ORIGINAL RESEARCH ARTICLE

# Maternal complication of caesarean section at tertiary center: Siriraj Hospital, Bangkok, Thailand

*Saifon Chawanpaiboon[1*], Vitaya Titapant[1] and Julaporn Pooliam[2]*

Division of Maternal-Fetal Medicine, Department of Obstetrics & Gynaecology, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok 10700, Thailand[1]; Clinical Epidemiological Unit, office for Research and Development, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand[2]

**\*For Correspondence:** Email: *saifon.cha@mahidol.ac.th*; Phone: 66-2419-47777-8

## Abstract

To study the complications of mothers related to caesarean sections, through a review of indications and details of complications occurring in mothers. This was a retrospective and descriptive study. A search of hospital records identified 3500 cases that underwent caesarean sections during 2017–2018. Demographic data, indications for caesarean section, maternal complications arising from the caesarean sections, and other relevant details were recorded. Most of the pregnant women were in their first pregnancy (43.49%) without underlying disease (86.40%). Two-thirds of the caesarean sections (70.23%; 2485/3500) were emergency procedures. A previous caesarean section (35.11%; 1229/3500) was the most frequent absolute indication for caesarean section, while advanced maternal age (34.14%; 1195/3500) was the most frequent relative indication. Caesarean sections at the request of mothers represented 7.11% of the cases (249/3500). All maternal complications were 5.14% (180/3500). Post-partum haemorrhage was the most common maternal complication (3.4%). In summary, maternal complications were found 5.14%. Most maternal complications were post-partum haemorrhage. Common indications for caesarean sections were a previous caesarean section and advanced maternal age. As the rate of caesarean sections continues to increase and is difficult to control, obstetricians must be well trained in performing caesarean sections to reduce maternal complications. *(Afr J Reprod Health 2022; 26[8]: 142-154).*

**Keywords:** Caesarean section, maternal complication

## Résumé

Étudier les complications des mères liées aux césariennes, à travers une revue des indications et des détails des complications survenant chez les mères. Il s'agissait d'une étude rétrospective et descriptive. Une recherche dans les dossiers hospitaliers a identifié 3500 cas ayant subi une césarienne en 2017-2018. Les données démographiques, les indications de césarienne, les complications maternelles découlant des césariennes et d'autres détails pertinents ont été enregistrés. La plupart des femmes enceintes en étaient à leur première grossesse (43,49%) sans maladie sous-jacente (86,40%). Les deux tiers des césariennes (70,23 % ; 2485/3500) étaient des procédures d'urgence. Une césarienne antérieure (35,11 % ; 1229/3500) était l'indication absolue la plus fréquente de césarienne, tandis que l'âge maternel avancé (34,14 % ; 1195/3500) était l'indication relative la plus fréquente. Les césariennes à la demande des mères représentaient 7,11% des cas (249/3500). Toutes les complications maternelles étaient de 5,14 % (180/3500). L'hémorragie du post-partum était la complication maternelle la plus fréquente (3,4%). En résumé, les complications maternelles ont été retrouvées 5,14%. La plupart des complications maternelles étaient des hémorragies post-partum. Les indications courantes des césariennes étaient une césarienne antérieure et un âge maternel avancé. Comme le taux de césariennes continue d'augmenter et est difficile à contrôler, les obstétriciens doivent être bien formés à la pratique des césariennes pour réduire les complications maternelles. *(Afr J Reprod Health 2022; 26[8]: 142-154).*

**Mots-clés**: Césarienne ; complication maternelle

# Introduction

Indicated caesarean section is an important operation that saves the lives of mothers and newborns. Indications for caesarean section include antepartum haemorrhage, foetal distress, breech presentation in a first pregnancy, and related maternal medical complications[1]. The rate of caesarean sections has been increasing markedly around the world for more than 30 years. The ideal rate of caesarean sections specified by the World Health Organization (WHO) is only 10%–15%[2]. On the other hand, caesarean rates increased worldwide in 2015 at an estimated rate of 21.1% (95% uncertainty interval 19.9–22.4)[3]. The rates varied greatly by region. For example, in Latin America and the Caribbean, caesarean rates were as high as 44.3%[1], whereas in low-income countries in Western and Central Africa, the rates were only 4.1%[3]. At the Faculty of Medicine of Siriraj Hospital, Mahidol University, Thailand, the rate of caesarean section was alarming, having risen to 48.86% in 2017[4]. Caesarean rates in high-income countries were 5 times higher than those in low- and middle-income countries. They were mainly related to educated families, private facilities, and the low obstetric risks of mothers and newborns[3].

Maternal and neonatal mortality rates in middle- and low-income countries were reported to be 10 to 20 times higher than those in high-income countries[5,6]. The causes of mortality and neonatal deaths were asphyxia, infection and prematurity[7]. Interestingly, birth asphyxia was usually caused by difficulties in labour, including obstructed labour[7], which occurs most frequently in low- and middle-income countries. Maternal mortality in low- and middle-income countries was due to haemorrhage, hypertensive diseases and infections[8]. Caesarean section is an intervention that can reduce maternal and neonatal mortality.

The study of Goldenburg *et al.*[9] showed that the highest maternal and neonatal mortality occurs during delivery. A United Nations review of strategies to reduce maternal and neonatal mortality rates confirmed that caesarean section is one of the prompt interventions that can be undertaken to save maternal and neonatal lives[10]. Our study aimed to investigate the complications of mothers and newborns arising from caesarean sections through a review of indications and details of complications that occurred in mothers and newborns at Siriraj Hospital.

