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Trends in Cesarean Section in a Tertiary Referral Hospital: Time-Series Analysis

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Objective: To analyze the causes and indications of C-sections conducted at the tertiary referral center and to forecast future patterns. **Methods:** We retrospectively analyzed 25,311 delivery records from 2013 to 2022 at the National Center for Maternal and Child Health, Mongolia. All C-sections from 22 weeks' gestation onward were included. Data were collected using a structured questionnaire form including maternal, obstetric history, surgical indications, and other influencing factors. Causes of C-sections were identified through descriptive statistics, logistic regression, and ARIMA time-series modeling. Statistical analysis was performed using Stata BE 18.0, with $p < 0.05$ considered significant. **Results:** The mean gestational age was 38.1±2.09 weeks, the 88.4% of pregnancies were term deliveries, and 42.6% were emergency C-sections. The most common indications for C-section were previous C-section, maternal comorbidity, severe preeclampsia, and fetal distress. According to time-series analysis, despite of no significant change in the C-section rate during the study period, the trends in C-sections are growing. The percentage of nulliparous women in total C-sections is likely to increase by 0.81% per year. In 2030, the percentage of C-sections will reach 35.5%, whereas the percentage of emergency C-sections in total C-sections will reach 59.5%. **Conclusions:** C-sections for nulliparous women were mainly due to failed birth induction, failed labor stimulation, and fetal distress. It is estimated that the percentage of C-sections in total births will increase by 0.02% annually, reaching 35.5% by 2030.

Keywords: Cesarean Sections; Indication; Risk Factors; Obstetric Labor; Forecasting

Introduction

Cesarean section (C-section) is a commonly used medical procedure to save the lives of mothers and babies when medically indicated. However, its overuse and associated complications has become a public health issue worldwide.

The World Health Organization (WHO) reports that cesarean sections now account for more than one in five deliveries worldwide, reaching 21% compared to an optimal level of 15%.[1] Since the C-section is a surgical intervention, it has potential risks and complications such as obstetric infection, blood loss, and increased risk of repeated C-sections in subsequent pregnancy. The study on the global incidence of cesarean deliveries on maternal request showed that cesarean delivery occurred 11 times higher in upper-middle-income countries than in lower or higher-income countries.[2] Furthermore, the cesarean delivery rates in Eastern Asia, Western Asia, and Northern Africa have also significantly increased reaching 44.9%, 34.7%, and 31.5%, respectively, over the last three decades.[3]

Likewise, in Mongolia, there has been a significant rise in the C-section rate over the last decade and reached 27.6% in 2021 as compared to 21.6% in 2011.[4] It has been reported that C-sections increased from 23% (2002) to 29% in 2022 at the tertiary level hospital, the National Center for Maternal and Child Health (NCMCH), Mongolia.[5] Although this increase in C-sections could be explained by the referral services nationwide, it is essential for health systems and service providers to carefully evaluate and consider the appropriateness of cesarean sections and its causes and contributing factors for this increase and identify the specific measures to further ensure the safety of both mother and newborn. Some factors associated with increased C-sections include the maternal age, the size of the baby, quality of antenatal care, maternal complications, and socioeconomic factors.[3]

Although C-section saves lives, it poses various risks for mothers, such as hemorrhage, infection, sepsis, thromboembolism, and heart attack.[6] Newborns delivered through C-section may experience respiratory distress syndrome and respiratory illnesses.[7] A meta-analysis comparing the long-term risks of vaginal and cesarean delivery found that children born via C-section face increased risks of asthma, overweight, and obesity, as well as higher risks of miscarriage and placenta previa in subsequent pregnancies for mothers.[8]

To ensure the safety and quality of care for mothers and newborns, the Ministry of Health (MoH) of Mongolia sanctioned the amendment of the clinical guideline on C-section deliveries which underscores the necessity for C-sections to be conducted solely based on medical indications. Given the continuous surge in C-section rates, a comprehensive review is needed, to analyze the current trends, forecast future patterns, identify the precise reasons behind the increasing numbers, and provide evidence on developing recommendations for further reduction. To analyze the causes and indications of C-sections conducted at the tertiary referral center, to uncover contributing factors to the rising trend of C-sections, and to forecast future patterns.

Material and Methods

Study Setting and Design

We conducted a retrospective analysis at the national referral hospital in Mongolia. Data were obtained from the medical record database (MRD) which is the most comprehensive source of information for monitoring maternal and neonatal health, recorded all birth-related data.

Study Population

A total of 25,311 medical records of deliveries from 22 weeks' gestation onward were included in the study (Fig 1). The inclusion criteria covered all women who underwent C-sections for any obstetric indication between January 2013 and December 2022 at NCMCH, with or without severe pregnancy complications, and with a gestational age between 22 and 42 weeks, provided they had complete medical records. Deliveries before 22 weeks' gestation, stillbirths, and records with missing clinical information were excluded from the analysis.

Data Collection

The questionnaire was developed from the literature and contextualized according to the Mongolian context. Data were collected by trained collectors from the paper medical record database of NCMCH using prepared questionnaires. First, the institution's overall C-section rate was calculated. All collected data were coded, and women were categorized into either emergency or elective C-sections. The overall hospital C-section rate and the emergency C-section rate were calculated separately. Information on socio-demographic factors (age, education, place of residence, etc.), obstetrical factors (parity and high-risk pregnancy status), C-section indications, and surgical techniques were extracted from the paper patient records. The data quality control was carried out randomly by obstetricians and gynecologists after every 1–year-period medical records were collected.

