

## Keywords

caesarean section; maternal mortality; infant mortality; early neonatal mortality; obstetric epidemiology; Uzbekistan.

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# National trends in caesarean section use and maternal and infant mortality in Uzbekistan, 1995-2023

## Abstract

Caesarean section (CS) is a life-saving intervention when medically indicated, but sustained population-level increases raise concerns about overuse and the balance of benefit and harm. This retrospective ecological time-trend study described changes in CS use and maternal and infant mortality in Uzbekistan using aggregated maternity-facility reports and publicly available national statistics for 1995–2023. The reported national CS rate increased from 3.5% in 1995 to 15.5% in 2017 and 26.4% in 2023. A previous uterine scar was the leading reported indication in 2023 (42.2%), followed by cephalopelvic disproportion (11.2%) and pre-eclampsia (11.1%). The maternal mortality ratio declined from 32 per 100,000 live births in 1995 to 21 in 2010 and 14.05 in 2023. Infant mortality declined from 26.6 per 1,000 live births in 1995 to 11.0 in 2010, 9.3 in 2019, and 8.5 in 2023. Early neonatal mortality decreased from 6.7 per 1,000 live births in 1995 to 4.1 in 2012 and subsequently remained approximately 4.5 per 1,000 over the last decade. The largest mortality improvements coincided with expansion of CS access to approximately 10–11%, whereas later increases were accompanied by smaller incremental gains. Because the analysis is ecological and uses aggregated reporting streams, causal thresholds cannot be inferred. Standardized denominators, indication-specific audits, Robson classification, and monitoring of morbidity as well as mortality are needed to optimize CS use in Uzbekistan.

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## INTRODUCTION

Caesarean section is an essential component of comprehensive obstetric care and can prevent severe maternal and neonatal outcomes when vaginal birth would create substantial risk. At the same time, unnecessary surgery exposes women and newborns to avoidable short- and long-term morbidity and increases the use of health-system resources. Global use has risen substantially: approximately 21.1% of births were by CS in 2018, with marked regional variation and projections approaching 28.8% by 2030 [1]. The determinants of rising CS use are heterogeneous and include previous CS, maternal request, fear of adverse vaginal birth outcomes, medico-legal concerns, provider practice patterns, and health system incentives [2].

Population-level targets remain debated. The 1985 World Health Organization (WHO) expert consultation suggested that national CS rates above 10–15% were not justified by the evidence available at that time [3]. In its 2015 statement, WHO emphasized that mortality declines as population CS rates rise toward approximately 10%, while also cautioning that population-level mortality alone is insufficient for defining an optimal rate and that hospital-level rates depend strongly on case mix [4]. A global survey of obstetricians reported a median perceived optimal national CS rate of 20%, with an interquartile range of 15–30% [5]. More recent evidence has refined this discussion. A 2024 joint position statement from the European Association of Perinatal Medicine and the European Midwives Association proposed that national rates in the 15–20% range are more consistent with contemporary evidence [6], while a 2025 national cohort study using natural variation found clinically relevant outcome differences across municipalities with CS rates broadly spanning approximately 10–20% [7].

Uzbekistan has experienced major demographic and health-system changes over the last three decades, alongside a pronounced increase in CS use. National trend analysis is therefore important for distinguishing improved access to medically necessary surgery from possible overuse and for identifying priorities for quality improvement. The objective of this study was to describe the national trend in CS use in Uzbekistan from 1995 to 2023, characterize the reported indications for CS in 2023, and examine contemporaneous trends in maternal, early neonatal, and infant mortality.

## 2. Materials and methods

### 2.1. Study design and data sources

A retrospective ecological time-trend design was used. The analysis was based on aggregated obstetric and neonatal reporting forms from maternity institutions in Uzbekistan, including reporting frameworks referenced in Ministry of Health orders No. 185 (2014) and No. 151 (2021), together with publicly available national statistical data for 1995–2023 from the Agency of Statistics of the Republic of Uzbekistan. No individual-level clinical records were analyzed in the source manuscript.

### 2.2. Study variables

The principal exposure indicator was the reported national CS rate. Additional descriptive variables included the absolute number of CS procedures, number of live births, and indication categories for CS in 2023. Outcome indicators were the maternal mortality ratio (deaths per 100,000 live births), early neonatal mortality rate (deaths per 1,000 live births), and infant mortality rate (deaths per 1,000 live births). The source dataset reported historical rates and absolute procedure counts through different national reporting streams; therefore, rate denominators were retained as originally reported and were not recalculated from the national live-birth series.

