Cesarean Delivery in Iran: A Population-Based Analysis Using The Robson Classification System

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Abstract

Background

The rise of Cesarean Section (CS) is a global concern. In Iran, the rate of CS increased from 40.7% in 2005 to 53% in 2014. This figure is even higher in the private sector.

Objective

To analyze the CS rates in the last two years using the Robson Classification System in Iran.

Methods

A retrospective analysis of all in-hospital electronically recorded deliveries in Iran was conducted using the Robson classification. Comparisons were made in terms of the type of hospital, CS rate, and obstetric population, and contributions of each group to the overall cesarean deliveries were reported.

Results

2322500 women gave birth, 53.63% delivered through CS. Robson group 5 was the largest contributing group to the overall number of cesarean deliveries (47.1%) at a CS rate of 98.36%. Group 2 and 1 ranked the second and third largest contributing groups to overall CSs (20.57% and 10.78%, respectively). The latter groups had CS rates much higher than the WHO recommendation of 67.23% and 33.07%, respectively. "Fetal Distress" and "Undefined Indications" were the most common reasons for cesarean deliveries at CS rates of 13.6% and 13.4%, respectively. There was a significant variation in CS rate among the three types of hospitals for Robson groups 1, 2, 3, 4, and 10.

Conclusion

The study revealed significant variations in CS rate by hospital peer-group, especially for the private maternity unit, suggesting the need for further attention and audit of the Robson groups that significantly influence the overall CS rate. The study results will help policymakers identify effective strategies to reduce the CS rate in Iran, providing appropriate benchmarking to compare obstetric care with other countries that have better maternal and perinatal outcomes.

Introduction

Increasing the prevalence of cesarean section (CS) is a global concern during recent decades and reducing CS rates (Natural Childbirth Promotion) is one of the priorities of Iran's Health Reform Plan(1–3).

World health organization (WHO) stated that the CS rate higher than 10% nationwide does not improve maternal and neonatal outcomes (4). Medically indicated CS will save the mother and newborn, but unnecessary CS is associated with higher morbidity(5) and healthcare costs(6). Iran's CS rates have dramatically increased since the beginning of the current century. Reports of the Iran Ministry of Health demonstrate that CS rates were 40.7% in 2005, reaching 53% in 2014(7, 8). This figure is even higher in the private sector, with the rate as high as 90% (7). Since 2014, the promotion of natural childbirth has been a core aim of the healthcare reform in Iran. Thus, ongoing national programs have led to a decrease in the rate of unnecessary CS, although the targeted values are not achieved (9). Analysis of CS rates in Iran using an appropriate classification tool can be an important step in reducing unnecessary CS rates(4).

To classify and compare CS rates, the Robson Ten-Group Classification System (Table 1) has been used since 2001 in many countries. This classification is based on characteristics of childbearing women: category of the pregnancy, previous obstetric record, course of labor, and gestational age (10). Within each of these ten groups, CS indications can be compared. Robson Classification, the most appropriate tool to compare CS rates across health care settings, allows policy-makers to analyze the overall status of obstetric care and birth interventions at the hospital, regional, and national levels (11).

This study reports the prevalence of CS in Iran. The objective is to analyze the CS rates in the last two years using the Ten-Group Robson Classification System in Iran; comparisons have been made considering the type of hospitals (public VS private VS other types).

Materials And Methods

Study setting and design

We conducted a retrospective analysis of all in-hospital deliveries in Iran. Data were obtained from the Iranian Maternal and Neonatal (IMaNe) database. IMaNe is an established national birth registry database for maternal and neonatal information, administered by the Iranian Ministry of Health. It is the most comprehensive source of information for monitoring maternal and neonatal health, recording all birth-related data electronically in and out of hospitals throughout the country since March 21, 2013 (12). The collected information includes demographic data, maternal characteristics, medical history, obstetric interventions, pregnancy and delivery complications, and perinatal outcomes. IMaNe provides a unique interface for interactive presentation and analysis of the collected information on a Qlikview platform representing data at hospital, medical university and national levels. All the obstetric parameters for applying the Robson Classification, based on the WHO implementation Manual, are available on the IMaNe registry database (13).