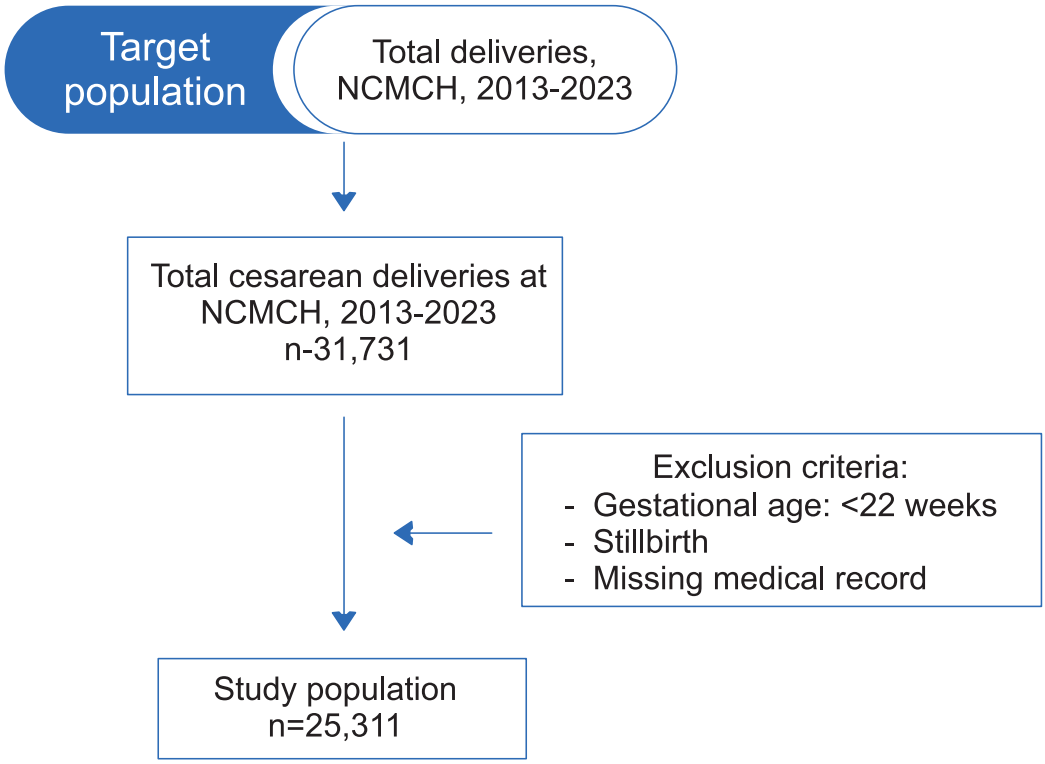

Figure 1. Flow chart of study design

Statistical Analysis

The statistical analysis was conducted using StataBE 18.0 software. The Chi-square test was used for evalution of the association between individual factors such as maternal age, preexisting medical conditions, obstetric indications, including social factors, and the likelihood of a C-section types. Bivariate logistic regression analysis was performed to identify significant independent maternal and obstetric factors for C section indications and types. Conducted a simple logistic regression for a single variable, and then performed a multiple logistice regression by including significant variables. The results of associated variables were presented as a odds ratio (OR) with a 95% confidence interval (CI). A significance level of 0.05 ($P < 0.05$) was chosen, and any p-values below this threshold were considered statistically significant. The distribution of numerical variables was determined using the Klomogrov-Simirnov test, and normally distributed variables were expressed as mean and standard deviation, and non-normally distributed variables were presented as median. The difference between the means of two groups was tested using the Mann-Whitney U test in cases of non-normal distribution (Table 2, 3).

The Auto-Regressive Integrated Moving Average (ARIMA) was used as time-series forecasting. This model has a greater ability to predict and describe changes in cesarean section rate which is calculated among total births by day, month, and season.[9-10] The parameters of the ARIMA model was defined as follows:

$Yt = c+\phi 1Ydt-1+\phi pYdt-p+...+\theta 1et-1+\theta qet-q+et$

p: The number of lag observations included in the model, also called the lag order.

d: The number of times that the raw observations are differenced, also called the degree of differencing.

q: The size of the moving average window, also called the order of moving average.

Ethical Considerations

Ethical approval was obtained from the Institutional Review Board at NCMCH (2023/03). The de-identified data was used without personally identifiable information.

Results

The C-section rates over the past decade increased from 23.7% to 27.1%. In maternal hospitals located in the capital city, rates were consistently above the national average, ranging from 29% to 30.4% whereas at the NCMCH, the rate rose by 2.8%. Provincial levels also experienced a rise in C-section rates, from 18% to 23.3% during the same period (Fig 2).