# Method

This retrospective study was conducted in the statistical unit of the Department of Obstetrics and Gynecology of the Faculty of Medicine, Siriraj Hospital. Before starting this research, its protocol was approved by the Ethics Committee of the Faculty of Medicine Siriraj Hospital (Si 060/2020) and registered in the Thai Clinical Trials Registry (TCTR 20200127001). The authors thank the Faculty of Medicine Siriraj Hospital, Mahidol University, for its financial support ([IO] R016333027).

Data related to all pregnant women who underwent caesarean sections during 2017–2018 were collected from hospital records. A total of 3500 cases were identified. The baseline characteristic data of the women were recorded. In addition, the following details were collected: laboratory blood test results, number of antenatal visits, indications for caesarean section, gestational age at caesarean section, people performing the caesarean section, anaesthetic method, timing and duration of caesarean section, maternal complications from caesarean section. The primary outcome was the complications of mothers arising from the caesarean sections at Siriraj Hospital. Secondary outcomes were relevant adverse outcomes of mothers.

## *Statistical analysis*

Demographic data were summarised using descriptive statistics. Categorical data are presented as numbers and percentages, and continuous data are presented as means ± standard deviations, or as medians and ranges. Statistical analyses were performed using PASW Statistics for Windows (version 18.0; SPSS Inc., Chicago, IL, USA).

Baseline data (qualitative parameters, and maternal and infant complications arising from caesarean section) were compared using the chi-squared test and Fisher's exact test. For quantitative variables, the Mann–Whitney U test was used for a univariate analysis, and multiple logistic regression was used for a multivariate analysis.

## Results

Most of the 3500 pregnant women who underwent a caesarean section were in their first pregnancy (43.49%) without underlying disease (86.40%; Table 1). All had at least 4 visits during the antenatal period. A third of the women had a weight gain of more than 10 and under 15 kilograms (34.57%; 1210/3500), and a quarter (25.5%) had a haematocrit < 33% (Table 1). Haemoglobin E trait (16.37%; 573/3500) and rhesus positivity (98.57%; 3450/3500) were common (Table 1).

Approximately two-thirds of the caesarean sections (70.23%; 2485/3500) were emergency procedures. Most of the 3500 women (84.89%; 2971/3500) did not have any maternal complications during their pregnancies (Table 1). A previous caesarean section (35.11%; 1229/3500) was the most frequent absolute indication for the caesarean sections, while advanced maternal age (34.14%; 1195/3500) was the most common relative indication (Table 1). Caesarean sections performed on maternal request represented 7.11% of the cases (249/3500; Table 1). All maternal complications were 5.14% (180/3500). Post-partum haemorrhage was the most common maternal complication (3.4%). There were similar proportions of caesarean sections performed during office hours (9 A.M. to 4 P.M.; 52.71%; 1845/3500) and outside office hours (4 P.M. to 9 A.M.; 45.29%; 1655/3500). The operation time was generally less than 1 hour (78.86%; 2760/3500; Table 2).

Post-partum haemorrhage was the most common maternal complication. It was significantly related to placenta previa marginalis (adjusted odds ratio [AOR] = 4.78; 95% CI, 1.17–19.45; $P$ = 0.029); placenta previa totalis (AOR = 44.66; 95% CI, 22.55–88.46; $P$ < 0.001); advanced maternal age

(AOR = 1.75; 95% CI, 1.08–2.83; $P$ = 0.022); and cephalopelvic disproportion (AOR = 2.45; 95% CI, 1.44–4.18; $P$ < 0.001; Table 3). Adjacent maternal organ injury was related to surgeon ages of < 40 years and of ≥ 50 years, with AOR = 19.01 (95% CI, 3.10–116.36; $P$ = 0.001) and AOR = 5.45 (95% CI, 1.06–28.08; $P$ = 0.043), respectively (Table 3). Bladder injury was associated with a parity of at least one (Table 4). Maternal weight was not related to maternal complications (Table 5). Pregnancy with gestational diabetes mellitus was significantly related to maternal complications (Table 6).

## Discussion

Of the 3500 pregnant women who underwent caesarean sections at Siriraj Hospital during 2017–2018, the majority of the indications for caesarean section were a previous caesarean section (35.11%; 1229/3500) and advanced maternal age (≥ 35 years; 34.14%; 1195/3500). In Thailand, the first of these is an absolute indication, while the latter is a relative indication. In many countries, mothers of advanced age can have spontaneous vaginal delivery. This indication can increase the caesarean section rate above the usual level. Caesarean sections have become increasingly common in developed countries[2]. Our research demonstrated the same results as another study, which found that the increase in the rate of caesarean sections was predominantly associated with advanced maternal age, especially in nulliparous women[11].

