for Latin America and the Caribbean region with 40.5%, followed by Northers America (32.3%), Oceania (31.1%), Europe (25%), Asia (19.2%) and Africa (7.3%). These data show an increase of 12.4% from 1990 to 2014 worldwide (Betran et al., 2016). In the United States (US), the rates of cesarean deliveries increased by 53% from 1996 (21%) to 2007 (32%). Six states even demonstrated increases of over 70%, namely Colorado, Connecticut, Rhode Island, Washington, Florida, and Nevada (Barber et al., 2011).

2.1.2.1 Frequency of CS in Europe

In Europe, the rate of deliveries in 1997 by CSs has risen from 172.49 per 1000 live births to 254.23 in 2010. Particularly in the European Union, 221 CSs were performed per 1000 live births in 2000. Eleven years later, in 2011 the number had risen to 268 per live birth (Mylonas & Friese, 2015).

2.1.2.2 Frequency of CS in Germany

The rate of deliveries by CS in Germany more than doubled between 1991 (15.3%) and 2012 (31.7%). However, there was a slight decrease (0.4%) in comparison to 2011. The number of other obstetric procedures also slightly decreased so that the ventouse was used in 5.7%, while the use of forceps declined to 0.5% (McGraw-Hill, 2009).

Table 2.1. Cesarean rates in selected countries (Mylonas & Friese, 2015).

Country	2008 (%)	2009 (%)	2010 (%)	2011 (%)
Albania	22.70	28.10	29.70	30.00
Belgium	19.50	19.30	19.90	
Bulgaria	28.40	32.80	31.00	33.10
Germany	30.20	31.30	31.90	32.10
Estonia	20.00	20.70	20.30	20.20
Finland	15.80	15.00	14.90	14.70
France	20.60	20.70		
Georgia	24.50	28.00	31.10	34.70
United Kingdom	23.20	23.70	23.80	24.10
Ireland	25.60	26.40	26.60	
Israel	19.50	19.20	19.30	19.90
Italy	39.10	39.10	38.80	
Latvia	22.60	23.30	23.60	23.40
Lithuania	21.10	21.20	21.40	20.40
Luxemburg	26.80	26.10	25.80	27.40
Netherlands	14.30	14.80	15.60	
Austria	27.10	28.20	28.20	28.30
Poland	19.30	22.80	26.00	29.90
Rumania		30.30	33.80	36.30
Russian Federation	19.70	20.80	22.10	
Sweden	16.70	16.90	16.40	16.20
Switzerland	32.50			
Serbia	19.30	21.10	23.90	
Slovenia	17.00	17.90	19.10	19.60
Spain	24.70	24.90	24.90	24.90
Czech Republic	20.50	21.20	22.50	23.30
Turkey	41.10	44.50	46.70	47.70
Ukraine	15.60	15.90	15.80	15.80
Hungary	30.40	31.70	32.70	33.40
Cyprus	8.30	9.50	11.40	
Europe	23.00	24.00	24.80	25.30
EU	25.00	25.60	26.20	26.80

2.1.3 Reasons for the rising CS rates

Progress in science, social and cultural changes, as well as legal reforms have resulted in a fundamental change in attitudes of patients and doctors towards CSs. Besides, the increasing maternal age, and the increase in maternal request although there is no medical indication for a CS, contributes to these high numbers. Furthermore, the changes in society should not be forgotten: financial, social, and cultural elements, all appear to play an important role. Finally, these factors when taken in consideration with the public view, that a CS is a procedure with almost no risks nowadays, might also contribute to the rising numbers of this delivery type (Mylonas & Friese, 2015).

2.1.3.1 Maternal request for CS

CSs on maternal request might be carried out for singleton pregnancies without medical indications. In the US, the rate of primary CSs for women without medical need was rising from 1991 and was approximately 11.2% in 2011. Studies showed that the main reason behind this decision is tocophobia. Tocophobia is the intense fear of delivery and is found to be the main cause of CSs on maternal request. Women, who present with this condition, should be offered adequate exploration of their fears together with counseling. (Nama, Antonios, Onwude, & Manyonda, 2011) According to the British guidelines, physicians should discuss and record the specific reasons for the request of having a planned CS. Risks and benefits of the CS should be compared with those of vaginal delivery. In this discussion, other members of the obstetrician team should be involved, particularly the obstetrician, midwife and anesthetist. In case of anxiety about childbirth, the patient should be referred to a healthcare professional with expertise in providing perinatal mental health support. But if the patient is still refusing a vaginal birth after discussion and offer of help and assistance, a planned CS has to be offered (NICE, 2011).

2.1.3.2 Maternal risk Profile

Significant factors contributing to the rise in CS rates, have been shown to be changes in the risk profile of mothers. But conflicting data exist. In the US for example, there has been a rise in the rates of CSs despite the fact that maternal risk factors were decreasing in the past year's thanks to better treatment and screening options (Franz & Husslein, 2010).

2.1.3.3 Increased maternal age

Certainly, age itself is no indication for a CS. Yet, can there be seen a higher rate of CSs with advanced age. The age for women being pregnant for the first time increases progressively. Thus, it seems to play a role in the increased cesarean delivery rates. As the age rises, the risk for certain morbidities increases, leading to the necessity of CS. Namely, these are risks of fetal congenital malformations, hypertension, or even diabetes mellitus (DM) (Franz & Husslein, 2010).

2.1.3.4 Obesity and diabetes mellitus

The necessity of CSs can also be increased independently by other pre-existing diseases in the mother and pregravid obesity. One significant condition is DM which can result in macrosomia of the fetus, meaning a birthweight over 4000g. As fetal macrosomia is considered a relative risk factor for CS, the risk for this procedure rises (Ehrenberg, Durnwald, Catalano, & Mercer; Voigt, 2008).

2.1.4 Indications for CSs

The question of whether to perform a CS or not is mainly based on what is safest for mother and child. Therefore, the indications for CS can be divided into absolute and relative indications. The elective CS, where no medical indication could explain the operative procedure, is considered as a separate indication (Mylonas & Friese, 2015).

In Germany, most of the CSs are performed due to relative indications. Only less than 10% of all deliveries by CS are the result of absolute indications (Basisauswertung., 2013).

Repeated CSs and those performed for dystocia have been the leading indications in the US and other western industrialized countries. The risk of adverse neonatal respiratory outcome increases in those delivered before the 39^{th} week for women in whom scheduled CS is selected (Clark et al., 2009; Oshiro et al., 2009). The American College of Obstetricians and Gynecologists (2008) recommends confirming fetal pulmonary maturity before scheduled delivery before the 39^{th} week of gestation unless fetal maturity can be determined from historical criteria (McGraw-Hill, 2009).

According to Association of Scientific Medical Societies in Germany guideline “Absolute and relative indications for cesarean section with discussion of cesarean delivery on maternal request”, the indications can be divided into relative and absolute (AWMF, 2015).

Table 2.2. Absolute and relative indications for CS according to AWMF (AWMF, 2015).

Absolute indications	**Relative indications**
CPD	Pathologic cardiotocography (CTG)
Maternal pelvic deformity	Failure of progress in labor
Chorioamnionitis	Previous CS
Eclampsia and HELLP syndrome	
Fetal asphyxia or fetal acidosis	
Umbilical cord prolapses	
Placenta previa	
Abnormal lie and presentation	
Uterine rupture	

In 1944, Notzon et al. showed in a study, that in the developed world approximately 30% of cesarean sections were repeated CSs after primary CSs, 30% were performed due to dystocia, 11% were performed due to breech position and 10% were performed for fetal distress (Notzon et al., 1994).

These values changed during the last decades as shown in another study from Wang et al. who compared indications for CSs from 1999 to the indications for CSs in 2009. The statistical analysis showed that CS attributable to breech and CPD had decreased while "1 previous CS" is the only indication that has significantly increased. Furthermore, "2 or more previous CS" has replaced "hypertensive disorders" as one of the most common indications for CSs a decade later in 2009. However, there was a greater than double increase in the absolute number of CS due to "1 previous CS" (Wang, Tan, Kanagalingam, & Tan, 2013).

2.1.4.1 Cephalopelvic disproportion

Abnormally slow process in labor, or dystocia, can result from CPD, malposition of the fetal head as it enters the birth canal, or weak uterine propulsive forces. CPD occurs when there is a mismatch between the size of the fetal head and the size of the maternal pelvis, which would result in obstructed labor that can endanger the lives of both mother and fetus (Maharaj, 2010). CPD is an absolute indication for primary CS. Still, the prognostic methods remain subjective. According to the latest UK guidelines, pelvimetry is not a reliable method regarding choosing the right delivery mode. Furthermore, shoe size, maternal height and estimations of fetal size (ultrasound or clinical examination) do not accurately predict CPD, and should not be used to predict "failure of progress" during labor. For example, the sensitivity of the ultrasonographic measurements of fetal head, femur and abdominal girth for estimating the fetal size and weight varies from 60 to 80% in Europe (Callec et al., 2015; NICE, 2011).

2.1.4.2 Fetal malpresentation

One complicating factor of 3.8% of pregnancies is the breech position at the 37th weeks of gestation and beyond, and more than 85% of pregnant women with a persistent breech presentation are delivering by cesarean (Lee, El-Sayed, & Gould, 2008). A recent study proves that the rate of attempted external cephalic version (ECV) was 46% and decreased during the labor period. Thus, ECV for malpositioning is underutilized, especially when considering that most patients with a successful ECV will give birth vaginally with no impairment of the fetal health (Clock, Kurtzman, White, & Chung, 2009).

2.1.5 Repeated CSs

Repeated CSs are one of the most common indications for CSs (even though it is not an absolute indication). Internationally, vaginal birth after cesarean (VBAC) rates have decreased in the recent years. From 1996 to 2004, the rates in the US have fallen from 28.3% to 9.2% with a corresponding increase in the rates of repeated CS (MacDorman, Menacker, & Declercq, 2008). Most of the women should at least attempt VBAC, as there are only few absolute indications for a repeated CS. However, the rates of VBAC varies worldwide from 52% in the US to only 9% in the UK (Black, Bhattacharya, Philip, Norman, & McLernon, 2016).

Nevertheless, patients experience some complications attributed to the prior CS. The operating time gets longer due to severe adhesions, which may arise with each CS performed. Besides, the risk for increased blood loss and the need for blood transfusions increases, too. Uterine rupture, placenta previa, preterm birth, and gestation age at delivery seem to influence repeated CSs, too (Gasim, Al Jama, Rahman, & Rahman, 2013).

2.1.5.1 The British Guidelines on previous CS

Currently, the UK seems to have the lowest numbers on repeated CSs. These rates might be explained by the British guidelines about pregnancy and childbirth after CS, that stress to consider the followings when advising about the mode of birth as a physician:

- Maternal preferences and priorities
- The risks and benefits of repeat CS
- The risks and benefits of planned vaginal birth after CS, including the risk of unplanned CS

The physicians should inform the patients that the risk of fever, bladder injuries and surgical injuries does not vary with the planned mode of birth and that the risk of uterine rupture is rare. Women who have a history of previous CS but are planning a vaginal delivery, should be provided with electronic fetal monitoring during labor. Furthermore, care should take place in a unit where immediate access to CS and on-site blood transfusion services is available. Moreover, the patients should be informed that pregnant women with both, a history of previous CS and vaginal delivery have an increased likelihood of achieving a vaginal birth than women who have had a previous CS but no previous vaginal delivery (NICE, 2011).

2.1.5.2 Vaginal birth after cesarean

VBAC is determined to be safe option for many women. To reduce the number of unnecessary abdominal births after a previous CS, many researchers support the trial of vaginal delivery for selected cases. Multicenter studies show that the average rate of success in appropriate candidates lies between 50 and 80%, with decreased hospital stay and complication rates in the VBAC group (Carroll, Magann, Chauhan, Klauser, & Morrison, 2003; Kobelin, 2001).

Clinical characteristics and obstetric variables have been evaluated to identify predictors of successful VBAC, including the followings: a prior vaginal delivery, and particularly, a prior VBAC, the indication for the CS, birth weight, and the induction of labor and inter-delivery interval (Grinstead & Grobman, 2004; Hendler & Bujold, 2004).

Out of these, a previous vaginal delivery was among the most common predictor of a successful VBAC, with a success rate of 86-89% (Landon et al., 2004). Grobman et al. also show similar results and describe that a clinically adequate pelvis, no other uterine scar or previous rupture, a physician who is immediately available throughout active labor capable of monitoring labor and performing an emergency CS, and the availability of anesthesia and personnel of emergency CS are reliable factors for choosing candidates for a trial of labor after a primary CS (Grobman et al., 2007).

In the US, VBAC rates have increased initially, but are currently in a decreasing trend. This is shown by current data, where the numbers fell from 28.3% in 1996 to 12.7% in 2002. The most driving force for this change is thought to be the progressive increase in the primary cesarean delivery rate (McGraw-Hill, 2009). Consequently, the rates of repeated CSs (ERC) have risen sharply. Currently, in Austria, 83% of women chose the ERC and almost 90% in the United States. On the other hand, in the United Kingdom, repeat cesarean now accounts for 28% of all births (Crowther et al., 2012).

The low rates of VBAC might be explained by concerns of patients over immediate maternal and neonatal complications, including uterine rupture, hysterectomy, and perinatal morbidity and mortality. On the other hand, this short-term morbidity must be balanced by the increase in maternal and neonatal risks which are associated with multiple repeated cesarean deliveries (Jackson & Paterson-Brown, 2001). Women planning ERC are at increased risk of surgical complications, placenta accrete, and numerous CSs. Furthermore, their infants are at risk of respiratory morbidity. Another explanation for the low rates of VBAC may be due to the erroneous assumption of many women with a previous CS, that the likelihood of VBAC success will be low in any case (Chauhan, Martin, Henrichs, Morrison, & Magann, 2003).

2.1.6 Risks and complications of repeated cesarean delivery

CS on maternal request is relatively rare in the UK (1-2% of births), whereas in some middle-income countries the rate is high and growing (20% of births in southeastern China in 2006), which makes it an emerging global public health concern. As mentioned, another contributor to the rising rates is the repeated CS. Even though not medically indicated in low obstetrical risk women, among US births in women with prior CS in 2006, over 90% were cesarean deliveries.