### 2.3. Statistical analysis

The analysis was descriptive. National time trends were summarized using reported annual or milestone values, absolute percentage-point changes, and clinically relevant periods corresponding to CS rates around 10–11%, 15–20%, and above 20%. No patient-level adjustment, causal modeling, or formal threshold estimation was performed because the available data were aggregated and did not include case mix, parity, Robson group, maternal age, comorbidity, referral status, or socioeconomic covariates. Accordingly, temporal co-movement between CS rates and mortality indicators is interpreted as ecological association rather than causation.

### 2.4. Ethical considerations

The study used aggregated institutional reports and publicly available national statistics without individual identifiers or direct participant contact.

Ethics approval and informed consent did not apply to this study because only aggregated institutional reports and publicly available national statistics were analyzed. No individual-level or personally identifiable data were used, and there was no direct contact with study participants.

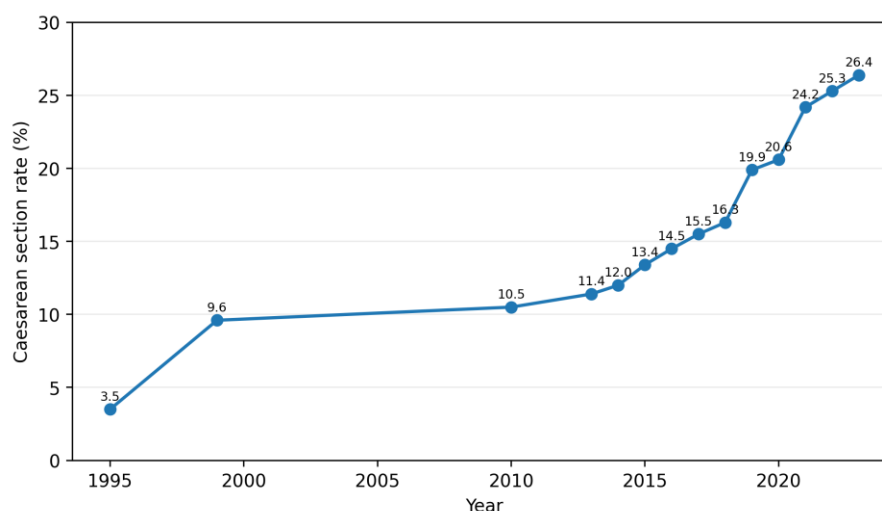
## 3. Results and discussion

### 3.1. National increase in caesarean section use

The reported CS rate increased from 3.5% in 1995 to 10.5% in 2010, 15.5% in 2017, 19.9% in 2019, 20.6% in 2020, and 26.4% in 2023 (Figure 1). This represents a 22.9 percentage-point increase from 1995 to 2023 and a 7.5-fold increase in the reported rate. The source manuscript also reported a rise in the absolute number of CS procedures from 12,578 in 1995 to 201,063 in 2023 (Table 1). National live births increased from 662,410 in 1995 to 961,962 in 2023. Because the reported CS-rate series and absolute-count series appear to originate from different reporting denominators, these figures should be interpreted as parallel national surveillance indicators rather than as numerator-denominator pairs. Harmonization of historical denominators is required before rate recalculation or formal time-series modeling. The direction of change is consistent with previous global analyses of rising CS rates [1,8]. The rate of 26.4% reported for Uzbekistan in 2023 is above the 15–20% national range proposed in the 2024 EAPM-EMA position statement [6]. However, a national percentage alone cannot determine appropriateness. A higher rate may reflect improved access for high-risk women, changing maternal age and comorbidity, referral patterns, repeated

CS, or potentially non-indicated procedures. A clinical audit, therefore, requires indication-specific and case-

mix-adjusted assessment rather than comparison with a single population target.