Demographic, educational and social changes are resulting in the delaying of pregnancies until women feel that they have a settled lifestyle[12]. Some women ≥ 35 years of age undergo fertility treatment to achieve pregnancy[13]. The proportion of nulliparous women of advanced maternal age has increased in many countries[14]. Our work found that nulliparous women ≥ 35 years of age who underwent a caesarean section accounted for up to a third of the women in the study cohort. In addition, mothers aged ≥ 35 years have been reported to generally have healthier lifestyles than younger mothers[15]. Many studies have concluded that the rates of caesarean section are increasing

**Table 1:** Demographic and relevant laboratory data of pregnant women underwent caesarean section

| Demographic data | Number (3500 cases) | Demographic data | Number (3500 cases) | Relevant details of caesarean sections | Number (3500 cases) |
|---|---|---|---|---|---|
| Maternal age (years) | 31.46 ± 5.87 (14–49) | Blood group | | Type of caesarean section | |
| | | O | 1316 (37.60%) | Elective | 1042 (29.77%) |
| | | A | 747 (21.34%) | Emergency | 2458 (70.23%) |
| | | B | 1175 (33.57%) | | |
| | | AB | 241 (6.89%) | | |
| | | Missing data | 21 (0.60%) | | |
| Body weight (kilograms) | 57.26 ± 12.76 (29–158) | Rh group | | Maternal complications during pregnancy | |
| BMI (kg/m$^2$) | 22.84 ± 4.75 (12.49–63.29) | Negative | 29 (0.83%) | Diabetes mellitus | 2971 (84.89%) |
| | | Positive | 3450 (98.57%) | Not present | 434 (12.40%) |
| Gravida | | Missing data | 21 (0.60%) | GDMA1 | 55 (1.57%) |
| 1 | 1522 (43.49%) | Haemoglobinopathy | | GDMA2 | 40 (1.14%) |
| 2 | 1290 (36.86%) | Not present | 2448 (69.94%) | Pre-existing diabetes mellitus | |
| 3 | 688 (19.65%) | Hb H disease | 18 (0.52%) | Hypertension | 3314 (94.69%) |
| Parity | | Beta thalassaemia | 55 (1.57%) | Not present | 61 (1.74%) |
| 0 | 1871 (53.45%) | Hb E trait | 573 (16.37%) | Pregnancy-induced hypertension | 10 (0.29%) |
| 1 | 1333 (38.09%) | Alpha thalassaemia | 228 (6.52%) | Gestational hypertension | 5 (0.14%) |
| 2 | 296 (8.46%) | Other | 167 (4.77%) | Pre-eclampsia without severe features | 110 (3.14%) |
| Abortion | | Missing data | 11 (0.31%) | Pre-eclampsia with severe features | 13 (0.37%) |
| 0 | 2727 (77.91%) | | | Myoma uteri | 93 (2.66%) |
| 1 | 773 (22.09%) | | | Submucosal type | 140 (4.00%) |
| Gestational age at delivery (weeks of gestation) | | VDRL | | Intramural type | 25 (0.71%) |
| <28 | 12 (0.3%) | Non-reactive | 3478 (99.37%) | Subserosal type | 115 (3.29%) |
| | 45 (1.3%) | Reactive | 22 (0.63%) | | 375 (10.71%) |
| | | | | | 2 (0.06%) |

| | | | | | |
|---|---|---|---|---|---|
| 28– <32 | 50 (1.4%) | HBs antigen | | Unspecified | |
| 32– <34 | 392 (11.2%) | Negative | 3421 (97.74%) | Ovarian tumours/cysts | |
| 34 <37 | 3001 (85.7%) | Positive | 79 (2.26%) | Pelvic adhesion | |
| ≥37 | | | | Other cyst | |
| Underlying diseases | | Anti-HIV | | **Indications for caesarean section** | |
| None present | 3024 (86.40%) | Non-reactive | 3485 (99.57%) | | |
| Heart disease | 28 (0.80%) | Reactive | 15 (0.43%) | *Absolute indications* | |
| Pulmonary disease | 4 (0.12%) | | | | |
| Thyroid disease | | Haematocrit | | Breech presentation | 372 (10.63%) |
| Diabetes mellitus | 68 (1.94%) | ≤33% | 659 (18.83%) | Cephalopelvic disproportion | 915 (26.14%) |
| Hypertension | 34 (0.97%) | >33% | 2837 (81.06%) | Failed induction of labour | |
| Other | 71 (2.03%) | Missing data | 4 (0.11%) | Previous caesarean section | 170 (4.86%) |
| | 271 (7.74%) | | | Not in labour | |
| Number of antenatal care visits | | | | In labour | 1229 (35.11%) |
| 0 | 29 (0.83%) | | | | |
| 1 | 17 (0.49%) | | | Meconium-stained amniotic fluid | 581 (16.60%) |
| 2 | 13 (0.37%) | | | Non-reassuring foetal heart rate status (NICHD categories II/III, foetal distress) | 648 (18.51%) |
| 3 | 34 (0.97%) | | | | 233 (6.66%) |
| 4 | 55 (1.57%) | | | PROM | 487 (13.91%) |
| >4 | 3352 (95.77%) | | | Oligohydramnios | |
| Total weight gain (kilograms) | | | | Placenta previa | |
| <5 | 107 (3.06%) | | | Marginalis | 305 (8.71%) |
| 5– <10 | 540 (15.43%) | | | Totalis | 97 (2.77%) |
| 10– <15 | 1210 (34.57%) | | | Placental accrete syndrome | |
| 15– <20 | 981 (28.03%) | | | Placental accrete | 39 (1.11%) |
| ≥20 | 456 (13.03%) | | | Placental increta | 73 (2.09%) |
| Missing data | 206 (5.88%) | | | Placental percreta | |
| | | | | | 2 (0.06%) |
| | | | | | 2 (0.06%) |

|  |  |
|---|---|
|  | 1 (0.03%) |
| ***Relative indications*** |  |
| Advanced maternal age | 1195 (34.14%) |
| Contracted pelvis | 74 (2.11%) |
| Prolonged infertility | 110 (3.14%) |
| Obesity | 538 (15.37%) |
| ***No indications*** |  |
| Maternal request | 249 (7.11%) |
| Hypertension | 417 (11.91%) |
| Other | 98 (2.80%) |
| ***Other indications*** |  |
| Infection | 32 (0.91%) |
| Other | 29 (0.83%) |