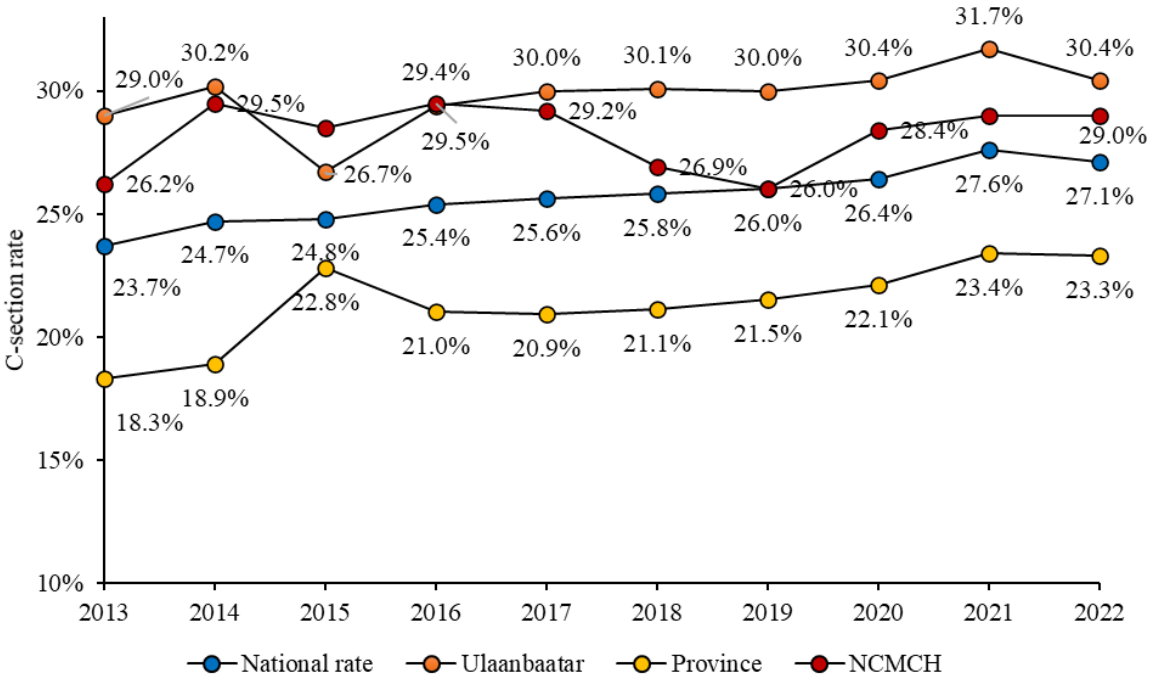

Figure 2. The C-section rate in Mongolia in the last decade, The Health Indicators, 2013-2022, NCMCH - National center for maternal and child health

Maternal Characteristics

The maternal characteristics of women who underwent C-section at NCMCH are described in Table 1. The mean age of women was 31.1±6.05 years, and the age distribution of C-sections was normal, with the highest percentage in women of 25-35 years of age.

Indications for C-section

The previous cesarean section, maternal comorbidity, severe preeclampsia were the most common indications for C-section (Fig 3).

Surgical Techniques and Post-operation Complications by Type of Surgery

The operation time for both emergency and elective C-sections ranged between 45 and 50 minutes. Regarding the type of incision, a vertical incision was used in 7.9% (n=182) of emergency cesarean sections and 12.3% (n=427) of elective cases, showing a statistically significant difference between the two groups (P<0.001). Overall, 27.5% (n=3181) of C-sections were performed on weekends, whereas 21.3% (n=2290) were emergency procedures. Observing the post-operation complications, infection was estimated in 0.3% of emergency C-sections and 0.7% of preterm pregnancy. The cesarean hysterectomies were higher in the elective C-section referring to an increased likelihood of placenta increta resulting from repeated cesarean deliveries (Table 2).

The babies born by emergency C-section and preterm infants had higher respiratory complications (P<0.001). Moreover, the NICU admission rate was also higher in emergency C-section (Table 3).

Table 1. Sociodemographic and psychological characteristics of the sample

Variables	n	%
Age groups, years		
15-19	353	1.4
20-24	3648	14.4
25-29	6316	25.0
30-34	7026	27.8
>35	7968	31.5
Residence		
Urban	14516	57.3
Rural	10795	42.6
Level of education		
No education	141	0.6
High school	4732	18.7
College and university	13778	80.7
Parity		
Nulliparous	5782	22.8
Multiparous	19529	77.2
Gestational age		
>37 weeks	22382	88.5
<37 weeks	2905	11.5
Missing	24	
Antenatal care visit		
No	59	0.2
Yes	25230	99.8
Missing	22	
Obstetric history		
Previous premature birth	624	2.5
Stillbirth	479	1.9
Abortion	6356	25.1
Miscarriage	2439	9.6
Complications of current pregnancy‡ǂ	4667	18.4
Gestational hypertension	2201	8.9
Pre-eclampsia	4058	16.3
Eclampsia	181	1.2
Gestational Diabetes Mellitus	172	0.7
Total preexisting diseases ǂ	5043	19.9
Cardiovascular disease	1781	35.3
Renal and urinary tract disease	1090	21.6
Hepatobiliary disease	813	16.1
Endocrine disease	456	9.0
Hematology disease	281	5.7
Eye disease	192	3.8
Neurology disease	134	2.7
Gynecologic disease	133	2.7
Pulmonary disease	60	1.2
Other disease	58	1.1
Total	25311	100.0

‡ Total participants for whom this condition is defined, ǂ Multiple answered questionnaire

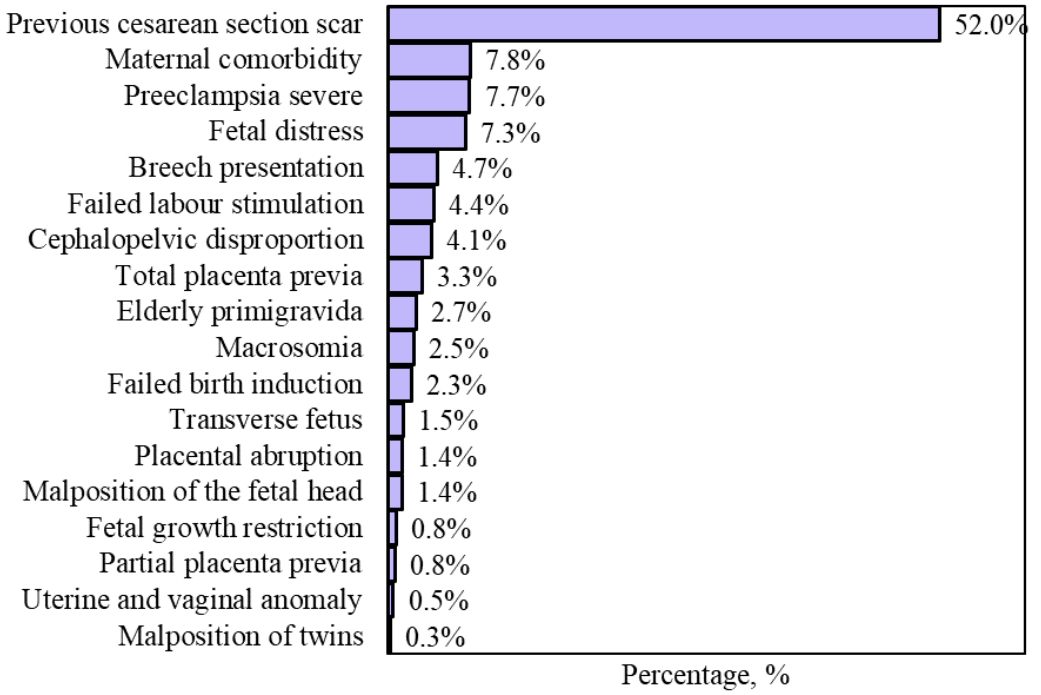

Figure 3. Common obstetric indications of C-section, at National center for maternal and child health (NCMCH), 2013-2022