The future parents want a mode of delivery which is safe for the baby. In case of emergencies, or in case of a fetal or maternal indication, the choice is clear. But in more calm situations, for example, repeat or maternal/ parental choice of cesarean, it makes sense to consider the risks and benefits of CS versus vaginal delivery (Blustein & Liu, 2015).

Both, repeated CSs and VBAC are associated with advantages and disadvantages. The cesarean delivery, for example, is associated with an increased risk of maternal complications such as bleeding, the need for blood transfusions, infections, damage to the bladder and bowel, and deep venous thrombosis. With the increasing number of CSs, the difficulty in performing the next surgery increases, too. An important outcome is the appearance of adhesions with each surgery. Another significant problem might be in conceiving a further child or the development of abnormal placentation as women with prior CSs are at increased risk for placental pathologies. Moreover, infants born via CS are at higher risk for developing transient tachypnea which may be related to the use of general anesthesia and gestational age (Crowther et al., 2012).

Table 2.3. Complications of CS compared with planned vaginal delivery among healthy women in Canada, 1991-2005 (Blustein & Liu, 2015)

Complication	**Cesarean (n=46,766)**	**Vaginal (n=2,292,420)**
Overall morbidity	1279 (2.73)	20,639 (0.90)
Hysterectomy	39 (0.09)	254 (0.01)
Transfusion	11 (0.02)	1500 (0.07)
Anesthetic complications	247 (0.53)	4793 (0.21)
Hypovolemic shock	3 (0.01)	435 (0.02)
Cardiac arrest	89 (0.19)	887 (0.04)
Venous thromboembolism	28 (0.06)	623 (0.03)
Puerperal infection	281 (0.60)	4833 (0.21)
Wound disruption	41 (0.09)	1151 (0.05)
Wound hematoma	607 (1.3)	6263 (027)
In-hospital deaths	0	41 (0.002)

Table 2.4. Complications in women with a prior CS (Landon et al., 2004)

Complication	**TOL n=17,898 (%)**	**Elective repeat CS n=15,801 (%)**	**Odds Ratio**
Uterine rupture	124 (0.7)	0	N/A
Uterine dehiscence	119 (0.7)	76 (0.5)	1.38
Hysterectomy	41 (0.2)	47 (0.3)	0.77
Thromboembolic disease	7 (0.04)	10 (0.1)	0.62
Transfusion	304 (1.7)	158 (1.0)	1.71
Uterine infection	517 (2.9)	285 (1.8)	1.62
Maternal death	3 (0.02)	7 (0.04)	0.38
Antepartum stillbirth 37-38 weeks	18 (0.4)	8 (0.1)	2.93
Antepartum stillbirth >38 weeks	16 (0.2)	5 (0.1)	2.70
Intrapartum stillbirth 37-39 weeks	1	0	N/A
Term hypoxic ischemic encephalopathy	12 (0.08)	0	N/A
Term neonatal death	13 (0.08)	7 (0.05)	1.82

2.1.6.1 Risks for long term child health

Until now, concerns about long-term child health have primarily focused on neurological impairment, but recent studies show that potential risks for chronic diseases exist. Meta-analysis of cohort and case-control studies find a positive association between children delivered by CSs and type 1 diabetes mellitus (T1DM), obesity and asthma, which should be taken into account in guidelines for CS (Cardwell et al., 2008; Li, Zhou, & Liu, 2013; Thavagnanam, Fleming, Bromley, Shields, & Cardwell, 2008).

Combined cohort and case-control studies showing higher evidence for T1DM are particularly compelling because many of these studies used very detailed sets of well-characterized clinical markers, namely birth weight, gestational age, maternal age, birth order, maternal diabetes, and breastfeeding. The meta-analysis by Cardwell et al. was based on assembling individual patient data from most component studies and calculate a pooled risk estimate, adjusting for known cofounders. The finally adjusted analysis found out that cesarean deliveries increased the relative risk of T1DM by 19%. Similar rates were found for other risks, e.g. asthma and obesity. The absolute rates are dependent on many assumptions, including local rates of cesarean and disease prevalence in the specific country. In the US, an overall childhood T1DM rate of 1.9/1000 translates to rates of 1.79/1000 children delivered vaginally and 2.13/1000 children delivered by CS (Cardwell et al., 2008).

Furthermore, the newborns miss out on the healthy and beneficial part of the labor when not being exposed to maternal bowel flora. There are studies suggesting that this exposure is necessary for the normal development of the newborn’s gut microbiome. Thus, CSs, which do not allow the contact between the fetus and the maternal gut flora, are adversely affected and have a less functioning immunity. This event may be explained by the increased risk of the offspring for asthma, T1DM, obesity, inflammatory bowel disease (IBD), and cancer in a study involving children delivered via CS (Black et al., 2016; Cook, Graubard, Rubertone, Erickson, & McGlynn, 2008).

Besides, studies have found out, that the APGAR scores of the children after birth varied by the mode of deliveries. Burt et al. showed that infants of women undergoing repeated CSs were more likely to have low APGAR scores by almost 30%, rather than those who delivered vaginally (Burt, Vaughan, & Daling, 1988).

2.1.6.2 Risks for long-term mother health

When comparing cesarean with vaginal delivery, CSs were associated with a three- to six-fold risk of severe complications. Operating times were longer in repeated CSs due to severe adhesions, as well as the need for blood transfusions. Mothers experienced a more severe blood loss and the risk for uterine rupture and placenta previa increases with each CS. Gestational week, and preterm birth contributed to the outcome of multiple CSs, too (Gasim et al., 2013). Moreover, it increases the long-term gynecological morbidity, including intermenstrual bleeding, chronic pelvic pain and risk of secondary infertility (Tihtonen & Nyberg, 2014).

2.1.7 Risks and complications of vaginal birth after cesarean

One uncommon, but potentially dangerous complication associated with a prior CS is that of the uterine rupture. This condition may occur before the onset of labor, or during the labor. In developed countries, it was the leading risk factor for uterine rupture, whose global incidence is estimated between 0.1% and 0.5% in patients with previous CSs. Women with a prior CS are also at higher risk for abnormal placenta insertion, where the risk of association is increasing with the number of previous cesareans: twice higher risk of placenta previa, and even more significant maternal morbidity associated with placenta previa. It is also a major risk factor for placenta accrete, especially in women combining previous CSs and placenta previa (Deneux-Tharaux, 2012).

Trauma to the woman's perineum with associated longer-term problems may develop when attempting (any) vaginal birth, including pelvic floor weakness, which could contribute to symptoms of prolapse and incontinence. (Crowther et al., 2012)

2.1.8 CS technique

Surgical performance of CS is comparable worldwide, with minor variations (McGraw-Hill, 2009).

2.1.8.1 Abdominal Incision

Either a midline vertical or a suprapubic transverse incision is used (McGraw-Hill, 2009).

2.1.8.1.1 Vertical incision

The quickest incision to create is the infraumbilical midline vertical incision, which should be sufficient of length to allow for delivery without any complications corresponding to the estimated fetal size. The anterior rectus muscle sheath should be freed with sharp dissection of subcutaneous fat to expose a 2-cm wide strip of fascia in the midline. The rectus and the pyramidalis muscles are separated in the midline by sharp and blunt dissection to expose tranversalis fascia and peritoneum and are dissected to reach the underlying peritoneum. Then, the peritoneum near the upper end of the incision is opened carefully, either bluntly, or by elevating it with hemostats. Now, it should be checked whether there are adhesions which might have occurred with after previous intraabdominal surgeries, including CS. The peritoneum is incised superiorly to the upper pole of incision, and downward to over the bladder (McGraw-Hill, 2009).

2.1.8.1.2 Transverse incision

The skin and the subcutaneous tissue are incised using a lower, transverse, slightly curvilinear incision at the level of the pubic hairline (Pfannenstiel incision). Afterwards, a sharp dissection is continued through the subcutaneous layer to the level of the fascia to separate them from each other for approximately 1 cm. Exquisitely, the two layers consisting of aponeurosis and internal and external oblique muscle are incised individually during lateral extensions of the fascial incision. Blood vessels between the muscles and fascia are either clamped, cut and ligated or fulgurated with electrocautery. To allow an adequate midline longitudinal incision of the peritoneum, the separation of the fascia should be carried out near enough to the umbilicus. The peritoneum is opened as discussed earlier after separating the rectus muscles in the midline (McGraw-Hill, 2009).

With this method, great cosmetic results can be achieved as the Pfannenstiel incisions follow the Langer lines of skin tensions. Furthermore, the rate of postoperative pain is decreased, also the incidence of fascial wound dehiscence, and of an incisional hernia (Hendrix et al., 2000).

2.1.8.2 Uterotomy

Gentle pressure is used to introduce a long anatomical forceps into the uterine cavity at the level of the isthmic cervical segment at an oblique angle of approximately 30° past the fetal head, or breech presentation after incising the uterine serosa 2 cm above the uterovesical fold. Now, the uterine wall is incised along a length of five to six cm and expanded manually using scissors situated between the two arms of the forceps (Vejnovic, Costa, & Ignatov, 2012).

2.1.8.3 Delivery of the baby

By pushing the upper (front) and lower (back) uterine wound using the fingers of the left hand, the presenting part is “born” and is assisted by pressure exerted on the uterine fundus with the right hand. As skin elasticity is enough, no wound retractors are needed. When the baby is delivered, the cord should be clamped, and the placenta should be removed using cord traction and pressure on the fundus. In case of suspicions that some parts of the placenta might have been retained, curettage is performed using a large blunt curette plus a manual cervical dilatation or a dilatation using Hegar pins to a width of 3 cm depending on the extent of the cervical dilatation (Vejnovic et al., 2012).

2.1.8.4 Uterine sutures

The closing of the uterine wall is performed by using two stitches starting from the middle of the uterotomy. For adequately approximating the corner of the wound, traction on the thread is used. A second suture thread is used to create a continuous line of sutures (Vejnovic et al., 2012).

2.1.8.5 Closure of the peritoneum and the fascia

The peritoneum is placed on the front wall of the uterus after inspecting both adnexa. However, the peritoneum is not being sutured. Instead of that, the fascia is closed as usual using a continuous suture (Vejnovic et al., 2012).

2.1.8.6 Skin sutures

The suturing of the skin should be initiated with intracutaneous continuous sutures, starting and ending approximately 2 cm medial to the corners of the wound. Which this method, the natural drainage of wound secretions and blood can be established. Finally, the wound is disinfected and a large compress is placed above the wound. Stitches will be removed between the 8th and 10th postoperative day (Vejnovic et al., 2012).

2.2 Hysterectomy

In case of severe obstetrical hemorrhages, a hysterectomy performed at, or following delivery may be lifesaving. We distinguish three main types being hysterectomies: during a cesarean delivery, hysterectomies after a cesarean delivery when the CS is completed by performing a relaparotomy and lastly, hysterectomies and after vaginal births.

The term "peripartum" hysterectomy shows, that the hysterectomies does not only happen after the labor was completed but also before the labor has even started. Taking uterine ruptures as an example, they can occur before the normal time of delivery which can lead to premature birth, prenatal death and severe hemorrhages resulting in hysterectomies (McGraw-Hill, 2009). Despite advances in medical and surgical fields, postpartum hemorrhage continues to be the leading cause of maternal morbidity and mortality. In modern obstetrics, emergency peripartum hysterectomy (EPH) is the most dramatic operation, and is performed only if all other conservative measures have failed to stop bleeding and achieve hemostasis in the setting of life-threatening hemorrhages (Machado, 2011).

2.2.1 Incidence of hysterectomies

The incidence of hysterectomies associated with CS is much higher than that of the vaginal deliveries. Approximately 80% of the hysterectomies are associated with cesarean deliveries, whereas only 20% might occur after vaginal births. CS itself is a known risk factor for hysterectomies (Knight, Kurinczuk, Spark, Brocklehurst, & United Kingdom Obstetric Surveillance System Steering, 2008; McGraw-Hill, 2009).

The incidence in Europe is different from country to country. The Netherlands has a rate of 0.33 hysterectomies per 1000 births (Kwee, Bots, Visser, & Bruinse, 2006).

The United Kingdom shows a slightly higher number with 0.41 hysterectomies per 1000 CS (Knight et al., 2008). Ireland showed hysterectomies which had to be performed 0.3/1000 live births. (Machado, 2011)

The study, conducted by Jakobsson et al., assessed the prevalence of EPH across the five Nordic countries reaching 0.35 hysterectomies per 1000 births. Finland showed the highest prevalence with 0.51 EPH out of 1000 CS and the incidence in Iceland (0.42 per 1000 births was higher than in Denmark, Norway, and Sweden, all with similar rates varying from 0.29-0.3/1000 CS. Norway had the lowest rate with 0.29 EPH per 1000 births (Jakobsson et al., 2015).

In the United States, the number is relatively higher than in Europe. In average, five hysterectomies can be expected per 1000 CS. However, this number depends on the institution varying from 0.8 to 8 hysterectomies (Forna, Miles, & Jamieson, 2004; Shellhaas et al., 2009).

With a frequency of 2.4 hysterectomies per 1000 CS, China shows a slightly lower number than the US (Chen et al., 2013).

2.2.2 Incidence of hysterectomies in women with prior CSs

The incidence of hysterectomies in women with a history of previous CS varies worldwide. In Saudi Arabia, hysterectomy rates account for 0.44% according to a study conducted by Makoha et al. in 2004. In Turkey, the rates are similar. Kaplanoglu et al. (2015) show 0.40% of hysterectomies happening after previous CS. European studies show better numbers with Italy having to perform hysterectomies after previous CS in 0.14% (Stivanello et al., 2010). Same results were shown in a Danish study conducted by Colmorn et al. In the Netherlands, 0.16% of hysterectomies are associated with previous CS (Kwee et al., 2006). In several American studies, the rates of hysterectomies associated with previous CS varied from 0.19%-0.33% (Flamm, Goings, Liu, & Wolde-Tsadik, 1994; Landon et al., 2004; Macones, Hausman, Edelstein, Stamilio, & Marder, 2001; McMahon, Luther, Bowes, & Olshan, 1996; Shellhaas et al., 2009)

2.2.3 Indications for hysterectomies

Most of the hysterectomies are performed in order to arrest hemorrhage from intractable uterine atony, lower segment bleeding associated with the uterine incision or abnormal placental implantation, uterine rupture, or uterine vessel laceration. Moreover, coagulopathies, retained products of conception, precipitate or prolonged labor, fetal macrosomia or multiparity, maternal obesity and previous primary postpartum hemorrhage play a role in performing hysterectomies. Traditionally, the most common indication for EPH was uterine atony. However, recent studies show a change in the trend towards abnormal placentation (Flood et al., 2009; Machado, 2011).