* Data are presented as mean ± SD (range) and n (%)

**Table 2:** Times, anaesthetic methods, surgeon-performed caesarean sections and complications from caesarean sections (can have more than 1 complication)

| Details of caesarean sections | Number (3500 cases) |
|---|---|
| Timing | |
| Office hours (9.00 A.M.–4.00 P.M.) | 1845 (52.71%) |
| Outside office hours (4.00 P.M.–9.00 A.M.) | 1655 (47.29%) |
| Time from incision to delivery | |
| <2 minutes | 13 (0.37%) |
| 2 minutes– <4 minutes | 419 (11.97%) |
| 4 minutes– <10 minutes | 2144 (61.26%) |
| ≥10 minutes | 924 (26.40%) |
| Total operation time (minutes) | |
| <60 | 2760 (78.86%) |
| <30 | 147 (4.20%) |
| 30– <45 | 1295 (37.00%) |
| 45– <60 | 1318 (37.66%) |
| 60– <120 | 715 (20.43%) |
| 60– <75 | 485 (13.86%) |
| 75– <90 | 150 (4.29%) |
| 90– <105 | 51 (1.45%) |
| 105– <120 | 29 (0.83%) |
| 120– <180 | 18 (0.51%) |
| 120– <150 | 12 (0.34%) |
| 150– <180 | 6 (0.17%) |
| • ≥180 | 7 (0.20%) |
| | |
| **Anaesthetic methods** | |
| Spinal block | 3260 (93.14%) |
| General anaesthesia | 156 (4.46%) |
| Combined spinal block with general anaesthesia | 42 (1.20%) |
| Other | 42 (1.20%) |
| **Surgeon (can have more than 1 surgeon)** | |
| Resident | 2214 (63.25%) |
| *First year* | *77 (2.20%)* |
| *Second year* | *1325 (37.85%)* |
| *Third year* | *812 (23.20%)* |
| Fellowship | 138 (3.94%) |
| Staff | 1148 (32.79%) |
| *30– <40 years* | *94 (2.68%)* |
| *40– <50 years* | *634 (18.11%)* |
| *>50 years* | *420 (12.00%)* |
| Resident followed by staff | 146 (4.17%) |
| Co-staff | 17 (0.48%) |
| **All maternal complications (N= 3500)** | |
| **180 cases (5.14%)** | |
| Post-partum haemorrhage | 119 (3.40%) |
| Post-partum sepsis | 11 (0.31%) |
| Bladder injury | 8 (0.23%) |
| Ureteric injury | 1 (0.03%) |
| Bowel injury | 2 (0.06%) |
| Post-operative ileus | 2 (0.06%) |
| Uterus injury | 49 (1.40%) |
| Other | 17 (0.49%) |

among mothers of advanced maternal age[16,17]. Pregnancy in this age group has been found to be strongly related to underlying medical diseases, such as diabetes mellitus, hypertension and high body mass index [18].

In our study, the overall rate of maternal complications from caesarean sections was 5.14% (180/3500). Almost half of the caesarean sections in our study were primary caesarean deliveries (43.49%; 1522/3500). Advanced maternal age (34.14%; 1195/3500) was the second most frequent relative indication. Approximately two-thirds of the caesarean sections were performed by residents. Interestingly, maternal complications were only found in 5.14% of the patients, whereas neonatal complications were as high as 49.23%. Post-partum haemorrhage was the most common maternal complication, with an incidence of 3.4%. It was related to indications for cephalopelvic disproportion and advanced maternal age, an operation time > 90 minutes and placenta previa. A recent systematic review found that post-partum haemorrhage was one of the common complications of obstructed labour. Early detection of obstructed labour after planning for an early caesarean section can help prevent post-partum haemorrhage[19].

Our study also found that bladder injury was significantly related to a previous caesarean section. Most bladder injuries can be recognised during surgery, and their prompt repair can reduce maternal morbidity[20]. However, bladder injury is a rare complication of caesarean delivery and has a good prognosis[21]. Staff younger than 40 years were more likely to injure an adjacent organ than 40- to 50-year-old staff, without clinical significance. The experience of the staff may be related to the complications of the operation. However, some international studies have reported a negative relationship between the likelihood of postoperative complications of caesarean section and the years of surgeon experience[22,23] as well as the number of caesarean sections performed by surgeons[24]. Those studies were carried out in rural hospitals where the obstetricians were well trained. Our study found that the experience of physicians at an academic