**Figure 1. Reported national cesarean section rate in Uzbekistan, selected years, 1995–2023. Values are reproduced from the maternity-institution reporting series in the source manuscript.**

**Table 1. Selected reported national cesarean section indicators in Uzbekistan.**

| Year | Reported CS rate)   rate)   rate (%) | Reported CS procedures (n) |
|------|--------------------------------------|----------------------------|
| 1995 | 3.5                                  | 12,578                     |
| 2000 | -                                    | 16,376                     |
| 2010 | 10.5                                 | 54,862                     |
| 2015 | 13.4                                 | 95,543                     |
| 2017 | 15.5                                 | -                          |
| 2019 | 19.9                                 | -                          |
| 2020 | 20.6                                 | 157,871                    |
| 2021 | 24.2                                 | 174,196                    |
| 2022 | 25.3                                 | 189,764                    |
| 2023 | 26.4                                 | 201,063                    |

Note: Rate and absolute-count series were reported through separate national surveillance streams in the source manuscript. The underlying denominators should be harmonized before recalculating historical rates.

### 3.2. Indications for cesarean section in 2023

A previous uterine scar was the dominant reported indication for CS in 2023, accounting for 42.2% (84,848 procedures). Cephalopelvic disproportion (11.2%) and pre-eclampsia (11.1%) were the next most frequent indications, followed by placental abruption (6.8%), breech presentation (6.6%), and acute fetal distress (6.4%) (Table 2). The concentration of procedures among women

with a uterine scar suggests that the growing pool of women with a previous CS is likely to be an important structural driver of future CS rates. This makes assessment of primary CS indications, eligibility for trial of labor after CS, and standardized management of women with a previous uterine scar central components of any national optimization strategy.

**Table 2. Reported indications for caesarean section in Uzbekistan, 2023.**

| Indication                  | Procedures (n) | Share (%) |
|-----------------------------|----------------|-----------|
| Previous uterine scar       | 84,848         | 42.2      |
| Cephalopelvic disproportion | 22,522         | 11.2      |
| Pre-eclampsia               | 22,295         | 11.1      |
| Placental abruption         | 13,672         | 6.8       |
| Breech presentation         | 13,270         | 6.6       |
| Acute fetal distress        | 12,893         | 6.4       |
| Transverse or oblique lie   | 9,391          | 4.7       |
| High-degree myopia          | 5,596          | 2.8       |
| Multiple pregnancy          | 4,846          | 2.4       |
| Abnormal labor              | 3,055          | 1.5       |

|                        |       |     |
|------------------------|-------|-----|
| Placenta previa        | 2,814 | 1.4 |
| Cardiovascular disease | 1,719 | 0.8 |
| Uterine fibroids       | 1,132 | 0.6 |

Note: Listed categories account for 98.5% of the reported 2023 procedures; minor unlisted categories and/or rounding account for the remainder.

### 3.3. Maternal and infant mortality trends

Maternal mortality declined substantially over the observation period, although the decline was not monotonic. The maternal mortality ratio was 32 per 100,000 live births in 1995, 21 in 2010, 19.6 in 2019, 18.5 in 2020, 14.4 in 2021, 13.9 in 2022, and 14.05 in 2023 (Figure 2). From 1995 to 2023, the reported ratio decreased by approximately 56%. The most pronounced early decline coincided with expansion of CS use from 3.5% to approximately 10–11%. Thereafter, CS use continued to increase, while maternal mortality improved more gradually and with year-to-year variation. This pattern is compatible with international ecological evidence suggesting diminishing mortality gains once access to necessary CS is broadly established, but it does not demonstrate that the change in CS rate caused the observed mortality trend [9].

Infant mortality also declined: from 26.6 per 1,000 live births in 1995 to 11.0 in 2010, 9.3 in 2019, and 8.5 in 2023, corresponding to an overall reduction of approximately 68% between 1995 and 2023. Early neonatal mortality was reported at 6.7 per 1,000 live births in 1995 and 4.1 in 2012, when the national CS rate was approximately 11%; the source manuscript states that the rate remained around 4.5 per 1,000 during the subsequent decade. These improvements occurred during a period of broad changes in maternal and newborn care. Access to emergency obstetric care, referral systems, antenatal care, infection control, neonatal intensive care, socioeconomic conditions, and underlying maternal health are important co-determinants and cannot be separated from CS use in an ecological analysis