2.2.3.1 Abnormal placentation

In 1984, it was reported that the leading indication for EPH was uterine atony in 43.45%, and placenta accreta in 33.9%. Nine years later, another study showed a change in the distribution of the indication. Placenta accrete then accounted for 45% of the cases as an indication for hysterectomies and uterine atony only 20%. Similar studies also show abnormal placentation as the predominant indication, the incidence ranging from 45-73.3% for abnormal placentation and 26.6% to 35.6% for uterine atony (Christopoulos et al., 2011; Engelsen, Albrechtsen, & Iversen, 2001).

As the numbers of pregnant women with previous CS have risen during the last years, the incidence of abnormal placentation has become more common. In patients with placenta accreta, the rate of previous CS is approximately 59.8% and the rate is 75% in patients with a placenta previa. Such reports show a high association between abnormal placentation and CSs and the high incidence of EPH is directly related to the progressively rising number of CSs (Karayalcin, Ozcan, Ozyer, Mollamahmutoglu, & Danisman, 2011).

Another report further confirmed this by showing an incidence of placenta previa which was 1.9/1000 after one previous CS. This number has risen 47 fold to 91/1000 in patients with four previous CS. Patients with placenta previa and a history of prior CS had a risk of 16% risk undergoing EPH compared to 3.6% in patients with no scar tissue on the uterus (Machado, 2011).

2.2.3.2 Uterine Atony

The indication for hysterectomies due to uterine atony ranges from 20.6 to 43%. It used to be the leading cause of EPH. However, the incidence has decreased as a result of newly developed pharmaceutical treatment strategies, including prostaglandins. Risk factors for uterine atony requiring EPH, were found to be multiparity and oxytocin use for uterine stimulation. Moreover, Combs et al. identified the followings as independent risk factors for uterine atony in patients with postpartum hemorrhage: pre-eclampsia, nulliparity, twins, induction, prolonged labor and augmentation (Christopoulos et al., 2011; Combs, Murphy, & Laros, 1991).

2.2.3.3 Uterine rupture

Uterine rupture can be classified into two categories: complete and incomplete. Complete uterine rupture is considered when all layers of the uterine wall are separated, and incomplete when the uterine muscle is separated, but the visceral peritoneum is intact. This type of rupture is called uterine dehiscence sometimes, too. (McGraw-Hill, 2009)

The number of patients with uterine rupture, as an indication for EPH, ranged from 11.4 to 45%. The most significant risk factor for this condition is considered to be multiple previous CSs. Motomura et al. conducted a secondary analysis, where the incidence of uterine rupture in 29 countries was calculated. The States were divided according to their Human Development Index (HDI). The extent of uterine rupture among females with prior CS was 0.3% in the very high-HDI group and 1.0% in the low-HDI group (Motomura et al., 2017).

However, a study by Yap et al confirms, that the relatively small risk of uterine rupture during vaginal birth after cesarean can be managed well and that it does not result in major maternal morbidity and mortality or in neonatal mortality, if there is in-house obstetric, anesthesia, and surgical staff, and where close monitoring of fetal and maternal well-being can be assured (Yap, Kim, & Laros, 2001).

Table 2.5. Number of total deliveries and uterine rupture among women with prior CS (Motomura et al., 2017)

		Women with prior CS			
		Total		**Uterine rupture**	
HDI	**Total deliveries**	**n**	**%**	**n**	**%**
Very high-HDI countries	17.294	2.843	16.4	8	0.3
High-HDI countries	68.066	13.125	19.3	20	0.2
Medium-HDI countries	104.2016	11.280	10.8	39	0.4
Low-HDI countries	125.030	10.118	8.1	103	1.0
All countries	314.623	37.366	11.9	170	0.5

2.2.4 Complications of hysterectomies

Major complications of hysterectomies are significant blood loss and an increased risk of urinary tract damage. The fact, whether the operation is performed planned or as an emergency has a significant influence on the complication rate with having higher morbidity rates in case of emergency situations (McGraw-Hill, 2009).

Table 2.6. Comparison of Morbidity Rates in case of Elective and Emergency peripartum hysterectomies (McGraw-Hill, 2009).

	Complications in Percent	
Complication	**Elective (n=345)**	**Emergency (n=644)**
Transfusions	28	83
Urinary tract injury	1.8	5.6
Surgical infection	21	25
Death	0	1.4

2.2.5 Technique for hysterectomies

Hysterectomies can be divided into two different parts: the subtotal (supracervical) hysterectomy where only the uterine body is removed and the total hysterectomy, where the uterine body and the cervix are removed. An advantage of the hysterectomy is that cervical cancer can be prevented, but on the other hand, the disadvantage is that cutting the cervix reduces the length of the vagina which can affect a woman's sexual life. (McGraw-Hill, 2009) Recent studies have shown that statistically there is no significant difference between total and subtotal hysterectomies regarding sexual function of individuals and urinary and intestinal function. The total hysterectomy group had less blood loss during the surgery while in the subtotal hysterectomy, vaginal bleeding was more common (Lethaby, Mukhopadhyay, & Naik, 2012).

2.2.5.1 Supracervical hysterectomy

The body of the uterus is amputated below the uterine artery ligation while the cervical stump may be closed with continuous sutures. To prevent hemorrhages during the pregnancy, a subtotal hysterectomy is often sufficient and may be more reasonable (Kastner, Figueroa, Garry, & Maulik, 2002).

2.2.5.2 Total hysterectomy

In this case, when removing the cervix, the bladder must be mobilized. With this method, a laceration or suturing of the bladder during cervical excision and vaginal cuff closure can be prevented. Furthermore, it will help carry the uterus caudad as the bladder is retracted beneath the symphysis. Now, the cervicovaginal junction has to be identified which can be performed with different methods, for example by an anterior uterine incision made in the midline. Below the level of the cervix, a curved clamp is placed across the lateral vaginal fornix, and the tissue is incised medially to the clamped uterine vessels. After the excision of the lateral vaginal fornix, it simultaneously can be ligated and sutured to the stump of the cardinal ligament. After being sure that the cervix has been removed entirely, the vagina can be repaired by suturing (McGraw-Hill, 2009).

2.2.5.3 Oophorectomy

According to Plauche et al., approximately 5% of postpartum hysterectomies are associated with removing one adnexum to stop bleeding. However, Briery at al report that a fourth of women had unilateral or bilateral oophorectomy and that a decision about the removal of the ovaries must be made which is not difficult in women who are progressing to the menopause. More difficult it gets when the women are in the reproductive age (Briery et al., 2007).

2.2.5.4 Cystotomy

A common complication in women undergoing cesarean hysterectomy is the incidental cystotomy. If laceration of the bladder is suspected, it may be confirmed by instillation of sterile infant formula into the bladder via a Foley catheter. With this method, the laceration may be identified, and its borders may be delineated. Moreover, cystoscopy may be performed to identify an injury further. The cut should be repaired at the primary surgery so that the formation of a vesicovaginal fistula may be prevented. After suturing the affected area, bladder drainage must be performed for seven to ten days postoperative (McGraw-Hill, 2009).

3 Materials and Methods

3.1 Study design

This retrospective study was conducted at the Rīgas Dzemdību nams (Miera iela 4, Riga-1013, Latvia). The data collection included patients with prior CS identified by the diagnosis "Cicatrix uteri" between January 2015 until November 2017. Further, the women were differentiated according their mode of delivery: repeated CS or VD. Different risk factors during the gestation were investigated and correlated with the incidence of hysterectomies. And fetal outcome was assessed and compared in the groups repeated CS and VD.

Following factors were observed by the study that potentially could have influenced the outcome of the labor: Maternal age, gestational week, fetal weight, maternal BMI before gestation, number of previous births, APGAR II score, and pregnancy complications (gestational diabetes mellitus, gestational hypertension, eclampsia, preeclampsia).

In total, 1620 patient histories were studied, from which all had a uterine scar as a result of previous CS. Out of these patients, 1513 had a repeat CS and 107 decided to have a further vaginal delivery. Patients with an expected retardation fetus, twins, and cephalopelvic disproportion were excluded from this study.

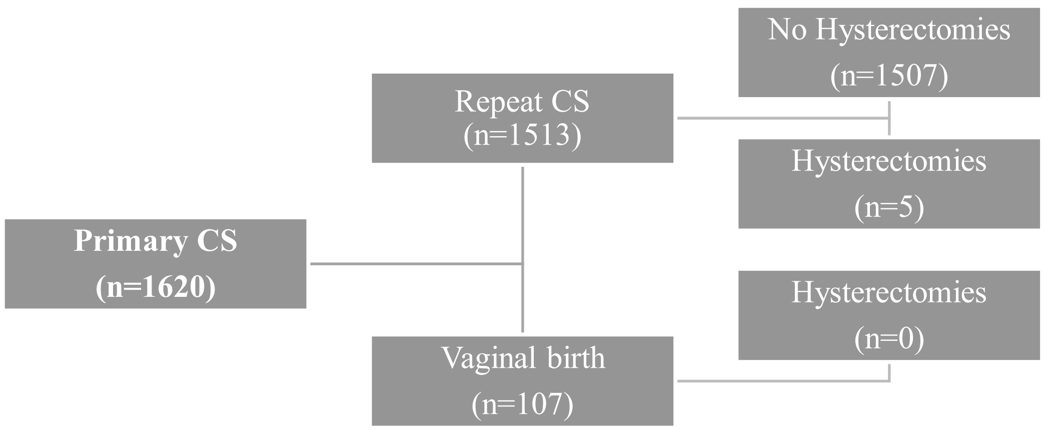

Figure 3.1. Schematic representation of patient cohort.

3.2 Data collection

The study is based on the data of the patients who delivered in the Maternity Hospital in Riga from January 2015 until November 2017 which were collected from the Archive. All of the patients in this study have had previous CS. All data were anonymously collected in an Excel table for further statistical analysis. This study was approved by the local Ethics Committee of the Rīgas Dzemdību nams, as well as the Scientific Ethics Commission of the Institute of Cardiology and Regenerative Medicine of the University of Latvia.

3.3 Data analysis and statistical methods

Statistical analysis was performed with IBM SPSS Statistics Software 24®. Categorical numbers are given as numbers and percentages (%). Values for continuous variables are shown as mean (M) ± standard deviation (SD). Furthermore, an independent sample t-test (two tailed) was used to compare the differences between groups hysterectomy and no hysterectomy, as well as for the groups repeated CS and VD after CS. Categorical variables were analyzed using Pearson Chi-Square test. For the comparison of our study with already published data, number of their total patients and the incidence of hysterectomies (%) were collected from 12 articles. P values and 95% confidence intervals were calculated for all articles and compared with our results. A p-value of < 0.05 was considered as statistically significant.

4 Results

4.1 Characteristics of groups

4.1.1 Characteristics of total patients

A total of 1620 patients between 18 years and 46 years with a history of at least one previous CS were included in the study. The mean age of all women was M=33±5 years. The mean number of children was M=2.3±0.6. 4.9% (n=79) of the females were diagnosed with gestational diabetes, 3.8% (n=62) with gestational hypertension, and 1.5% (n=24) with eclampsia/ preeclampsia. The fetuses were delivered between the 27th and the 42nd week; this means that the mean gestational week was M=38±1. 3.7% (n=60) of the infants were delivered preterm, and the remaining 96.3% were delivered term. The mean fetal weight was M=3538±1025g. One of the newborns died prenatally. 53% of the infants were male (n=862) and 47% were female (n=756). The median APGAR II was M=8.8±0.56.

Table 4.1. Characteristics of the patients in total.

Total number of patients	100% (n=1620)
Mean age of patients	33±5
Mean number of total children/ mother	2.3±0.6
Patients delivering via cesarean section	93.4% (n=1513)
Patients delivering via vaginal delivery	6.6% (n=107)
Mean age of the women (years)	33±5
Gestational Diabetes	4.9% (n=79)
Gestational Hypertension	3.8% (n=62)
Mean total child number (± SD)	1.5±24
Mean gestational week	38±1
Preterm deliveries	3.7% (n=60)
Term deliveries	96.3% (n=1560)
Mean weight of children (grams)	3538±1025
Mean gestational week	38±1
Mean APGAR II	8.8±0.56

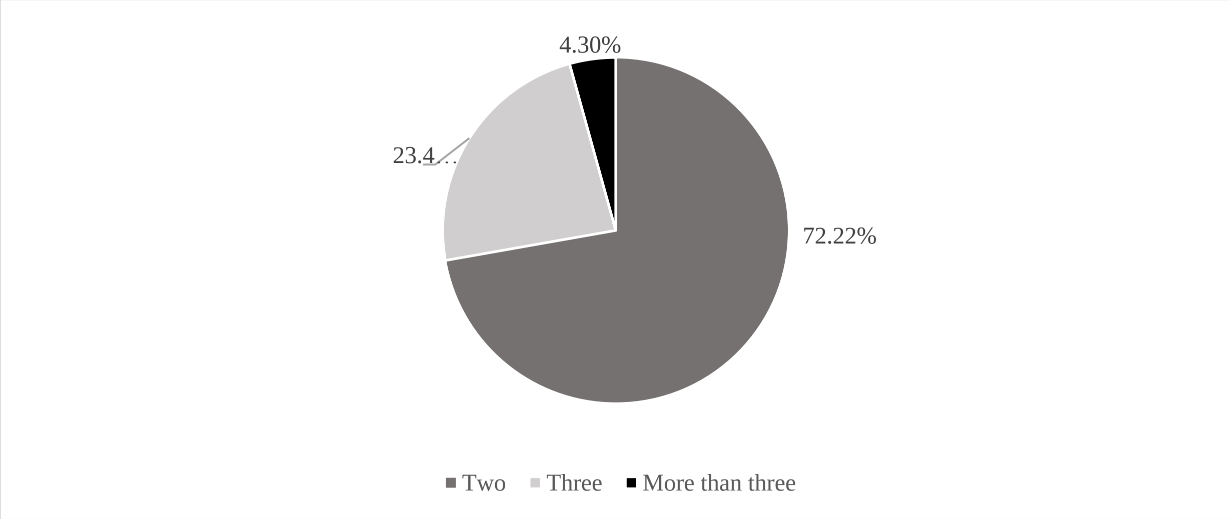

Figure 4.2. Distribution of the number of children among the women.