**Table 3.** Factors associated with post-partum haemorrhage and adjacent organ injuries of mothers (bladder, bowel and ureter)

| Factors associated with post-partum haemorrhage | Unadjusted odds ratio (95% CI) | *P* value | Adjusted odds ratio (95% CI) | *P* value | Factors associated with adjacent organ injuries | No (n=3489) | Yes (n=11) | Unadjusted odds ratio (95% CI) | *P* value | Adjusted odds ratio (95% CI) | *P* value |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Post-partum haemorrhage** | | | | | **Adjacent organ injuries** | | | | | | |
| Surgeon age (years) | 1.00 | - | 1.00 | - | Surgeon age (years) | 2349 (99.87%) | 3 (0.13%) | 1.00 | - | 1.00 | - |
| Resident and Fellow | 2.01 (0.85–4.75) | 0.109 | 1.20 (0.36–3.99) | 0.762 | Resident and Fellow | | | | | | |
| 30– <40 | 1.21 (0.77–1.92) | 0.411 | | 0.812 | Staff age (years) | 92 (97.87%) | 2 (2.13%) | 17.02 (2.81–103.11) | 0.002 | 19.01 (3.10–116.36) | 0.001 |
| 40– <50 | 0.80 (0.42–1.51) | 0.482 | 1.08 (0.56–2.11) | 0.941 | 30– <40 | 631 (99.53%) | 3 (0.47%) | 3.72 (0.75–18.49) | 0.108 | 4.47 (0.86–23.21) | 0.075 |
| ≥50 | | | 0.97 (0.42–2.26) | | 40– <50 | 417 (99.29%) | 3 (0.71%) | 5.63 (1.13–28.01) | 0.035 | 5.92 (1.14–30.85) | 0.035 |
| Time of caesarean: night | 0.83 (0.57–1.20) | 0.325 | 0.77 (0.48–1.25) | 0.296 | ≥50 | | | | | | |
| Duration of operation (minutes) | | | | | Time of caesarean | 1838 (99.62%) | 7 (0.38%) | 1.00 | - | 1.00 | - |
| <30 | 1.00 | - | 1.00 | - | Day | 1651 (99.76%) | 4 (0.24%) | 0.64 (0.19–2.18) | 0.471 | 0.98 (0.27–3.56) | 0.982 |
| 30– <60 | 0.82 (0.25–2.68) | 0.745 | 0.63 (0.17–2.33) | 0.491 | Night | | | | | | |
| 60– <90 | 2.89 (0.88–9.50) | 0.081 | 2.51 (0.66–9.59) | 0.179 | | | | | | | |
| 90– <120 | 14.95 (4.27–52.39) | <0.001 | 18.85 (4.57–77.68) | <0.001 | | | | | | | |
| ≥120 | 102.0 (24.68–421.53) | <0.001 | 96.49 (17.57–529.74) | <0.001 | | | | | | | |
| Underlying disease | 1.73 (1.10–2.72) | 0.018 | 1.52 (0.85–2.71) | 0.156 | Previous caesarean | | | | | | |
| Cephalopelvic-disproportion | 1.39 (0.94–2.06) | 0.095 | 2.45 (1.44–4.18) | 0.001 | No | 2266 (99.78%) | 5 (0.22%) | 1.00 | - | 1.00 | 0.890 |
| | | | | | Yes | | 6 (0.49%) | | 0.188 | 0.89 (0.17–4.56) | |

| Post-partum haemorrhage | | | | | Adjacent organ injuries | | | | | | |
| Factors associated with post-partum haemorrhage | Unadjusted odds ratio (95% CI) | *P* value | Adjusted odds ratio (95% CI) | *P* value | Factors associated with adjacent organ injuries | No (n=3489) | Yes (n=11) | Unadjusted odds ratio (95% CI) | *P* value | Adjusted odds ratio (95% CI) | *P* value |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Advanced maternal age (AMA) | 1.75 (1.21–2.53) | 0.003 | 1.75 (1.08–2.83) | 0.022 | | 1223 (99.51%) | | 2.22 (0.68–7.30) | | | |
| Placenta previa | | | | | Gravida | | | | | | |
| No | 1.00 | - | 1.00 | - | 0-1 | 1520 (99.87%) | 2 (0.13%) | 1.00 | - | 1.00 | - |
| Marginalis | 4.61 (1.60–13.26) | 0.005 | 4.78 (1.17–19.45) | 0.029 | ≥2 | 1969 (99.54%) | 9 (0.46%) | 3.47 (0.75–16.10) | 0.128 | 2.12 (0.12–38.41) | 0.611 |
| Totalis | 33.26 (19.97–55.41) | <0.001 | 44.66 (22.55–88.46) | <0.001 | | | | | | | |
| Prolonged infertility | 3.01 (1.53–5.93) | 0.001 | 1.61 (0.56–4.65) | 0.381 | | | | | | | |
| Maternal weight (kilograms) | 1.01 (0.99–1.03) | 0.116 | 1.01 (0.99–1.02) | 0.537 | Parity | | | | | | |
| Birthweight (grams) | | | | | 0 | 1868 (99.84%) | 3 (0.16%) | 1.00 | - | 1.00 | - |
| Normal (2500–4000) | 1.00 | - | 1.00 | | ≥1 | 1621 (99.51%) | 8 (0.49%) | 3.07 (0.81–11.60) | 0.127 | 2.25 (0.15–33.62) | 0.558 |
| Low (>1500–2499) | 1.96 (1.26–3.06) | 0.003 | 1.71 (0.94–3.12) | | | | | | | | |
| High (>4000) | 2.23 (0.95–5.23) | 0.066 | 1.96 (0.73–5.26) | | | | | | | | |
| Maternal haematocrit ≤33% | 0.97 (0.92–1.03) | 0.351 | 1.08 (0.60–1.93) | 0.807 | Abortion | | | | | | |
| Gravida: ≥2 | 1.03 (0.71–1.49) | 0.888 | 1.02 (0.04–1.06) | 0.056 | 0 | 2719 (99.71%) | 8 (0.29%) | 1.00 | - | 1.00 | - |
| Parity: ≥1 | 1.17 (0.82–1.69) | 0.389 | 3.58 (0.89–14.42) | 0.073 | ≥1 | 770 (99.61%) | 3 (0.39%) | 1.32 (0.35–5.00) | 0.716 | 0.99 (0.20–5.02) | 0.998 |
| Abortion: ≥1 | 0.79 (0.50–1.27) | 0.337 | 0.90 (0.40–2.01) | 0.794 | | | | | | | |