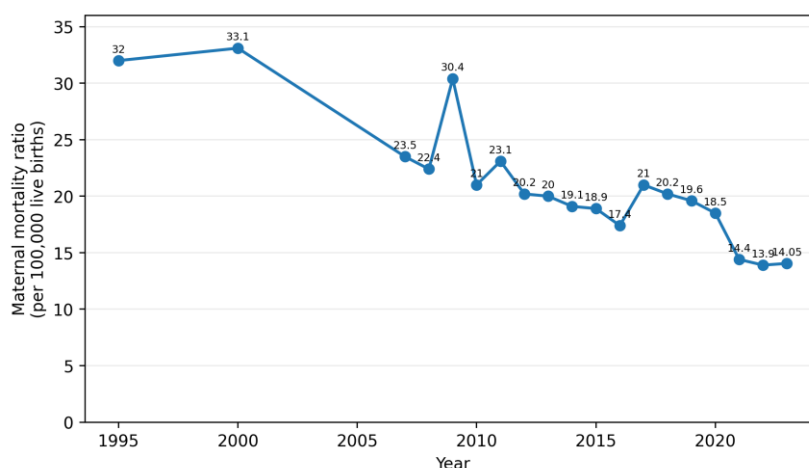


Figure 2. Maternal mortality ratio in Uzbekistan, selected years, 1995–2023, as reported in the source manuscript.

Table 3. Selected mortality milestones reported in the national series.

| Year | CS rate (%) | Maternal mortality ratio* | Early neonatal mortality† | Infant mortality‡ |
|------|-------------|---------------------------|---------------------------|-------------------|
| 1995 | 3.5         | 32.0                      | 6.7                       | 26.6              |
| 2010 | 10.5        | 21.0                      | -                         | 11.0              |
| 2012 | ≈11.0       | 20.2                      | 4.1                       | -                 |
| 2019 | 19.9        | 19.6                      | ≈4.5‡                     | 9.3               |
| 2023 | 26.4        | 14.05                     | ≈4.5‡                     | 8.5               |

\*Per 100,000 live births. †Per 1,000 live births. ‡The source manuscript reports an approximately stable level of 4.5 per 1,000 over the last decade rather than a specific annual value.

### 3.4. Interpretation and implications for obstetric practice

The central finding is not that a single national CS rate is inherently safe or unsafe, but that Uzbekistan has moved from a low-access setting to a high-use setting. At low population rates, increasing access to timely surgery plausibly captures women who previously lacked needed operative delivery. At higher rates, the marginal benefit

depends increasingly on whether additional procedures are clinically indicated and whether surgical quality is maintained. WHO therefore recommends focusing on the need for CS in individual clinical circumstances and on standardized classification rather than pursuing a universal hospital target [4]. The Robson ten-group classification is particularly useful because it separates women into mutually exclusive obstetric groups and can

identify whether the increase is driven by nulliparous term cephalic pregnancies, previous CS, breech presentation, multiple pregnancy, preterm birth, or other groups.

The predominance of a previous uterine scar in the 2023 indication profile reinforces the importance of preventing avoidable primary CS. Repeated surgery can increase the risk of placenta previa/accreta spectrum, uterine rupture in subsequent pregnancies, adhesions, chronic pelvic symptoms, and scar-related pathology; neonatal consequences may include respiratory morbidity and altered early-life outcomes, although risks vary by indication, gestational age, and clinical context [10–12]. These risks should not be used to deny necessary CS. Rather, they support a quality-improvement approach that strengthens evidence-based indications, shared decision-making, safe vaginal birth when appropriate, and structured review of primary and repeat CS.

### 3.5. Strengths and limitations

This study provides a long national perspective extending from 1995 to 2023 and combines CS utilization, indication patterns, and key maternal and infant mortality indicators. Several limitations are important. First, the analysis is ecological and cannot establish individual-level benefit, harm, or causal thresholds. Second, the historical CS-rate and absolute-count series appear to derive from different reporting denominators; the underlying primary records should be reconciled before formal modeling or submission of recalculated rates. Third, detailed annual data were unavailable for all outcomes and years. Fourth, the analysis lacks adjustment for maternal age, parity, previous CS, multiple pregnancy, comorbidity, gestational age, referral status, socioeconomic status, and changes in clinical coding or reporting. Fifth, mortality alone does not capture important maternal and neonatal morbidity. These limitations mean that the observed temporal pattern should be interpreted as a surveillance signal rather than proof of an optimal national CS rate.