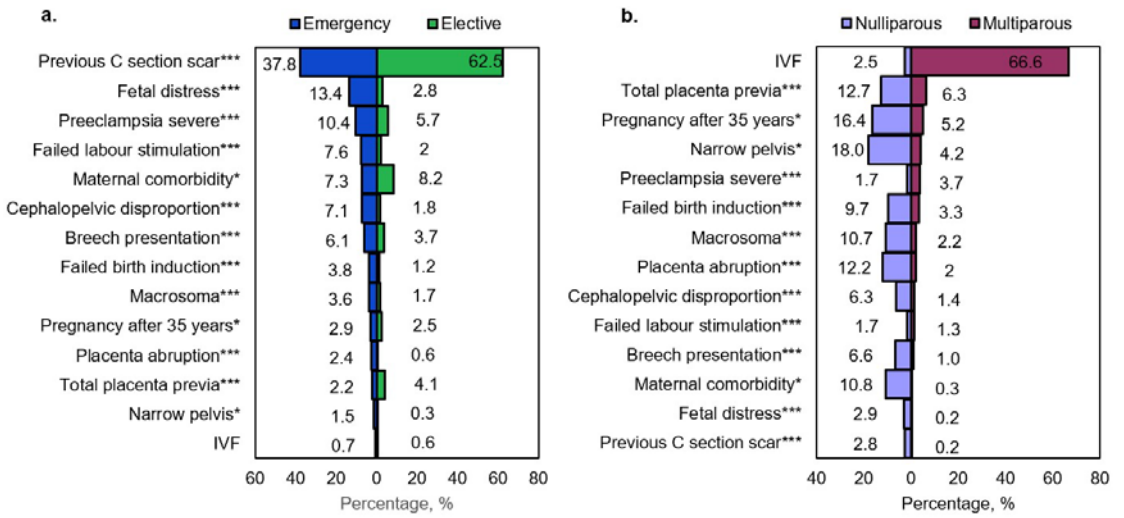

Figure 4. Comparison of obstetric indications by C section types and Parity, 3a. Cesarian obstetrics indications by surgical types, 3b. Obstetric indications, by parity, *P<0.05, **P<0.001, *** P<0.0001, P values ware calculated using Chi square test

Table 2. Surgical technique and postoperative complications by c section types and term pregnancy

	C section types		P value	Gestational age		P value
	Emergency	Elective		Term	Preterm	
	%(n)	%(n)		%(n)	%(n)	
Length of operation, minute	43(15-235)	45(15-190)	<0.001‡	45(15-190)	45(15-235)	0.4979╪
Blood loss, ml	400(100-7500)	450(100-7500	<0.001‡	400(100-7000)	500(100-7500)	<0.001╪
Type of incision, %(n)						
Transverse	92.1 (2117)	87.6 (3044)	0.000‡	91.2 (4456)	80.0 (179)	0.000‡
Vertical	7.9 (182)	12.3 (427)		8.8 (432)	20.0 (714)	
Anesthesia methods %(n)						
Spinal	100 (2570)	99.8 (3814)	0.075	99.9 (4453)	99.5 (923)	0.000
General	0.0 (1)	0.2 (8)		0.1 (4)	0.5 (5)	
Use of prophylactic antibiotics %(n)						
No	32.8 (788)	19.0 (647)	0.000‡	25.2 (1259)	21.4 (179)	0.020‡
Yes	67.2 (1614)	81.0 (2763)		74.8 (3730)	78.6 (659)	
Operation day, %(n)						
Weekday	78.7 (8482)	94(13579)	0.000‡	87.5 (19580)	86.9 (2525)	0.412‡
Weekend	21.3 (2290)	6 (891)		12.5 (2802)	13.1 (380)	
Post operation complications, %(n)						
Infection	0.3 (37)	0.2 (25)	0.007	0.2 (42)	0.7 (20)	0.000‡
Blood loss	2.1 (230)	2.3 (327)	0.504	1.7 (378)	6.2 (179)	0.000‡
Hysterectomy	1.3 (85)	2.2 (202)	0.000	0.8 (108)	9.8 (179)	0.000‡
Total	100(14470)	100(10772)		100(22382)	100(2905)	

‡ Mann-Whitney U test, ‡ Chi square test, P value is significance level, SD is standard deviations

Factors Associated with C-section

The risk of having C-sections due to severe preeclampsia was 1.88 times higher in nulliparous women than multiparous women (Table 4).

The risk factors of C-section in nulliparous women calculated by binary logistic regression analysis were pregnancy after 30 years (OR 1.52, 95% CI:1.41-1.64), failed birth induction (OR 1.88, 95% CI:1.73-2.04), fetal distress (OR 1.88, 95% CI:1.73-2.04). Moreover, risk factors associated with emergency C-sections were total placenta previa (OR 2.1, 95% CI:1.8-2.5), previous cesarean scar (OR 1.7, 95% CI:1.6-1.8), partial placenta previa (OR 1.6, 95% CI:1.2-2.2), macrosomia (OR 0.8, 95% CI:0.7-0.9) and breech presentation (OR 0.7, 95% CI:0.6-0.76, p=0.000) (Fig 5a, b).

Trend of cesarean rate and ndications over the 10 years and forecast analysis of total and emergency caesarean rate.

In 2022, the rate of emergency C-sections decreased by 3.5% compared to 10 years ago, but the monthly weighted average showed an upward trend (Fig 6).