**Table 4:** Associations between obstetrics history of maternal gravid, parity, and abortion (GPA) with complications from caesarean sections (univariate analysis)

| | All (N=3500) | Gravida 1 (n=1522) | ≥2 (n=1978) | *P* value | Parity 0 (n=1871) | ≥1 (n=1629) | *P* value | Abortion 0 (n=2727) | ≥1 (n=773) | *P* value |
|---|---|---|---|---|---|---|---|---|---|---|
| **Maternal complications** | **180 (5.14%)** | **71 (4.66%)** | **109 (5.51%)** | **0.280** | **85 (4.54%)** | **95 (5.83%)** | **0.092** | **143 (5.24%)** | **37 (4.79%)** | **0.646** |
| Post-partum haemorrhage | 119 (3.40%) | 51 (3.35%) | 68 (3.44%) | 0.925 | 59 (3.15%) | 60 (3.68%) | 0.401 | 97 (3.56%) | 22 (2.85%) | 0.370 |
| Post-partum sepsis | 11 (0.31%) | 6 (0.39%) | 5 (0.25%) | 0.548 | 7 (0.37%) | 4 (0.25%) | 0.559 | 8 (0.29%) | 3 (0.39%) | 0.716 |
| Bladder injury | 8 (0.23%) | - | 8 (0.40%) | 0.025 | 1 (0.05%- | 7 (0.43%) | 0.029 | 6 (0.22%) | 2 (0.26%) | 0.692 |
| Ureteric injury | 1 (0.03%) | - | 1 (0.05%) | 1.000 | - | 1 (0.06%) | 0.465 | - | 1 (0.13%) | 0.221 |
| Bowel injury | 2 (0.06%) | 2 (0.13%) | - | 0.189 | 2 (0.11%) | - | 0.502 | 2 (0.07%) | - | 1.000 |
| Post-operative ileus | 2 (0.06%) | 1 (0.07%) | 1 (0.05%) | 1.000 | 1 (0.05%) | 1 (0.06%) | 1.000 | 1 (0.04%) | 1 (0.13%) | 0.393 |
| Uterus injury | 49 (1.40%) | 16 (1.05%) | 33 (1.67%) | 0.147 | 19 (1.02%) | 30 (1.84%) | 0.054 | 38 (1.39%) | 11 (1.42%) | 1.000 |
| Other | 17 (0.49%) | 8 (0.53%) | 9 (0.46%) | 0.810 | 9 (0.48%) | 8 (0.49%) | 1.000 | 15 (0.55%) | 2 (0.26%) | 0.393 |

**Table 5:** Maternal weight gain during current pregnancy and complications from caesarean sections

| Complications | All (N=3500) | Weight gain: n (%) <5 kg (n=107) | 5– <10 kg (n=540) | 10– <15 kg (n=1210) | 15– <20 kg (n=981) | >20 kg (n=456) | *P* value |
|---|---|---|---|---|---|---|---|
| **Maternal complications** | **180 (5.14%)** | **9 (8.41%)** | **26 (4.81%)** | **59 (4.88%)** | **43 (4.38%)** | **23 (5.04%)** | **0.487** |
| Post-partum haemorrhage | 119 (3.40%) | 5 (4.67%) | 11 (2.04%) | 42 (3.47%) | 31 (3.16%) | 14 (3.07%) | 0.485 |
| Post-partum sepsis | 11 (0.31%) | 1 (0.93%) | 3 (0.56%) | 2 (0.17%) | 4 (0.41%) | 1 (0.22%) | 0.500 |
| Bladder injury | 8 (0.23%) | - | 1 (0.19%) | 3 (0.25%) | 1 (0.10%) | 2 (0.44%) | 0.743 |
| Ureteric injury | 1 (0.03%) | - | - | - | - | - | - |
| Bowel injury | 2 (0.06%) | - | 1 (0.19%) | 1 (0.08%) | - | - | 0.781 |
| Post-operative ileus | 2 (0.06%) | 1 (0.93%) | - | 1 (0.08%) | - | - | 0.064 |
| Uterus injury | 49 (1.40%) | 2 (1.87%) | 8 (1.48%) | 17 (1.40%) | 9 (0.92%) | 8 (1.75%) | 0.693 |
| Other | 17 (0.49%) | - | 6 (1.11%) | 4 (0.33%) | 5 (0.51%) | - | 0.077 |