### 4. Conclusions

The reported cesarean section rate in Uzbekistan increased markedly from 3.5% in 1995 to 26.4% in 2023. During the same period, maternal and infant mortality declined substantially. The steepest early improvements coincided with expansion of CS access to approximately 10–11%, while later increases in CS use were accompanied by smaller incremental mortality gains. These ecological data do not establish a causal threshold and should not be interpreted as evidence that a specific national percentage is optimal for every facility or patient population. Future national monitoring should standardize denominators, adopt Robson classification, audit primary and repeat CS indications, and track severe maternal and neonatal morbidity in addition to mortality. Particular attention should be directed to the prevention of avoidable primary CS because previous uterine scar accounted for more than two-fifths of reported procedures in 2023.

### Declarations

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None.

### Author contributions

[Complete using the journal-required contribution statement/CRediT roles for M.E.Suyarkulova, Sh.D. Babazhanova, and M.I. Oblayorova.]

### Conflict of interest

The authors declare that they have no conflict of interest.

### Data availability

Public national statistics used in this study are available through the Statistics Agency of the Republic of Uzbekistan. The additional data analyzed in this study were derived from aggregate reports of maternity facilities. No individual-level or personally identifiable patient data were used.

### Generative AI disclosure

OpenAI ChatGPT (GPT-5.6 Sol) was used for English-language editing, structural organization, and manuscript formatting. The authors remain responsible for verifying all scientific content, numerical data, references, interpretations, and the final submitted version.

### References

1. Betran AP, Ye J, Moller AB, Souza JP, Zhang J. Trends and projections of caesarean section rates: global and regional estimates. *BMJ Glob Health*. 2021;6(6):e005671. doi:10.1136/bmjgh-2021-005671.
2. Jenabi E, Khazaei S, Bashirian S, Aghababaei S, Matinnia N. Reasons for elective cesarean section on maternal request: a systematic review. *J Matern Fetal Neonatal Med*. 2020;33(22):3867–3872. doi:10.1080/14767058.2019.1587407.
3. World Health Organization. Appropriate technology for birth. *Lancet*. 1985;2:436–437.
4. World Health Organization. WHO statement on caesarean section rates. Geneva: World Health Organization; 2015. WHO/RHR/15.02.
5. Cavallaro FL, Cresswell JA, Ronsmans C. Obstetricians' opinions of the optimal caesarean rate: a global survey. *PLoS One*. 2016;11(3):e0152779. doi:10.1371/journal.pone.0152779.
6. Ayres-de-Campos D, Simon A, Modi N, Tudose M, Saliba E, Wielgos M, et al. European Association of Perinatal Medicine (EAPM)-European Midwives Association (EMA) joint position statement: Caesarean delivery rates at a country level should be in the 15–20% range. *Eur J Obstet Gynecol Reprod Biol*. 2024;294:76–78. doi:10.1016/j.ejogrb.2024.01.005.
7. Moster D, Wilcox AJ, Lie RT. What is the safest population-level caesarean delivery rate? A national cohort study using natural variation. *BJOG*. 2025;132(12):1781–1788. doi:10.1111/1471-0528.18301.
8. Betrán AP, Ye J, Moller AB, Zhang J, Gülmezoglu AM, Torloni MR. The increasing trend in caesarean section rates: global, regional and national estimates:

- 1990-2014. PLoS One. 2016;11(2):e0148343. doi:10.1371/journal.pone.0148343
9. Ye J, Zhang J, Mikolajczyk R, Torloni MR, Gülmezoglu AM, Betran AP. Association between rates of caesarean section and maternal and neonatal mortality in the 21st century: a worldwide population-based ecological study with longitudinal data. BJOG. 2016;123(5):745-753. doi:10.1111/1471-0528.13592.
10. Tanos V, Toney ZA. Uterine scar rupture - prediction, prevention, diagnosis, and management. Best Pract Res Clin Obstet Gynaecol. 2019;59:115-131. doi:10.1016/j.bpobgyn.2019.01.009.
11. Zhang P, Sun Y, Zhang C, Yang Y, Zhang L, Wang N, et al. Cesarean scar endometriosis: presentation of 198 cases and literature review. BMC Womens Health. 2019;19:14. doi:10.1186/s12905-019-0711-8.
12. Słabuszewska-Jóźwiak A, Szymański JK, Ciebiera M, Sarecka-Hujar B, Jakiel G. Pediatrics consequences of caesarean section - a systematic review and meta-analysis. Int J Environ Res Public Health. 2020;17(21):8031. doi:10.3390/ijerph17218031