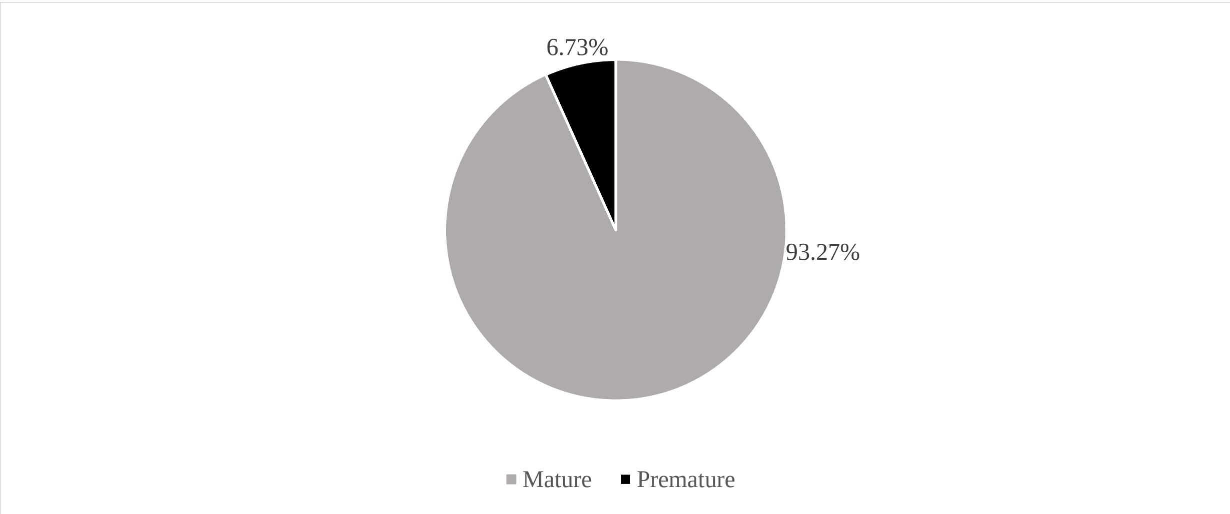

Figure 4.3. Percentage of mature and premature deliveries.

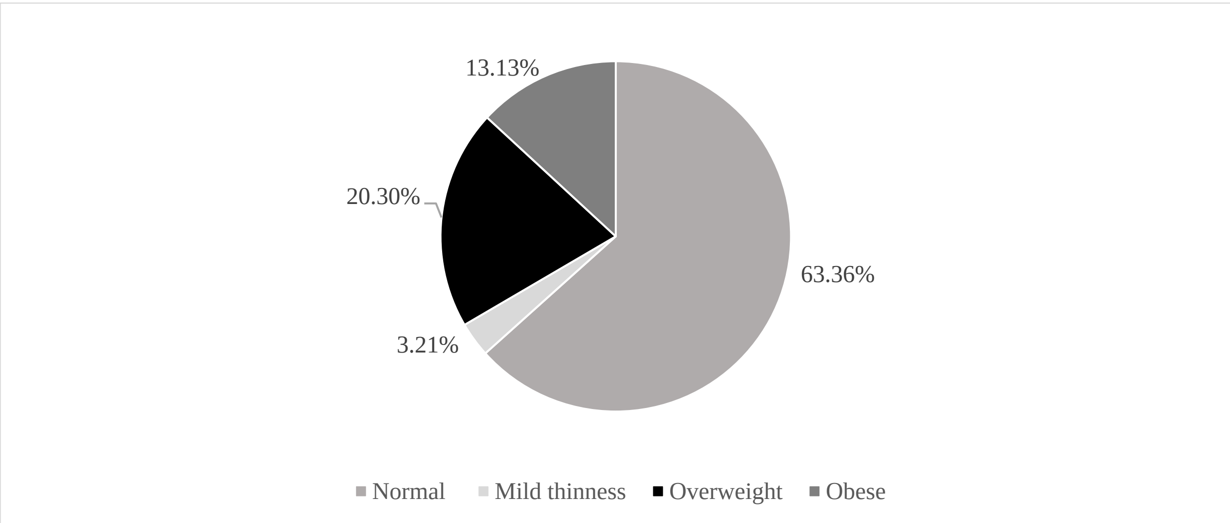

Figure 4.4. Distribution of Body Mass Index among the women.

4.1.2 Characteristics of the CS group

From the 1620 patients, 93.4% (n=1513) performed a repeat CS. The mean number of children in this CS group was M=2.3±0.6. The infants were born between the 27th and the 42nd week. So, the mean gestational week was M=38±1. Out of those 1513 patients, 5.2% (n=78) had gestational diabetes, 4.1% (n=62) had gestational hypertension, and 1.6% (n=24) had eclampsia/preeclampsia. Before the gestation, the BMI of the mothers had a mean of M=24.7±4.9 kg/cm^2.The mean fetal weight was M=3528±536 g and the mean APGAR II score was M=8.83±0.5.

Further, the CS group was dived in two groups. The first group included women, who had to undergo a hysterectomy, and in the second group no hysterectomy was needed to be performed. Overall, in 0.33% (n=5) of the cases, a hysterectomy had to be performed. The indications for the hysterectomies were uterine rupture in 60% (n=3) of the cases, multiple myomas in 20% (n=1), and bleeding/ hemorrhage in another 20% (n=1).

Table 4.5. Characteristics of the patients in repeat CS.

Patients delivering via cesarean section	100% (n=1513)
Elective repeat cesarean section	65.7% (n=990)
Acute cesarean section	34.2% (n=517)
Mean age of the women (years)	33±5
Mean number of children	2.3±0,6
Mean BMI before pregnancy (kg/cm^2)	24.7±4.9
Gestational Diabetes	5.2% (n=78)
Gestational Hypertension	4.1% (n=62)
Eclampsia/ Preeclampsia	1.6% (n=24)
Mean gestational week	38±1
Mean weight of children (grams)	3528±536
Mean APGAR I	7.82±0.5
Mean APGAR II	8.83±0.5
Hysterectomy	0.33% (n=5)

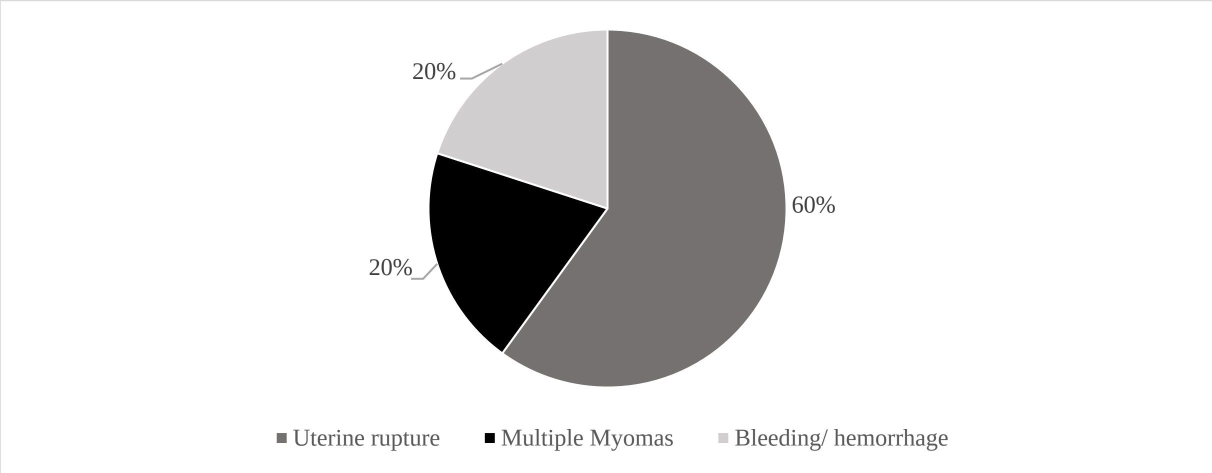

Figure 4.6. Indications for hysterectomies.

4.1.3 Characteristics of the VD group

Out of the 1620 patients, 6.6% (n=107) delivered vaginally. The women in this group, were between 22 and 44 years old, hence the mean value was M=22±4. 0.9% (n=1) of the patients had gestational DM. None of them had gestational hypertension or eclampsia/ preeclampsia. The mean gestational week was M=37±1, and the fetal weight ranged between 2720 and 4498 which showed a mean of M=3358±432.55. The mean APGAR II score was M=8.9±0.4. No hysterectomies were recorded in this patient group.

Table 4.7. Characteristics of patients delivering vaginally.

Patients delivering vaginally	100% (n=107)
Mean age of the women (years)	22±4
Gestational Diabetes	0.9% (n=1)
Gestational Hypertension	0
Eclampsia/ Preeclampsia	0
Mean gestational week	37±1
Mean weight of children (grams)	3358±432.55
Mean APGAR I	7.9±0.4
Mean APGAR II	8.9±0.4
Hysterectomy	0

4.2 Comparison of the groups "hysterectomy" and "no hysterectomy"

To find out the association between CSs and hysterectomies, the women who underwent a repeated CS, were divided in two groups. The first group included women who had to undergo a hysterectomy, and the second group included women where no hysterectomy was needed. table 4.8. shows a summary of the findings which will be discussed below in this section.

Table 4.8. Summary of significant and not significant findings in the following sections.

	Hysterectomy	No Hysterectomy	Mean differences (95%CI)	p-value*
Age	38±3.64	33.1±4.54	4.9 (0.92…8.88)	0.04**
Gestational week	35.2±4.44	38.55±1.67	3.35 (0.75…1.87)	<0.001**
Fetal weight	3177.5±948.9	3529.4±535.6	352 (175.2…879.1)	0.19
BMI	26.84±7.50	24.72±4.88	2.19 (-2.167…6.43)	0.33
Previous deliveries	1.6±0.89	1.3±0.60	0.27 (0.26…0.80)	0.54

*= T-test p-value

**= significant p-values

4.2.1 Incidence of hysterectomies compared to international and national data

In 0.33% (n=5) (95%CI: 0.14…0.77) of the women delivering via CS, a hysterectomy had to be performed. Comparing our findings to international data, no statistically significant difference could be shown (p-value=0.07-0.84). However, a statistically significant difference was seen when comparing our findings to another study conducted by I. Titevica in 2004 (p-value <0.0001). The p-values calculated for each study are shown in table 4.9.

Table 4.9. Comparison of the incidence of hysterectomies in our study with the literature.

Study Author	Hysterectomies	p-value compared to our study	Country
Stivanello et al, 2010	0.14% (95% CI:0.09…0.22)	p-value=0.07	Italy
Colmorn et al, 2016	0.14% (95% CI:0.10…0.20)	p-value=0.06	Denmark
Kwee et al, 2006	0.16% (95% CI:0.09…0.22)	p-value=0.07	Netherlands
Kaplanoglu et al, 2015	0.40% (95% CI:0.20…0.90)	p-value=0.09	Turkey
Makoha et al, 2004	0.44% (95% CI:0.25…0.76)	p-value=0.58	Saudi Arabia
Cheng et. Al, 2011	0.28% (95%CI: 0.12…0.67)	p-value=0.07	USA
Macones et al, 2005	0.19% (95% CI:0.16…0.22)	p-value=0.22	USA
Shellhaas et al, 2009	0.33% (95% CI:0.27…0.40)	p-value=0.84	USA
Landon et al, 2004	0.30% (95% CI:0.22…0.40)	p-value=0.84	USA
Flamm et al, 1994	0.27% (95% CI:0.11…0.62)	p-value=0.74	USA
McMakon et al, 1996	0.20% (95% CI:0.10…0.46)	p-value=0.45	USA
Irena Titevica, 2004	2.89% (95% CI:0.01…0.06)	p-value <0,0001**	Latvia, Daugavpils

**= significant p-values

4.2.2 Maternal age in the groups hysterectomy and no hysterectomy

The mean ages in the groups with hysterectomy and no hysterectomy were compared using T-Test. The variances were not equal (Levene-test, p-value=0.481) and the T-test showed significant differences (p-value=0.04).

Table 4.10. The mean and standard deviation of the age in the groups hysterectomy and No hysterectomy in women delivering via CS.