Table 3. Comparison of Perinatal outcomes by C-section type and term pregnancy

	C section types		P value	Gestational age		P value
	Emergency	Elective		Term	Preterm	
	Median (min-max)	Median (min-max)		Median (min-max)	Median (min-max)	
Birth weight, gr	3400(120-5900)	3500(440-6400)	<0.001	3500(450-6400)	2350(120-5350)	<0.001
Apgar score (at 1 min)	7(0-10)	7(1-9)	<0.001	7(1-10)	5(0-9)	<0.001
Apgar score (at 5 min)	8(0-10)	8(2-10)	<0.001	8(2-10)	6(0-10)	<0.001
Respiratory problems %(n)	6.5 (658)	3.5 (479)	<0.001	1.9 (400)	0(0)	-
NICU admission %(n)	2.5 (67)	2.1 (79)	<0.001	0.5 (27)	13.7 (120)	<0.001
Total %(n)	100(14470)	100(10772)		100(22382)	100(2905)	

gr-Gramm, SD is standard deviations, NICU -Neonatal intensive care unitt

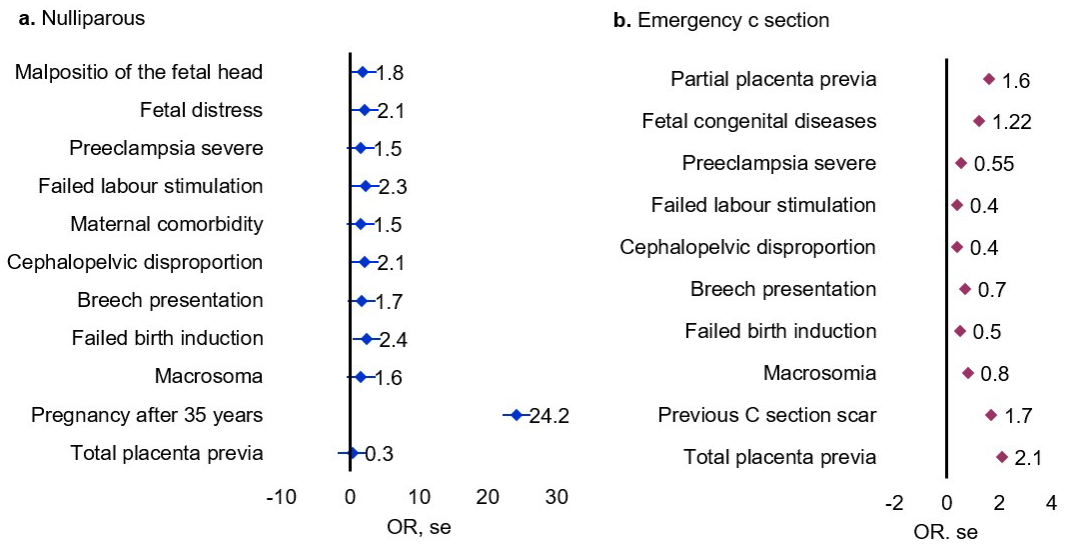

Figure 5. Logistic Regression Analysis on Factors Influencing First-Time Cesarean and emergency C sections, a. Factors Influencing Cesarean Section in Nulliparous Women (comparing women with nulliparous and parous), b. Factors Influencing Emergency Cesarean Section (comparing with emergency and elective caesarean), OR is Odds ratio, se - Standard error

Table 4. Outcomes of Binary Logistic Regression on Maternal Influencing Factors for C-Section Indications

Dependent variable -> Independent variables	COR (95% CI)	P value	AOR (95% CI)	P value
1. Severe preeclampsia				
Nulliparous	1.64 (1.52-1.77)	<0.001	1.88(1.73-2.04)	<0.001
Maternal age (≥30 y)	1.23(1.15-1.32)	<0.001	1.52(1.41-1.64)	<0.001
Education				
University	Ref		Ref	
High school	1.68(1.51-1.87)	<0.001	1.76(1.59-1.97)	<0.001
No or primary education	1.27(1.16-1.38)	<0.001	1.30(1.20-1.42)	<0.001
Fetal weight (>4000 gr)	1.04(0.95-1.14)	0.359		
Other comorbidity	1.42(1.32-1.54	<0.001	1.30(1.20-1.41)	<0.001
2. Fetal distress				
Nulliparous	5.06 (4.59-5.58)	<0.001	1.88(1.73-2.04)	<0.001
Maternal age (≥30 y)	0.531(0.483-0.584)	<0.001	0.9(0.81-0.99)	0.049
Education				
University	Ref		Ref	
High school	1.31(1.13-1.53)	<0.001	1.35(1.16-1.58)	<0.001
No or primary education	1.21(1.08-1.36)	<0.001	1.26(1.12-1.42)	<0.001
Fetal weight (>4000 gr)	0.89(0.78-1.01)	0.073		
Other comorbidity	0.77(0.68-0.87)	<0.001	0.65(0.576-0.749)	<0.001
3. Failed birth induction				
Nulliparous	6.68 (5.89-7.58)	<0.001	1.88(1.73-2.04)	<0.001
Maternal age (<30 y)	3.25(2.86-3.69)	<0.001	1.91(1.67-2.20)	<0.001
Education				
University	Ref		Ref	
High school	1.35(1.13-1.63)	0.001	1.25(1.03-1.51)	0.024
No or primary education	1.09(0.94-1.26)	0.252	1.07(0.92-1.24)	0.401
Fetal weight (>4000 gr)	2.11(1.84-2.41)	<0.001	5.4(4.72-6.17)	<0.001

COR - Crude odds ratio, AOR - adjusted odds ratio, Dependent Variable: C-Section indications, independent variables: Maternal Influencing Factors, including age, pregnancy during complications (e.g., hypertension, eclampsia), fetal distress, and other clinical factors associated with C-section decisions, CI is confidence intervals, Ref - Reference group of independent variables, gr - Gramm