**Table 6:** Mothers with underlying diseases of diabetes mellitus and hypertension and complications from caesarean sections

| Complications | All (N=3500) | Maternal diseases during pregnancy Gestational diabetes (GDM) n (%) | | | | *P* value |
|---|---|---|---|---|---|---|
| | | No (n=2971) | GDMA1 (n=434) | GDMA2 (n=55) | Pre-existing diabetes mellitus (n=40) | |
| **Maternal complications** | **180 (5.14%)** | **139 (4.68%)** | **32 (7.37%)** | **6 (10.91%)** | **3 (7.50%)** | **0.023** |
| Post-partum haemorrhage | 119 (3.40%) | 92 (3.10%) | 22 (5.07%) | 3 (5.45%) | 2 (5.00%) | 0.133 |
| Post-partum sepsis | 11 (0.31%) | 8 (0.27%) | 2 (0.46%) | - | 1 (2.50%) | 0.104 |
| Bladder injury | 8 (0.23%) | 6 (0.20%) | 2 (0.46%) | - | - | 0.685 |
| Ureteric injury | 1 (0.03%) | 1 (0.03%) | - | - | - | 1.000 |
| Bowel injury | 2 (0.06%) | 2 (0.07%) | - | - | - | 1.000 |
| Post-operative ileus | 2 (0.06%) | 2 (0.07%) | - | - | - | 1.000 |
| Uterus injury | 49 (1.40%) | 36 (1.21%) | 9 (2.07%) | 3 (5.45%) | 1 (2.50%) | 0.080 |
| Others | 17 (0.49%) | 14 (0.47%) | 2 (0.46%) | - | 1 (2.50%) | 0.279 |
| Complications | All (N=3500) | Hypertension (HT) n (%) | | | | *P* value |
| | | No (n=3314) | Gestational HT/transient (n=61) | Mild to severe pre-eclampsia (n=15) | Pre-existing HT (n=110) | |
| **Maternal complications** | **180 (5.14%)** | **166 (5.01%)** | **4 (6.56%)** | **-** | **10 (9.09%)** | **0.173** |
| Post-partum haemorrhage | 119 (3.40%) | 107 (3.23%) | 4 (6.56%) | - | 8 (7.27%) | 0.059 |
| Post-partum sepsis | 11 (0.31%) | 9 (0.27%) | - | - | 2 (1.82%) | 0.103 |
| Bladder injury | 8 (0.23%) | 8 (0.24%) | - | - | - | 1.000 |
| Ureteric injury | 1 (0.03%) | 1 (0.03%) | - | - | - | 1.000 |
| Bowel injury | 2 (0.06%) | 2 (0.06%) | - | - | - | 1.000 |
| Post-operative ileus | 2 (0.06%) | 2 (0.06%) | - | - | - | 1.000 |
| Uterus injury | 49 (1.40%) | 49 (1.48%) | - | - | - | 0.397 |
| Other | 17 (0.49%) | 14 (0.42%) | 1 (1.64%) | - | 2 (1.82%) | 0.133 |

centre affects the complications of caesarean section, with a higher level of experience being associated with fewer complications.

In our investigation, parity and previous caesarean sections were not related to maternal adjacent organ injuries, which is consistent with a previous study with a large population. That study concluded that bladder injury is a rare complication of caesarean delivery with favourable prognosis and no long-term sequelae[23].

Many studies have shown that being overweight before pregnancy and gaining weight during pregnancy were associated with higher risks of maternal complications and caesarean section[25,26]. Maternal complications (post-partum haemorrhage and adjacent organ injuries) were found, but without statistical significance. This may be due to the low rate of maternal complications (5.14%) in our study.

It has been found that pregnant women with gestational diabetes mellitus tend to have a higher incidence of emergency caesarean delivery than normal pregnant women[27]. According to our study, maternal complications were commonly found in mothers with gestational diabetes. However, hypertension in the women in our study was only significantly related to neonatal complications. Additionally, maternal complications were not common, possibly due to the low incidence of such complications in our investigation.

## Conclusion

The most common indications for caesarean sections were a previous caesarean section and an advanced maternal age. Most maternal complications were post-partum haemorrhage..

## Author contributions

Saifon Chawanpaiboon contributed to the conception and design of the research; the acquisition, analysis and interpretation of data; the drafting and critical revision of the manuscript; and the approval of the final manuscript.

Vitaya Titapant contributed to the conception and design of the research, revision of the manuscript, and approval of the final manuscript.

Julaporn Pooliam contributed to the analysis and interpretation of data, critical revision of the manuscript, and approval of the final manuscript.

## Conflicts of interest

The authors have each completed the International Committee of Medical Journal Editors' Form for Uniform Disclosure of Potential Conflicts of Interest. All authors have nothing to disclose. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee (Si 060/2020) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study.

## Acknowledgements

## References

1. Mylonas I and Friese K. Indications for and Risks of Elective Cesarean Section. Dtsch Arztebl Int. 2015;112)29–30(:489–95.
2. World Health Organization Human Reproduction Programme A. WHO Statement on caesarean section rates. Reprod Health Matters. 2015;23)45(:149–50.
3. Boerma T, Ronsmans C, Melesse DY, Barros AJD, Barros FC, Juan L, Moller AB, Say L, Hosseinpoor AR, Yi M, de Lyra Rabello Neto D and Temmerman M. Global epidemiology of use of and disparities in caesarean sections. Lancet. 2018;392)10155(:1341–8.
4. Anekpornwattana S, Yangnoi J, Jareemit N and Boriboonhirunsarn D. Cesarean section rate in Siriraj Hospital according to the Robson classification. Thai J Obstet Gynaecol. 2020;28)1(:6–15.
5. Alkema L, Chou D, Hogan D, Zhang S, Moller AB, Gemmill A, Fat DM, Boerma T, Temmerman M, Mathers C

and Say L. Global, regional, and national levels and trends in maternal mortality between 1990 and 2015, with scenario-based projections to 2030: a systematic analysis by the UN Maternal Mortality Estimation Inter-Agency Group. Lancet. 2016;387)10017(:462–74.