		Number	Mean	Standard deviation
Age	**Hysterectomy**	5	38.00	3.67
	No hysterectomy	1508	33.10	4.53

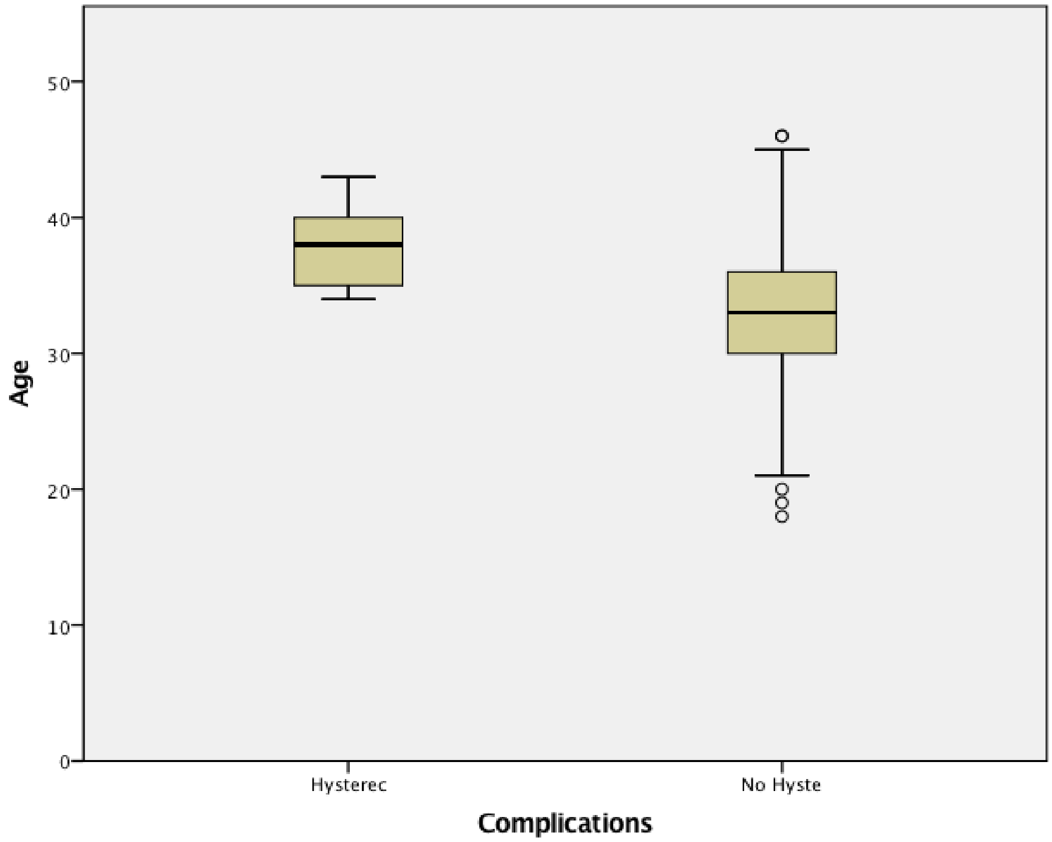

Figure 4.11. Boxplot showing the mean age in the groups hysterectomy and no hysterectomy in women delivering via CS.

The proportion of women who were 35 years old, or older at the time of delivery is different in both groups (Chi square test p-value=0.05). The proportions are given in table 4.12.

Table 4.12. The distribution of the age (<35, >35) in the groups hysterectomy and no hysterectomy in women delivering via CS.

	Hysterectomy		**No hysterectomy**	
	Number	**Percentage**	**Number**	**Percentage**
<35 years	1	20%	935	61.8%
>35 years	4	80%	573	38.2%

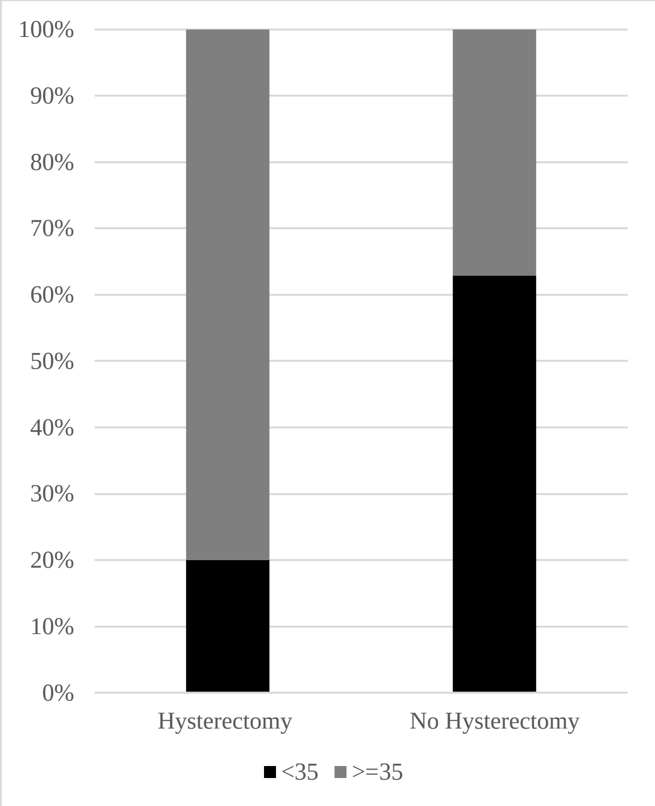

Figure 4.13. The distribution of the age categories (<35, >35) in the groups hysterectomy and no Hysterectomy in women delivering via CS.

4.2.3 Gestational week at labor in the groups hysterectomy and no hysterectomy

The mean values of gestational weeks were compared using the T-test. Variances were equal (Levene-test, p-value <0.001), and the T-test showed a statistically significant difference (p-value <0.001).

Table 4.14. The mean and standard deviation of the gestational week in the groups hysterectomy and no hysterectomy in women delivering via CS.

		Number	Mean	Standard deviation
Gest. week	**Hysterectomy**	5	35.20	4.44
	No hysterectomy	1508	38.55	1.67

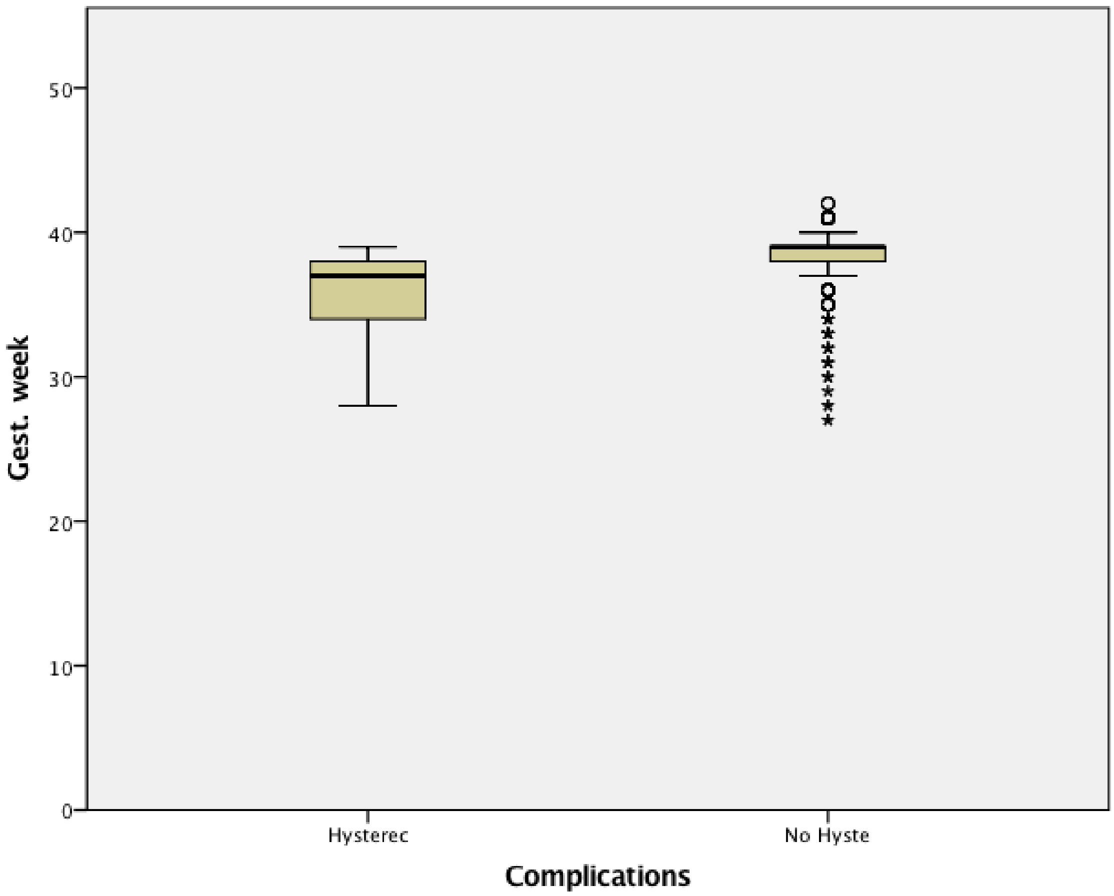

Figure 4.15. The mean and standard deviation of the gestational week in the groups hysterectomy and no hysterectomy in women delivering via CS.

4.2.4 Birth weight in the groups hysterectomy and no hysterectomy

The mean values of the fetal weight were compared using the T-test. The variances were not equal (Levene test, p-value=0.55), and there was no statistically significant difference (p-value=0.19).

Table 4.16. The mean and standard deviation of the infantile weight in the groups hysterectomy and no hysterectomy in women delivering via CS.

		Number	**Mean**	**Standard deviation**
Weight end	**Hysterectomy**	4	3177.5	948.90
	No hysterectomy	1508	3529.4	535.6

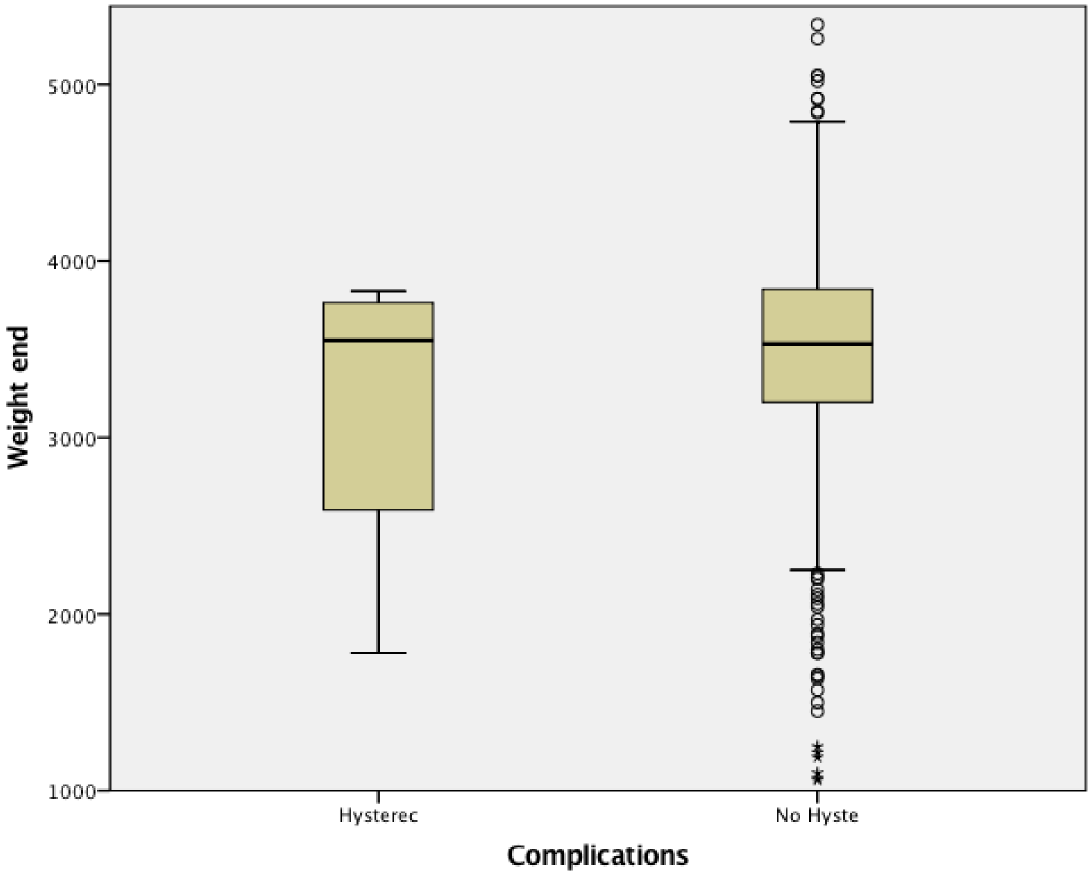

Figure 4.17. The mean and standard deviation of the birth weight in the groups hysterectomy and no hysterectomy in women delivering via CS.

The proportion of the birth weight below 3500g and above 3500g was assessed in the groups hysterectomy and no hysterectomy. There was no statistically significant difference in both groups (Chi-square test p-value=0.852).

Table 4.18. The distribution of fetal weight <3500g and >3500g in the groups hysterectomy and no hysterectomy in women delivering via CS.

	Hysterectomy		**No hysterectomy**	
	Number	**Percentage**	**Number**	**Percentage**
<3500	3	60%	684	45.2%
>3500	2	40%	842	54.8%

4.2.5 Maternal BMI in the groups hysterectomy and no hysterectomy

The mean maternal BMI was compared in both groups using the T-Test. The variances were not equal (Levene test p-value=0.35), and there was no statistical significant difference (p-value=0.33).

Table 4.19. The mean and standard deviation of the maternal BMI in the groups hysterectomy and no hysterectomy in women delivering via CS.