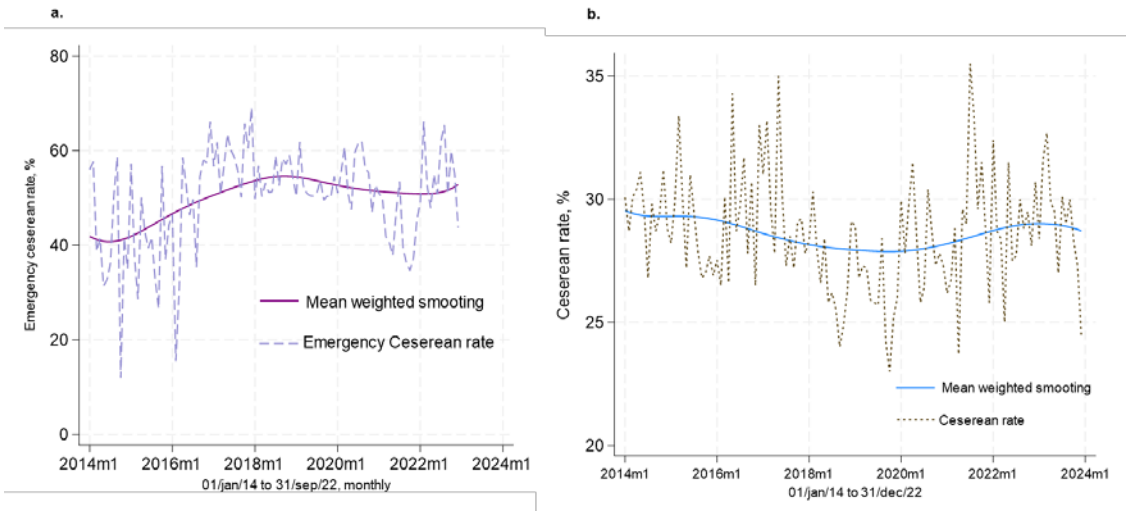

Figure 6. Total and emergency cesarean rate trend fit locally weighted scatterplot smoothing (LOWESS)

Although various interventions are being implemented to reduce the proportion of C-sections in total deliveries. However, the monthly weighted average for C-sections due to emergency indications has increased (Fig 6a). Notably, the 25.5% of women were nulliparous women among C-section deliveries. In the past decade, there has been a noticeable increase in the proportions of indications such as breech presentation, fetal distress, pregnancy after 35 years, and malposition of the fetal head. Conversely, there has been a decrease in the prevalence of total placenta previa and severe preeclampsia over the years (Figure 7).