6. Oza S, Lawn JE, Hogan DR, Mathers C and Cousens SN. Neonatal cause-of-death estimates for the early and late neonatal periods for 194 countries: 2000–2013. Bull World Health Organ. 2015;93)1(:19–28.

7. Goldenberg RL and McClure EM. Maternal, fetal and neonatal mortality: lessons learned from historical changes in high income countries and their potential application to low-income countries. Matern Health Neonatol Perinatol. 2015;1:3.

8. Pasha O, McClure EM, Saleem S, Tikmani SS, Lokangaka A, Tshefu A, Bose CL, Bauserman M, Mwenechanya M, Chomba E, Carlo WA, Garces AL, Figueroa L, Hambidge KM, Krebs NF, Goudar S, Kodkany BS, Dhaded S, Derman RJ, Patel A, Hibberd PL, Esamai F, Tenge C, Liechty EA, Moore JL, Wallace DD, Koso-Thomas M, Miodovnik M and Goldenberg RL. A prospective cause of death classification system for maternal deaths in low and middle-income countries: results from the Global Network Maternal Newborn Health Registry. BJOG. 2018;125)9(:1137–43.

9. Goldenberg RL, McClure EM and Saleem S. Improving pregnancy outcomes in low- and middle-income countries. Reprod Health. 2018;15(Suppl 1):88.

10. UNFPA (United Nations Population Fund), UNICEF (United Nations Children's Fund), WHO (World Health Organization), and World Bank. Trends in maternal mortality: 1990 to 2010. Geneva: WHO; 2012.

11. Moore EK and Irvine LM. The impact of maternal age over forty years on the caesarean section rate: six year experience at a busy district general hospital. J Obstet Gynaecol. 2014;34)3(:238–40.

12. Cohen W. Does maternal age affect pregnancy outcome? BJOG. 2014;121)3(:252–4.

13. Kenny LC, Lavender T, McNamee R, O'Neill SM, Mills T and Khashan AS. Advanced maternal age and adverse pregnancy outcome: evidence from a large contemporary cohort. PLoS One. 2013;8(2):e56583.

14. Saloojee H, Coovadia H. Maternal age matters: for a lifetime, or longer. Lancet Glob Health. 2015;3(7):e342–3.

15. Petropanagos A. Is Advanced Maternal Age a Public Health Issue? Am J Bioeth. 2015;15)11(:56–8.

16. Klemetti R, Gissler M, Sainio S and Hemminki E. At what age does the risk for adverse maternal and infant outcomes increase? Nationwide register-based study on first births in Finland in 2005–2014. Acta Obstet Gynecol Scand. 2016;95)12(:1368–75.

17. Richards MK, Flanagan MR, Littman AJ, Burke AK and Callegari LS. Primary cesarean section and adverse delivery outcomes among women of very advanced maternal age. J Perinatol. 2016;36)4(:272–7.

18. Oakley L, Penn N, Pipi M, Oteng-Ntim E and Doyle P. Risk of Adverse Obstetric and Neonatal Outcomes by Maternal Age: Quantifying Individual and Population Level Risk Using Routine UK Maternity Data. PLoS One. 2016;11(10):e0164462.

19. Ayenew AA. Incidence, causes, and maternofetal outcomes of obstructed labor in Ethiopia: systematic review and meta-analysis. Reprod Health. 2021;18(1):61.

20. Tarney CM. Bladder Injury During Cesarean Delivery. Curr Womens Health Rev. 2013;9)2(:70–6.

21. Salman L, Aharony S, Shmueli A, Wiznitzer A, Chen R and Gabbay-Benziv R. Urinary bladder injury during cesarean delivery: Maternal outcome from a contemporary large case series. Eur J Obstet Gynecol Reprod Biol. 2017;213:26–30.

22. Eyelade OR, Adesina OA, Adewole IF and Adebowale SA. Blood Transfusion Requirement during Caesarean Delivery: Risk Factors. Ann Ib Postgrad Med. 2015;13)1(:29–35.

23. Hadar E, Melamed N, Tzadikevitch-Geffen K and Yogev Y. Timing and risk factors of maternal complications of cesarean section. Arch Gynecol Obstet. 2011;283)4(:735–41.

24. Guglielminotti J, Deneux-Tharaux C, Wong CA and Li G. Hospital-Level Factors Associated with Anesthesia-Related Adverse Events in Cesarean Deliveries, New York State, 2009–2011. Anesth Analg. 2016;122)6(:1947–56.

25. Mochhoury L, Razine R, Kasouati J, Kabiri M and Barkat A. Body mass index, gestational weight gain, and obstetric complications in Moroccan population. J Pregnancy. 2013;2013:379461.

26. Simko M, Totka A, Vondrova D, Samohyl M, Jurkovicova J, Trnka M, Cibulkova A, Stofko J and Argalasova L. Maternal Body Mass Index and Gestational Weight Gain and Their Association with Pregnancy Complications and Perinatal Conditions. Int J Environ Res Public Health. 2019 May 17;16(10):1751. doi: 10.3390/ijerph16101751. PMID: 31108864; PMCID: PMC6572546.

27. Boriboonhirunsarn D and Waiyanikorn R. Emergency cesarean section rate between women with gestational diabetes and normal pregnant women. Taiwan J Obstet Gynecol. 2016;55(1):64–7.