		Number	**Mean**	**Standard deviation**
BMI	**Hysterectomy**	5	26.84	7.55
	No hysterectomy	1508	24.72	4.88

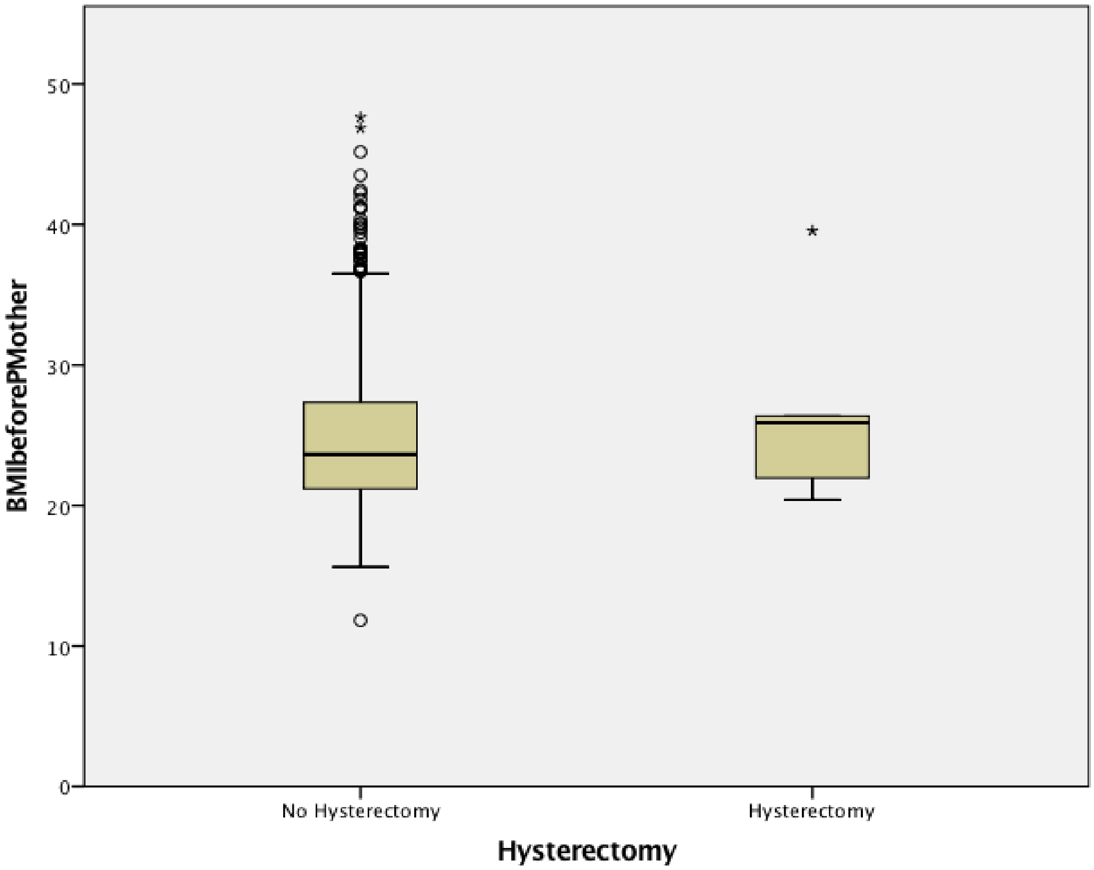

Figure 4.20. Boxplot showing the mean and standard deviation of the BMI in the groups hysterectomy and no hysterectomy in women delivering via CS.

The proportions of BMI groups, divided in normal (<24.9 kg/m^2) and overweight (>25 kg/m^2), are similar in both groups and there is no statistically significant difference (Chi square test p-value=0.34).

Table 4.21. The mean and standard deviation of the age in the groups hysterectomy and no hysterectomy in women delivering via CS.

		Hysterectomy		**No hysterectomy**	
		Number	**Percentage**	**Number**	**Percentage**
BMI	**Normal**	2	40%	909	60.1%
	Overweight	3	60%	586	39.9%

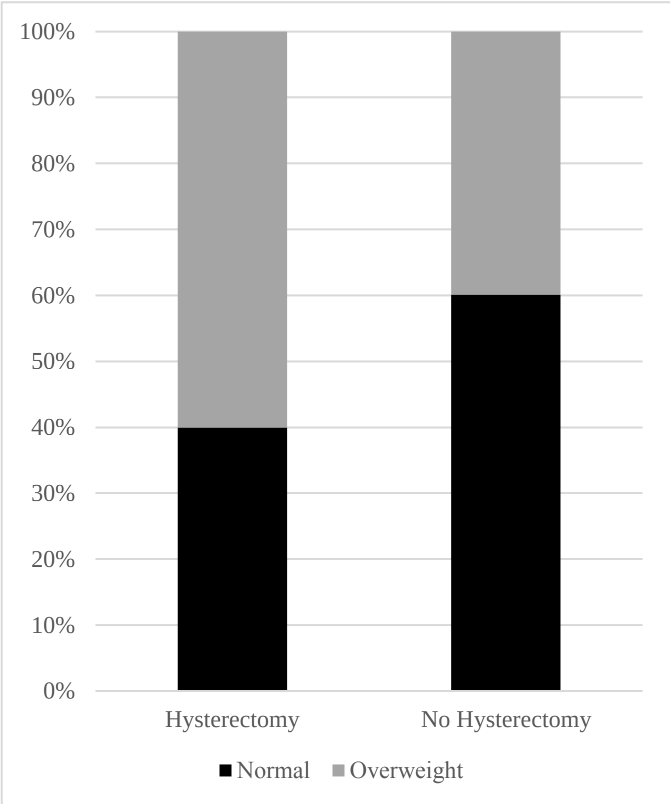

Table 4.22. The distribution of the BMI categories in the groups hysterectomy and no hysterectomy in women delivering via CS.

4.2.6 Previous deliveries in the groups hysterectomy and no hysterectomy

The number of previous deliveries does not have influence on hysterectomies (T-test p-value=0.537). There is also no statistically significant difference when dividing the women in two groups: women who have had one delivery before, and women who have had more than one delivery before (p-value=0.537).

Table 4.23. The distribution of the previous deliveries in the group hysterectomy and no hysterectomy in women delivering via CS.

		Hysterectomy		No hysterectomy	
		Number	**Percentage**	**Number**	**Percentage**
Previous birth	**1**	1089	72.3%	3	60%
	2	354	23.5%	1	20%
	3	54	3.6%	1	20%
	4	8	0.5%	0	0%
	5	1	0.1%	0	0%

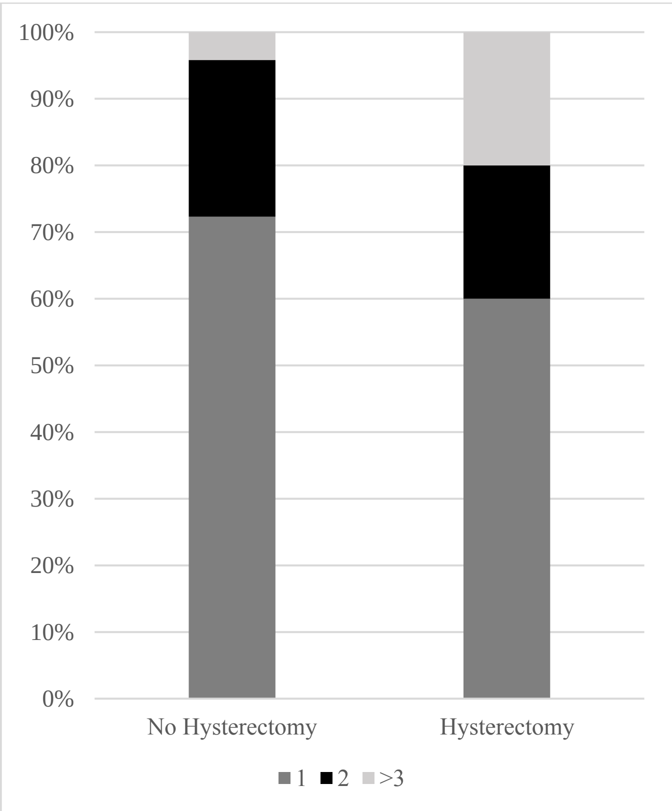

Figure 4.24. The distribution of previous deliveries in the groups hysterectomy and no hysterectomy in women delivering via CS.

4.3 Comparison of groups “CS” and “VD”

All of the patients in this study have a history of a previous CS, and were divided into two groups according their further delivery mode: repeated CS and VD after CS. To assess the fetal outcome via APGAR II scores, and to detect other factors which might influence the delivery mode, following statistical analyses were performed.

Table 4.25. Summary of significant and not significant findings in the following sections.

	CS	**VD**	**Mean Difference (96%CI)**	**p-value***
Age	33.12±4.54	31.66±4.40	1.45 (0.056…2.34)	0.001**
Gest. week	38.54±1.69	37.87±1.14	0.67 (0.35…1.00)	<0.001**
Fetal weight	3551.55±1054.06	3350.55±432.55	193 (-8.10…394)	0.06
APGAR II	8.83±0.57	8.94±0.4	0.116 (0.19…0.33)	0.007**

*= T-test p-value

**= significant p-values

4.3.1 Maternal age in the groups CS and VD

The difference of age was tested with the T-test, and it showed that there is a significant difference in age in both groups (p=0.001; equality of variances not assumed, Levene-test of equality showed p-value=0.406). However, the difference between means is two years, which should not influence any comparison analyses.

Table 4.26. Mean values and standard deviation of the groups CS and VD and their ages.

		Number	**Mean**	**Standard deviation**
Age	**CS**	1513	33.12	4.54
	VD	107	31.66	4.40

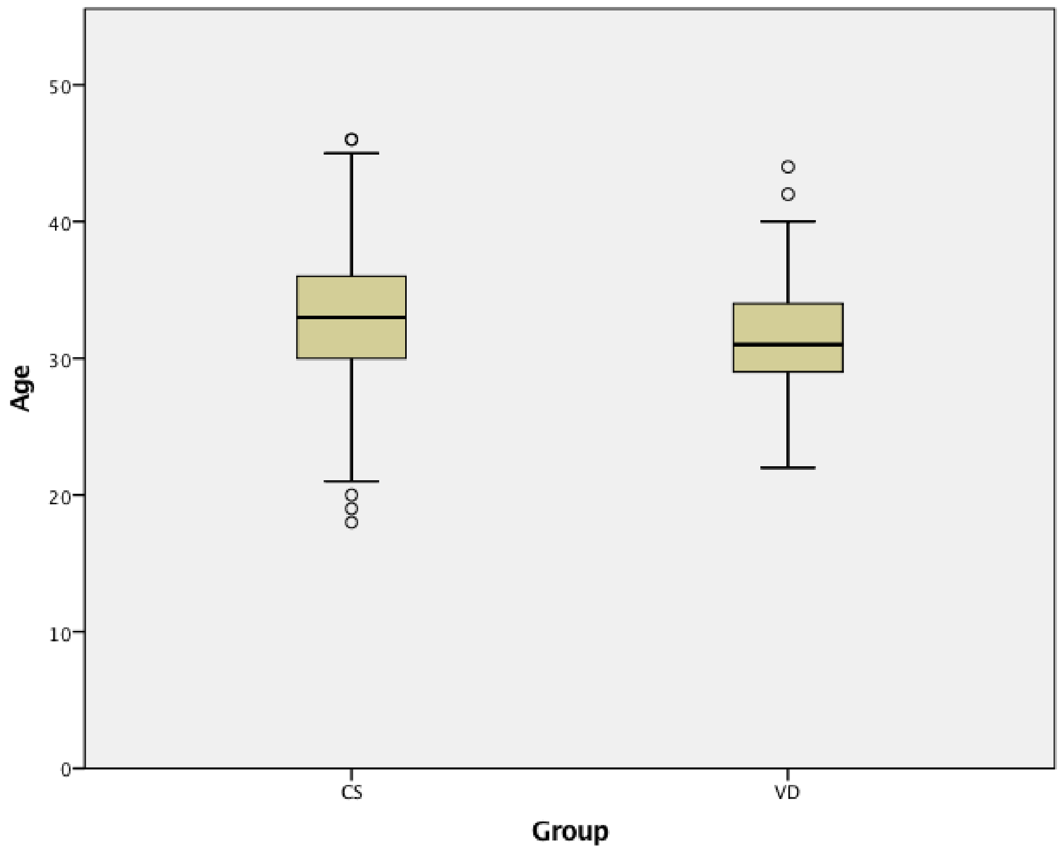

Figure 4.27. Boxplot showing the mean age distribution in the groups CS and VD.

4.3.2 Gestational week in the groups CS and VD

The differences in gestational weeks were tested using the T-Test for mean values of independent groups. Variances were equal (Levene test, p-value=0.17), and T-Test p-value <0.001 showed a statistically significant difference.

Table 4.28. Mean values and standard deviation of gestational weeks in the groups CS and VD.

		Number	**Mean**	**Standard deviation**
Gest. week	**CS**	1513	38.54	1.69
	VD	107	37.87	1.14

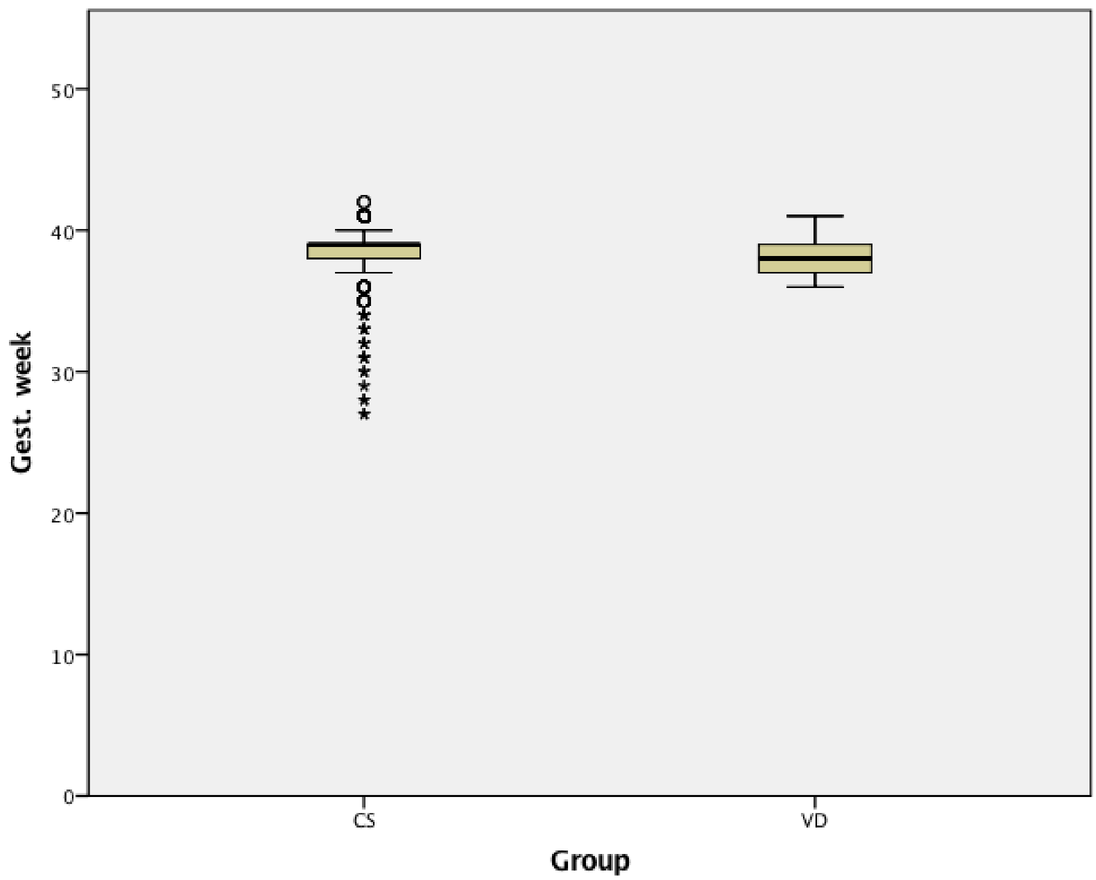

Figure 4.29. Boxplot showing the distribution of mean gestational weeks among the groups CS and VD.