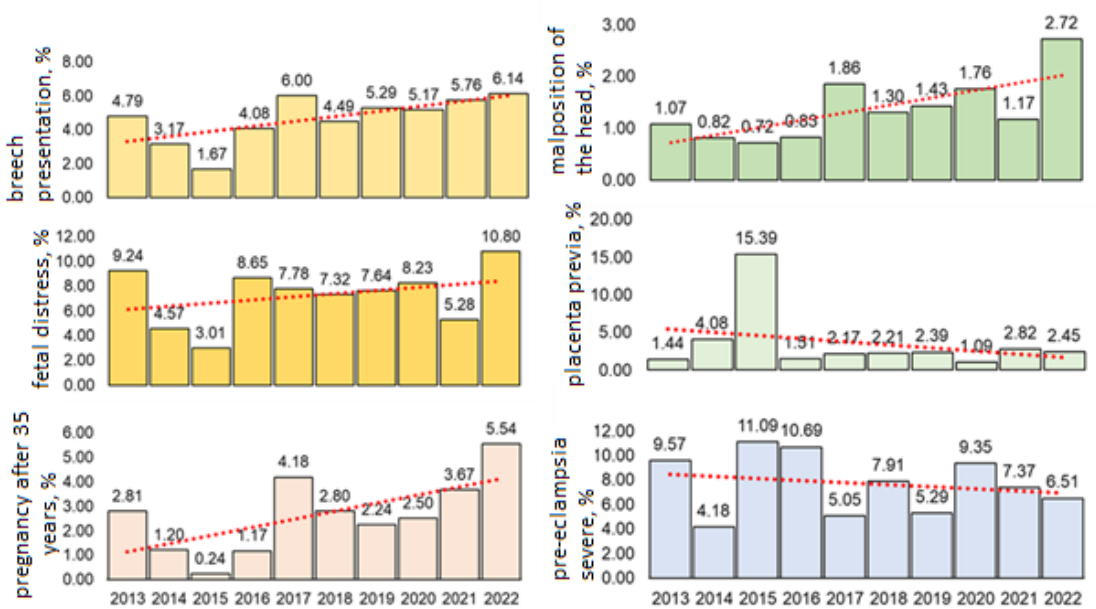

Figure 7. Trends in indications for the last 10 years

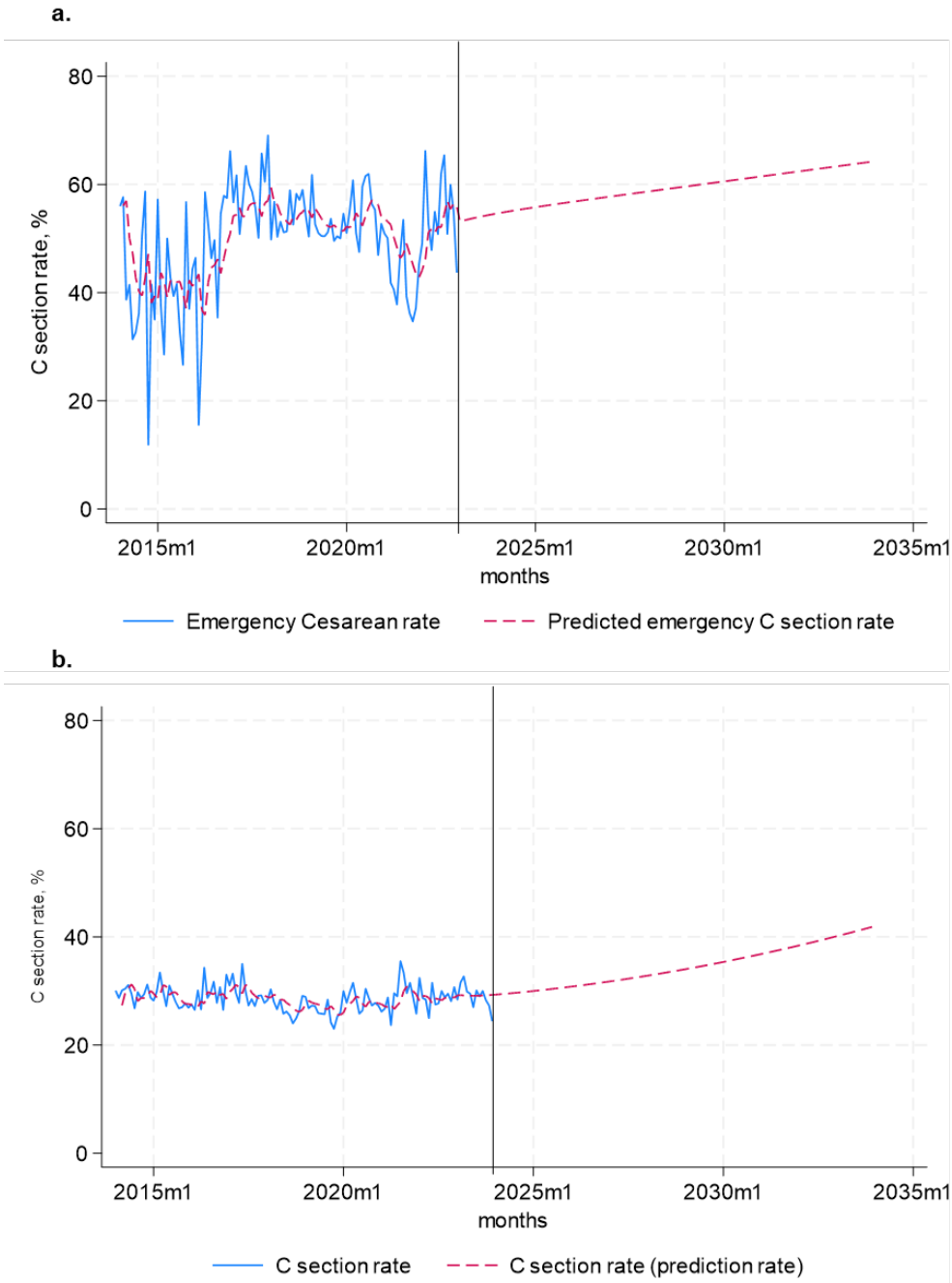

Figure 8. 10-Year prediction of cesarean sections based on the ARIMA Model, a. Emergency cesarean rate, b. Total cesarean rate in delivery, red line is predicted rate, blue line is cesarean rate of NCMCH, 2013 to 2022

Discussion

This study is pioneering in evaluating trends, prevalence, and contributing factors to C-section deliveries at the referral hospital in Mongolia over the past decade. At the NCMCH, C-section rates varied between 27.7% and 28.6%, peaking in 2014. A similar trend was also observed in the national data from 23.7% to 27.1% over the last decade, with a peak of 27.6%. The consistently higher rates at NCMCH, compared to national averages, are likely attributable to its status as a referral center. Although the rate of C-sections in Mongolia is higher than the WHO-recommended rate, it is lower or closer to U.S. rate of

32.1% reported by the CDC.[11]

Studies published elsewhere reported even higher rates at other major maternity hospitals, which saw an increase from 26.7% in 2008 to 35.1% in 2018.[12] Cesarean rates at tertiary hospital in Mongolia remain higher than the Asian average of 23.1% (95% CI: 19.9 – 26.3) but are below the Eastern Asian average of 33.7% (95% CI: 27.3 – 40.1). These findings echo the global trend of increasing cesarean deliveries, highlighted in a WHO study, which noted a rise from 7% in 1990 to 21% today, projecting an increase to nearly 29% by 2030.[10] The high rates of C-section deliveries in other countries may continue to rise with time and this increase to some extent is due to C-sections that are not clinically indicated (non-clinical factor). Although the study team did not categorize indications as any medical or non-medical, the list of maternal indications included a category "pregnancy after 35 years" which is one of the maternal indications for C-section that is not purely medical indications. These findings are consistent with other studies.[13]

This study made the first effort to conduct the projection analysis using the data to predict and further the trend of C-section deliveries using an ARIMA intervention model. This predicts significant differences in C-section rate changes, rise in the C-section rate at NCMCH to 35.5% by 2030, significantly exceeding the global average. Alarmingly, emergency C-sections are anticipated to constitute up to 59.5% of all cesareans at NCMCH by then. Given its role as the primary referral center for both urban and rural areas, NCMCH typically handles more complex cases, likely contributing to the higher prevalence of emergency procedures. As the trend analysis indicates a continuous rise in C-section rates, the referral center must implement and develop evidence-based clinical guidelines alongside a comprehensive strategy tailored to local determinants. This strategy should focus on monitoring and assessing C-section rates and maternal-perinatal outcomes. To achieve this, NCMCH needs to adopt the WHO Robson Classification system as a global standard for better assessing, monitoring, and comparing C-section rate.[14] According to the WHO, C-section rates above 10-15% do not correlate with decreases in maternal and newborn mortality rates.[14] Evaluating our projections against this WHO guideline may underscore the potential overuse of C-sections at NCMCH and guide necessary policy adjustments. The inclusion of non-medically indicated factors, such as first birth over the age of 30, as reasons for C-sections suggests that societal and provider-initiated practice patterns might be contributing to these high rates. This could reflect broader trends in maternal requests and healthcare provider policies that favor C-sections for non-medical reasons.