Although there were significant differences between the mean values of gestational weeks, the proportion of preterm birth is similar in both groups, and there was no statistically significant difference (p-value=0.129).

Table 4.30. Percentages of Mature and Premature births in the groups CS and VD.

	CS		**VD**	
	Number	**Percentage**	**Number**	**Percentage**
Mature	1415	93.5%	96	89.7%
Premature	98	6.5%	11	10.3%

4.3.3 Birth weight in the groups CS and VD

The mean weight of the newborns in both groups was tested for similarity using T-Test. The variances were not equal (Levene test, p-value=0.492), and the T-test showed that a statistically significant difference (p-value <0.001).

Table 4.31. Mean values and standard deviation of the infantile weights in the groups CS and VD.

		Number	Mean	Standard deviation
Fetal weight	**CS**	1512	3551.55	27.10
	VD	107	3358.55	41.86

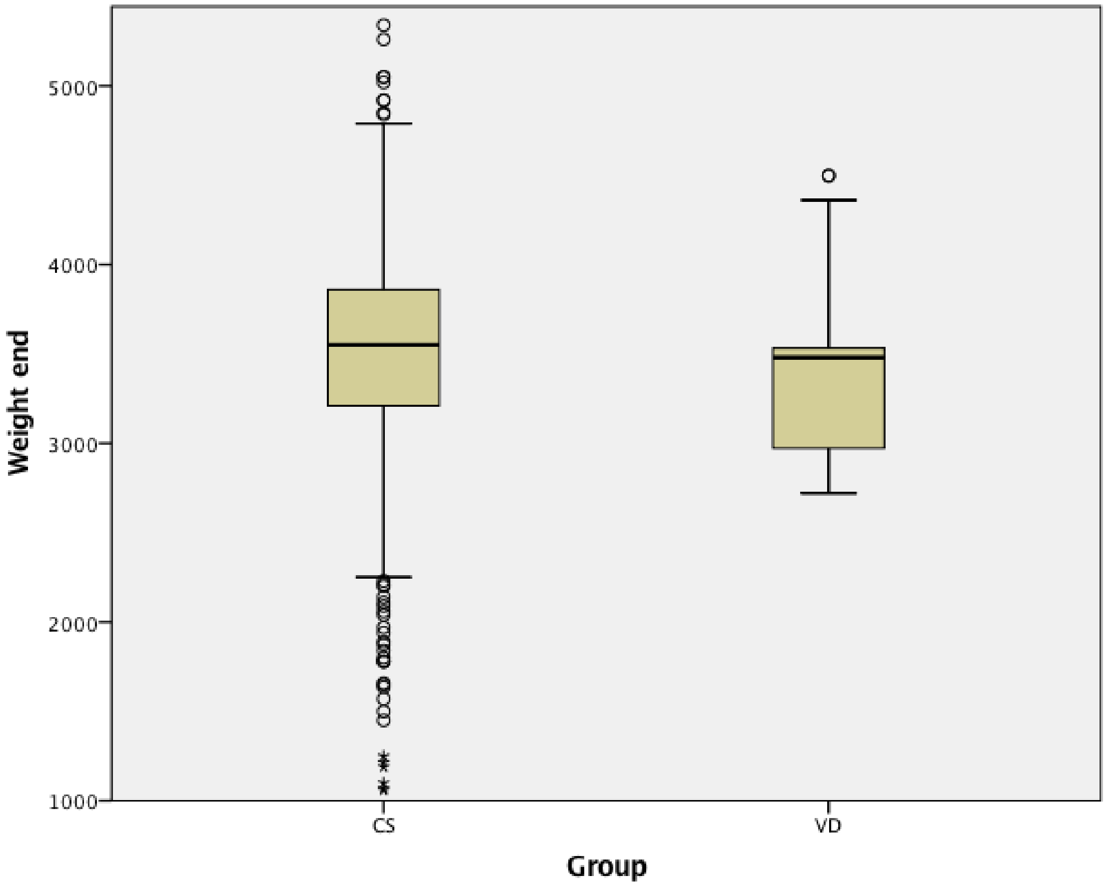

Figure 4.32. Boxplot showing the mean infantile weights in the groups CS and VD.

4.3.4 APGAR II score in the groups CS and VD

The difference between APGAR II scores in CS and vaginal delivery groups was assessed by comparing the mean value using T-test for independent samples. Variances of both variables were equal (Levene test p-value=0.001) and the p-value of the t-test was 0.039. This result shows a significant difference in APGAR II scores in both groups.

Table 4.33. Mean values and standard deviation of the APGAR II score in the groups CS and VD

		Number	Mean	Standard deviation
APGAR II	**CS**	1512	8.83	0.57
	VD	107	8.94	0.40

4.3.5 Gestational diabetes in the groups CS and VD

The proportion of gestational diabetes was different in both groups (p-value=0.05). The proportions are presented in the table 4.34.

Table 4.34. Mean values and standard deviation of the groups CS and VD and gestational diabetes.

	CS		**VD**	
	Number	**Percentage**	**Number**	**Percentage**
No gestational diabetes	1434	94.8%	106	99.1%
Gestational diabetes	78	5.2%	1	0.9%

The mean weight of children was compared in the groups with, and without gestational diabetes. The variances were not equal (Levene test p-value=0.73), and there was no statistically significant difference (p-value=0.113).

Table 4.35. Mean values and standard deviation of the weight of the infants and their relations with gestational diabetes.

		Number	Mean	Standard deviation
Weight end	**No gestational diabetes**	1540	3532.85	1041.6
	Gestational diabetes	79	365.82	635.73

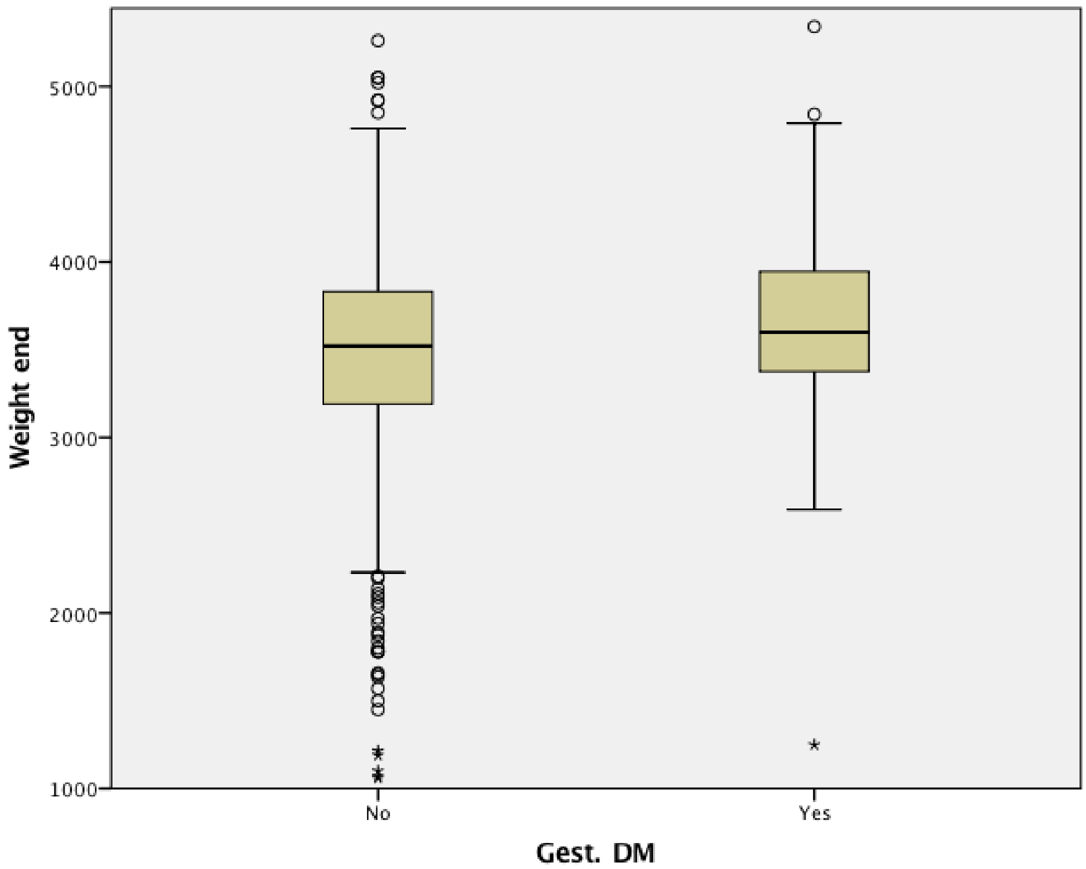

Figure 4.36. Boxplot showing the relation of the gestational diabetes and weight of the infants.

The percentage of macrosomia was similar in both groups (p-value=0.271). The percentages are given in table 4.37.

Table 4.37. The distribution of fetal weight divided in “macrosomia” and “no macrosomia” in relation to gestational diabetes.

	No gest. DM		**Gest. DM**	
	Number	**Percentage**	**Number**	**Percentage**
Macrosomia	258	16.8%	17	21.5%
No macrosomia	1282	83.2%	62	78.5%

4.3.6 Gestational hypertension in the groups CS and VD

The proportion of women who developed gestational hypertension was different in both groups (p-value=0.033). The proportions are shown in table 4.38.

Table 4.38. Distribution of gestational hypertension among the groups CS and VD.

	CS		VD	
	Number	**Percentage**	**Number**	**Percentage**
Gestational hypertension	1451	95.9%	107	100%
No gestational hypertension	62	4.1%	0	0.0%

4.3.7 Eclampsia/ Preeclampsia in the groups CS and VD

The proportions of women who developed eclampsia/ preeclampsia were similar in both groups and did not show statistically significant difference (p-value=0,189). The proportion is shown in table 4.39.

Table 4.39. The distribution of Eclampsia/ Preeclampsia among the groups CS and VD.

	CS		VD	
	Number	**Percentage**	**Number**	**Percentage**
Eclampsia/ Preeclampsia	1489	98.4%	107	100%
No Eclampsia/ Preeclampsia	24	1.6%	0	0.0%

5 Discussion

The rates of primary CSs have risen during the last decades and are rising progressively worldwide. Therefore, rates of repeated CSs are rising sharply, too.

In thus study, 93.4% out of the 1620 patients with a history of previous CS further delivered via CS, and only 6.6% delivered vaginally. Similar rates for repeated CSs are also shown in international data. In the US, the number of women repeating a CS is approximately 90%, and the rates are slightly lower in Austria with 83%. These high numbers might be explained by the fear of pain the women are worried about, and also by the fear of complications (e.g. uterine rupture), the patients are worrying about even though they are minimal. These countries have no guidelines for repeated CSs. However, the UK shows significantly lower values. Only 28% of women with a previous CS deliver with a repeated CS. These low numbers might be explained by the NICE guidelines, which are intended to encourage and direct women in direction of VD, rather than a repeated CS.

Groups: "Hysterectomy" and "No Hysterectomy":

This study focused on the hysterectomies associated with CSs. Thus, the CS group was divided into two groups. One group included women who had to undergo a hysterectomy, and the second group was composed of the women, where no hysterectomy was necessary. Five hysterectomies had to be performed, which made up the number of 0.33% (95%CI: 0.14…0.77). Comparing this rate with international data, no statistically significant difference between those studies, and our findings could be shown. However, the 0.33% lies above the mean range of the below-mentioned studies (mean percentage=0.26%). On the other hand, comparing our data to a Latvian study, a statistically significant difference is revealed.

Starting with the international data, the Italian study conducted by Stivanello et al. showed a rate of 0.14% for hysterectomies associated with repeated CSs (Stivanello et al., 2010). Even though statistically no significant difference could be found when comparing the numbers with our study (p-value=0.07), the numbers of hysterectomies is lower Italy compared with Latvia. There is a tendency, that with a larger population study, the p-value will be statistically significant, too.

Colmorn et al. showed in a similar Danish study, that 0.14% of the women with a previous CS had to undergo a hysterectomy (Colmorn, Krebs, Langhoff-Roos, & group, 2016). This shows no statistically significant difference from our study (p-value=0.06), although there is a trend that with more study samples, a significance could be seen.

A Dutch study showed, that 0.19% of the hysterectomies were associated with repeated CSs. These findings show no statistically significant difference from our findings (p-value=0.7). However, the percentage is lower in the Netherlands than in Latvia (Kwee et al., 2006).
Another study in Turkey, conducted by Kaplanoglu et al. (Kaplanoglu, Bulbul, Kaplanoglu, & Bakacak, 2015), revealed a rate of 0.4% for hysterectomies associated with repeated CSs, which is also not significantly different from our findings (p-value=0.097). Besides, our study shows better results compared to that.
A Saudi-Arabian study by Makoha et al., showed a higher percentage than our findings, too. 0.44% of the women with a history of previous CS had to undergo hysterectomies (Makoha et al., 2004). Still, these findings show no statistically significant difference compared to our study (p-value=0.58).
In the American study, Cheng et al. (Cheng et al., 2011) estimated a rate of 0,28% for the hysterectomies, that were associated with CSs in women with prior cesarean deliveries. This number shows no statistically significant difference from the results obtained in this study (p-value=0.07). In another American study, Macones et al. (Macones et al., 2005) showed that hysterectomies accounted for 0.19%, in the repeated CS category. Again, this finding shows no statistically significant difference compared to this study (p-value=0.22). Shellhaas et al., showed that the number of hysterectomies among patient undergoing a repeat CS in America was 0.33% (Shellhaas et al., 2009). This finding is similar to our study and shows no statistically significant difference (p-value=0.84). Landon et al. also revealed similar percentages of hysterectomies in patients undergoing repeat CSs (also in the US). They found out that 0.30% hysterectomies had to be performed in this group which is not significantly different from our findings (p-value=0.84). In another American study performed by Flamm et al., 0.27% of the women with a previous CS had to undergo a hysterectomy (Flamm et al., 1994), which also does not show a statistically significant difference to our study (p-value=0.74). McMahon et al., determined hysterectomy rates of 0.21% in women with a previous CS undergoing a repeated CS (again in the US) (McMahon et al., 1996). This finding shows no statistically significant difference to our findings (p-value=0.45).
On the other hand, comparing our rate of hysterectomies with national data, enormous differences can be shown. A study involving a regional hospital in Daugavpils, conducted by Irena Titevica in 2014, shows that from a total count of 1004 births via CS, 18 hysterectomies (1.79%) had to be performed. Out of these 1004 patients, 242 women had a history of a previous CS and further performed a repeated CS, from which 7 patients had to undergo a hysterectomy due to complications. This shows that 2.89% of the women delivering via repeated CS had to undergo a hysterectomy compared to 0.33% in our case in the Maternity Hospital in Riga.

Statistically, these findings show a significant difference with a p-value <0.0001. Thus, the rates in Latvia vary drastically between hospitals and cities. Such results like 2.89% would dramatically change the overall national data, with the result that Latvia could possibly not compete with other countries anymore. Taking the average of both hospitals, hysterectomies in Latvia in patients with previous CS would account for 1.60%, which would not even be comparable with other countries. This unfortunate situation could be explained by less educated patients in rural areas, less effort from the physician's side to encourage women for vaginal deliveries, and personnel, who is maybe not prepared enough for complications that might arise.

Table 5.1. Comparison of our findings with the international and national findings in literature.

Author	Hysterectomies	p-value compared to our study	Country
Stivanello et al, 2010	0.14% (95% CI:0.09…0.22)	p-value=0.07	Italy
Colmorn et al, 2016	0.14% (95% CI:0.10…0.20)	p-value=0.06	Denmark
Kwee et al, 2006	0.16% (95% CI:0.09…0.22)	p-value=0.07	Netherlands
Kaplanoglu et al, 2015	0.40% (95% CI:0.20…0.90)	p-value=0.09	Turkey
Makoha et al, 2004	0.44% (95% CI:0.25…0.76)	p-value=0.58	Saudi Arabia
Cheng et. Al, 2011	0.28% (95%CI: 0.12…0.67)	p-value=0.07	USA
Macones et al, 2005	0.19% (95% CI:0.16…0.22)	p-value=0.22	USA
Shellhaas et al, 2009	0.33% (95% CI:0.27…0.40)	p-value=0.84	USA
Landon et al, 2004	0.30% (95% CI:0.22…0.40)	p-value=0.84	USA
Flamm et al, 1994	0.27% (95% CI:0.11…0.62)	p-value=0.74	USA
McMakon et al, 1996	0.20% (95% CI:0.10…0.46)	p-value=0.45	USA
Irena Titevica, 2004	2.89% (95% CI:0.01…0.06)	p-value <0.0001	Latvia, Daugavpils

The main indication for the hysterectomies was uterine rupture in 60% (n=3), multiple myomas in 20%(n=1), and bleeding/ hemorrhage in 20% (n=1). Although these indications are listed in the literature as well, the most common indication for hysterectomies nowadays seems to be abnormal placentation. This might be explained by the increasing numbers of cesarean deliveries where the scar on the uterus plays a role as the predisposing risk factor for abnormal placentation. This condition can only be prevented by one way: decreasing the numbers of unnecessary primary CS (Kwee et al., 2006; Machado, 2011; Sakse, Weber, Nickelsen, & Secher, 2007). Our indications for the hysterectomies can be explained by the previous CSs the women had undergone, too. Three of five cases of hysterectomies (60%) had to be performed due to uterine rupture which might be explained by the disruption of the integrity of the uterine wall by the previous CS, leading to a rupture. In one case, this condition even led to perinatal death in the 27^{th} week.

The average age of women who had to undergo a hysterectomy was 38±3.67, and the mean age for women where a hysterectomy was not necessary was 33±0.41 (p-value=0.03). This difference shows a statistical significance and corresponds to findings in the literature (Machado, 2011), which also prove that older women have a higher risk for hysterectomies. With the cut off value – 35 years – for increased risk for hysterectomies, we could confirm that 80% of the women who had to undergo a hysterectomy were above the mentioned age group. Nevertheless, it is a non-modifiable risk factor. The age for women being pregnant for the first time is increasing gradually worldwide and women experience their first pregnancy even after the age of thirty in some countries. This can be explained by the increasing number of women focusing on their career, and postponing their family planning.

The mean gestational week at labor for the women of the hysterectomy group was 35.2±4.44 while it was 38.5±1.65 in the group of women without having to undergo a hysterectomy. This shows a statistically significant difference in both groups (p-value of <0.001). Other studies have shown similar findings. It is determined that the risk for hysterectomies increases with each gestational week (Makoha et al., 2004). This might be explained by the size and weight of the fetus, which increases with every gestational week, stretches the uterine wall, and in turn, increases the risk for uterine rupture in women who already have a scar on the uterus. In our study, three out of five hysterectomies were related to uterine rupture. In one of these three cases, this complication even led to perinatal death as the rupture happened only in the 27^{th} week of gestation.

The average birth weight in the hysterectomy group was 3177.5±948.9 and 3539.69±1026.03 in the group without hysterectomies (p-value=0.554), which means that the difference is not statistically significant. According to literature, the risk for hysterectomy increases with the fetal weight. Thus, the higher the weight of the child, the higher the risk for hysterectomies (Makoha et al., 2004; McMahon et al., 1996; Stivanello et al., 2010). This lack of difference could be caused by the small sample size of women who had to undergo a hysterectomy. The association of macrosomia related hysterectomies is expected to be larger in a larger sample size. Again, the higher the weight, the more pressure on the uterine walls and the higher the risk of rupture (Bodelon, Bernabe-Ortiz, Schiff, & Reed, 2009; Machado, 2011).

Other described risk factors for hysterectomies are BMI and number of previous births. The average BMI in the hysterectomy group was 26.84±7.55 and 24.72±4.88 in the group without hysterectomies. There is no statistically significant difference (p-value=0.56) as shown in some other studies (Colmorn et al., 2016). However, there is literature, which has proven a significant difference in BMI among women undergoing hysterectomies and women, where a hysterectomy was not necessary. They explain that the risk of hysterectomy increases proportionally with an increased BMI (Howell & Johnston, 2012; Machado, 2011). Although statistically not significant in our study, the majority of the women (60%, n=3) undergoing a hysterectomy were overweight/obese.

The previous number of births were also similar in both groups (p-value=0.507), thus there was no statistically significant difference. The number of hysterectomies is thought to be higher in multiparous women, who delivered via CS in the previous pregnancy. This can be explained by the weakened uterine wall, the incidence of abnormal placentation in case of repeat CSs, and the high incidence of uterine atony after multiple CSs (Colmorn et al., 2016; Howell & Johnston, 2012; Sakse et al., 2007).

Groups: “CS” and “VD”:

Dividing the 1620 women with a history of previous CS in the groups repeated CS and VD following interpretations can be made:

The statistical tests showed a statistically significant difference in the age of the study groups with the mean for CS being M=33.12±4.54, and for VD being M=31.66±4.40 (p-value=0.001). This can be explained by the increase of pregnancy morbidities with the age of the women, which might necessitate an operative delivery.

The average gestational week in the CS group was 38.54±1.69, while in the VD group it was 37.89±1.14. This shows that there is a statistically significant difference in the duration of the pregnancy (p-value <0.001) and that the variance is larger in the CS group. This might be due to several outliers with too early CSs, which could be explained by some clinical acute complications that occurred during the pregnancy and lead to emergency CSs. However, 93.5% of CS were carried out in the normal range of gestational weeks (37^{th}-42^{nd} week), and 89.7% of the VD happened at normal term (no significant difference; Chi square test p-value=0,129).

The mean APGAR II score was different in both groups: 8.83±0.57 in the CS group and 8.94±0.41 in VD group (p-value=0.039). There might not be a clinical significance, yet statistically the difference is significant and may be explained by the comparatively larger number of the preterm babies in the CS group. However, this finding is supported by similar outcomes in the literature, which also detected better APGAR scores after vaginal deliveries compared to CSs (Eriksen & Buttino, 1989).

5.1 Practical implications

Literature has shown, that the risk for hysterectomies is higher in the group of patients undergoing a repeated CS, rather than a vaginal delivery. Creating a model of a woman, who is at risk for a hysterectomy, following factors should be taken in account: maternal age, the gestational week, the weight of the newborn, maternal BMI before gestation, and the number of previous births (Machado, 2011).

The older the woman, the higher the risk for a hysterectomy. In this study, there was a statistically significant difference between the women undergoing a hysterectomy (38±3.67) and the ones who did not (33±0.41). Although age is not a modifiable risk factor, women should be educated about this risk by physicians, or even by media early enough in order to prevent such events (if possible).

Our data and other studies have shown that there is an association between hysterectomies and the gestational week. The risk for this complication (specifically uterine rupture, which might lead to a hysterectomy) increases with every week, particularly when the pregnancy duration is above the 38^{th} week (Makoha et al., 2004). This could practically be implicated by a closer observation of the pregnant women at risk. Guidelines could be introduced, showing specific observational methods for pregnant women in the advanced pregnancy weeks,

The higher the fetal weight, the higher the risk for hysterectomy. The bigger the fetus, the more pressure is exerted on the uterus, which can lead to uterine rupture and hemorrhages. In our study, the fetal weight did not play a statistically significant role, although there is a tendency, that with a larger sample size, the findings would be significant. But certainly, it is a non-modifiable risk factor. Still, better observation could decrease the risk for complications, such as uterine rupture.

The higher the BMI, the higher the risk for hysterectomies (Colmorn et al., 2016; Howell & Johnston, 2012; Machado, 2011). In our study, even though statistically not significant, the majority of the women, who underwent a hysterectomy were overweight/ obese, and larger studies are ought to confirm the significance of this risk factor. Therefore, weight reduction is one of the modifiable risk factors concerning hysterectomies, and would possibly contribute to decreasing the number of hysterectomies.

Studies have shown, that the number of previous births via CS increases the risk for hysterectomies in the following pregnancies, which can only be prevented by decreasing the numbers of primary/ previous and unnecessary CSs. However, in our study, this hypothesis could not be supported.

Sixty percent of the indications for the hysterectomies were a uterine rupture. 20% were performed due to bleeding/ hemorrhage, and another 20% due to multiple myomas which are comparable with the literature findings (Allam, Gomaa, Fathi, & Sukkar, 2014; Machado, 2011; Shellhaas et al., 2009). The scar on the uterus (from the previous CSs) predisposes for this condition of uterine rupture, as the integrity of the uterine wall gets disrupted by the cut. This condition can markedly be diminished by reducing the number of unnecessary primary and repeated cesarean deliveries and can help preventing women from hysterectomies, especially in their reproductive age.
Fetal outcome in the groups repeated CS and VD showed a statistically significant difference in APGAR II scores. The infants in the VD group had better outcomes in the APGAR II score, which shows that neonates delivered vaginally seem healthier. Women should be motivated by this fact to try a vaginal delivery even if they had a previous CS before. Women, who are pregnant for the first time should take these findings as an encouragement to deliver vaginally and overcome their fears of pain, if there is no absolute indication for performing a CS. Guidelines, as the NICE guidelines in the UK, show that it is possible to decrease the rates of repeated CSs. Thus, such regulations should be introduced, which patients and physicians are ought to follow.

In summary, it can be stated that women should be encouraged to choose VD for their first pregnancies, and also for their further pregnancy, if there is no medical indication for a CS to decrease the overall rate for primary CSs. One of the leading cause for performing a primary CS is the maternal request due to fear of pain during labor, which certainly is no absolute medical indication for a CS. Physicians should take time and talk to the patients in order to understand their fears, but also to compare the advantages and disadvantages of an operative delivery. On the other side, one of the major causes for the repeated CS is the prior CS women have undergone. Women are afraid of complications which might occur when further delivering vaginally, or they feel just more comfortable to repeat the CS and to avoid the pain of labor. The only method how to escape from the vicious cycle, which leads the women who had a primary CS to further following cesarean deliveries, is to bypass the primary CS. The WHO recommendation says that the optimal number for CS should not be more than 10-15%. The aim of each medical institution and each country should be to reach these numbers. Thus, a drastic reduction in the rates of primary CS should be targeted.

5.2 Limitations

There are a few limitations in this study. First of all, the study includes a relatively small sample size for comparison (VD group has only 107 patients and CS group 1513; hysterectomy group has 5 patients and no hysterectomy group has 1615 patients). Larger studies would show more comparable data. Furthermore, it is a retrospective analysis, where we depend on already collected data. Moreover, we did not consider, whether the patients from the CS group were trying to deliver vaginally in the first place, and if some complications forced them to deliver via CS.

6 Conclusions

1) In our study, 0.33% hysterectomies had to be performed in women with a history of previous CS. Compared with international data, there is no statistically significant difference between our findings and the findings in other countries, even though the number of hysterectomies is less in other European countries (Italy, Denmark and the Netherlands). There is a statistically significant difference between our study and another national study from a regional Hospital in Daugavpils, Latvia.
2) The mean of maternal age and the mean of the gestational week at labor differed significantly in the groups hysterectomy and no hysterectomy. Compared to the no hysterectomy group, the maternal age was higher in the hysterectomy group, and the gestational week was lower in the hysterectomy group. No statistically significant differences were found between the groups when comparing fetal weight, BMI, and number of previous births.
3) Mean APGAR II score shows better results in the VD group compared to the CS group.

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