Hence, the trend analysis underscores the need for policy revisions at NCMCH and potentially at a national level to manage C-section rates effectively that encourage medical review and second opinions for elective C-sections might help reduce rates that are not medically indicated. Moreover, enhancing training for healthcare providers on labor management and promoting the benefits of natural birth could help mitigate the trend toward elective C-sections. Additionally, patient education campaigns to address societal preferences and fears about vaginal delivery could be beneficial.

C-section among nulliparous women: In our study, nulliparous women accounted for 22.8% of the participants and represented 25.5% of the total cesarean sections during the study period. The frequency of cesarean sections among nulliparous women showed an annual increase of 0.81%. At the secondary level maternity hospital, the proportion of cesarean deliveries among nulliparous women whether induced or pre-labor remained significant in both 2008 and 2018. Specifically, cesarean rates for nulliparous women with spontaneous labor increased threefold, while those for induced labor declined in 2018 compared to 2008. It has been shown that the rising preference for cesarean sections among nulliparous women is driven by their fear of pain and concerns for safety.[15] Similarly, Mercedes C. and colleagues observed that an increase in cesarean sections among lower-risk nulliparous women has led to more women having cesarean scars, reflecting the overall rise in cesarean rates.[16] Additionally, the increase in cesarean sections among women aged over 30 can be attributed to earlier first cesareans, which often necessitate subsequent cesarean deliveries. This trend has led to a rise in the proportion of women with previous cesarean scars.

A growing number of researches has revealed several critical issues concerning the relationship between the socioeconomic status, education, and residence of women and the prevalence of cesarean sections. Typically, an increase in cesarean sections among women with lower socioeconomic status and lower educational levels, as well as those living in urban areas, has been observed.[17-18] These trends raise important questions about the underlying factors influencing these patterns. However, the findings from our study present a slight deviation from those

findings. Our data indicate that the majority of women who underwent cesarean deliveries had college (57.6%) or higher (26.6%) education levels. This difference can be attributed to the fact that the majority of our subjects were from urban areas, where educational attainment is generally higher and this suggests that urban residence and higher educational levels may also be significant factors in the decision to opt for a cesarean section, potentially due to better access to healthcare facilities or greater awareness and preference for this mode of delivery among more educated women. The finding that less educated women are more likely to undergo cesarean sections could reflect differences in health literacy. Women with higher education levels may be better equipped to understand and navigate their options during childbirth, including advocating for non-surgical interventions when possible. Conversely, less educated women might not feel as empowered to question or decline recommendations for surgical delivery, or they might not receive as comprehensive counseling on the risks and benefits of different birth methods.

On the other hand, the higher frequency of cesarean sections among urban women could be due to several factors. Urban hospitals might have better surgical facilities and more staff trained in cesarean delivery, making it a more readily available option than in rural areas. Additionally, urban settings may have different healthcare practices and patient demographics, including risk factors that could make cesarean delivery more common.

Impact of Delivery Mode on Perinatal Outcomes: The data from our study shows a higher incidence of respiratory problems and NICU admissions among newborns delivered via emergency cesarean section compared to those delivered via elective cesarean section. The statistical significance ($P<0.001$) of these findings suggests that the complications leading to emergency cesarean sections may also be contributing to the poorer initial health outcomes observed in these infants. Emergency cesarean sections are often performed in response to unforeseen complications that could risk the health of the mother or baby, hence the associated increased risk of adverse outcomes like respiratory distress and the need for NICU care. Overall, these findings highlight the importance of gestational age and the conditions surrounding delivery in determining newborn health outcomes. Moreover, it can be suggested that closer medical attention and evidence-based intervention strategies are required for preterm infants and those delivered under emergency conditions to improve their immediate and long-term health prospects.

The study was constrained by its reliance on data solely from patient charts of individuals who underwent cesarean sections, omitting direct responses from the mothers themselves. Our analysis did not investigate the reasons for cesarean sections, particularly whether they were performed at the request of the women. Moreover, the lack of data on staff experience precluded an assessment of how staffing factors might influence decision-making regarding cesarean sections. Therefore, the study findings are limited to explaining both clinical and non-clinical factors of c-section use. Despite these limitations, this is the first study to analyze trends, rates, and indications of cesarean sections at a tertiary referral hospital in Mongolia.

Future research should prioritize prospective, multi-center studies that incorporate maternal perspectives and healthcare staff factors to comprehensively examine the multiple contributors to high cesarean section rates particularly in secondary-level hospitals. These studies should assess the perceptions of women, their partners, and families regarding the decision-making process for the mode of delivery. In addition, investigating long-term maternal and neonatal outcomes based on the indications for cesarean section, while integrating socio-cultural and provider-related influences, will deepen understanding of the determinants of cesarean delivery. Evaluating the impact of interventions aimed at safely reducing unnecessary cesarean sections on both maternal and neonatal health is also essential for informing clinical practice and health policy.

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Conflict of interest

All other authors have no conflicts of interest.

Authors Contribution

Davaasambuu Emkhmaa: conceptualized and planned the

study, wrote and edited the first and final drafts of the paper, and contributed to the framing and analysis.

Oyunkhand Emkhtaiwan: analyzed the data, wrote the first and final drafts of the paper, Baljinnyam Batsuuri analyzed the data, wrote the first and final drafts of the paper.

Nasantogtokh Erdenebileg: analyzed the data, wrote the first and second drafts of the paper and made additional data analysis required by reviewers.

Khishgee Seded: reviewed the paper and contributed to the framing and recommendations, Tsolmon Khadaa reviewed the paper and contributed to the framing and recommendations.

Tsedmaa Baatar: provided comprehensive technical assistance throughout the development of the research paper, including reviewing and revising the initial and second-to-last drafts, guiding the interpretation of results, and contributing to the design of the results section.

Shinetugs Bayanbileg reviewed the paper and contributed to the framing and recommendations, Khalid Sharifi conceptualized the research study and provided the research protocol, including the design of the report format.

Altantuya Shirchinjav: reviewed the paper and contributed to the framing, and recommendations.

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