Data collection

In the present study, we included all women who had given birth between March 21, 2019, and March 21, 2021, two consecutive years (March 21 marks the beginning of a new year in Iran). Hospitals were

assigned to three peer groups of Public, Private, and Other Hospitals. Public hospitals were defined as those in which the government and health insurance cover all medical bills; they are administered by public universities and provide clinical education to students across allied health professions. In Private hospitals, all delivery costs are self-funded or covered by private health insurance. The category “Other Hospitals” includes settings that are a subset of a specific organization (i.e. charity, affiliated with Islamic Azad University, affiliated with Social Security Organization, and affiliated with Armed Forces).

Deliveries were categorized using the Ten-Group Robson Classification System. We described maternal and neonatal characteristics, obstetric interventions, medical conditions, and obstetric outcomes. Then, for each Robson group, we reported the total number of CS, the total number of women delivered, group size to the overall population, CS rate, absolute group contribution to overall CS rate, and relative contribution of the group to overall CS rate for the national level. Rates were calculated and extracted from the IMaN registry database according to the WHO implementation manual.

Statistical Analysis

Data analysis was performed with the statistical software SPSS version 26.0 (SPSS, Chicago IL, USA). Categorical data are shown as frequencies (percentages). One-way ANOVA and Kruskal Wallis Tests were used to compare between hospital peer-group for each Robson group. To compare CS indications by hospital peer-group, we applied the Chi-Square test. We used funnel plots to report CS rates in 66 Iranian medical universities by hospital peer-group. The plots were created at 95% and 99% confidence limits using R software (version 4.0.2). The funnel plots show CS rates against the number of deliveries for that rate, displayed as a scatter plot. The dashed horizontal line in the middle of the funnel shows the national CS rate for each Robson group. The significance level was set at $\alpha = 0.05$. This study was a sub analysis of data from IMaN national registry and did not require ethics approval.

Results

The total number of women who had given birth in 962 Iranian hospitals affiliated with 66 medical universities was 2322500 between 21 March 2019 and 21 March 2021. Characteristics of the obstetric population, medical and obstetric conditions are shown in Table 2 (See Additional File 1). The total rate of Cesarean Sections was 51.63%.

All the deliveries were categorized into the 10 Robson groups (Table 3). There was no missing data on Robson Classification, as the record of the Robson criteria is obligatory for birth registries on the IMaN.

The largest contributing group to the total number of cesarean sections was Robson group 5, which consisted of all multiparous women with at least one previous CS, with a single cephalic pregnancy and ≥ 37 weeks gestation. The size of this group accounted for one-fourth of the total obstetric population (24.72%), identified as the largest group in the whole study population. Its CS rate was 98.36%, with the largest absolute contribution (564782 CS of 2322500, 24.32%).

The second-largest contribution group to the overall number of cesarean deliveries was Robson group 2, consisting of nulliparous women with a single cephalic pregnancy, and ≥ 37 weeks gestation who were induced or delivered by CS before labour. This group accounted for 15.79% of the total obstetric population, with a CS rate of 67.23%. Although the obstetric population in subgroups 2a and 2b were almost the same, group 2b accounted for 15.82% of the total cesarean deliveries in Iran, with a Cs rate at 97.74%.

Nulliparous women with a single cephalic pregnancy and ≥ 37 weeks gestation who had spontaneous labour (Robson group 1) were ranked the third-largest contribution to the overall CSs (10.78%). This group accounted for 16.83% of the total obstetric population, with a CS rate of 33.07%.

Analyses by hospital peer-group are shown in Table 4. There was a significant statistical difference ($p < 0.05$) in CS rate between private hospitals and the other two peer groups in all Robson groups (excluding group 9). The relative contribution in all Robson groups (except for groups 2 and 10) showed a significant statistical difference ($p < 0.05$) between other hospitals and the other two peer groups (public and private hospitals). There was a significant statistical difference in relative contribution between public and other hospitals in Robson group 2. There was also a significant difference between private and other hospitals in Robson group 10.

Table 5 represents CS indications by hospital peer-group for two consecutive years in Iran. “Fetal Distress” and “Undefined Indications” were the most common reasons for cesarean deliveries at CS rates of 13.6% and 13.4%, respectively. There was a significant statistical difference between public hospitals and the other two peer groups for fetal distress. This difference was also significant between private units and the other two peer groups for undefined indications.

Our study showed that out of 2322500 deliveries between 21 March 2019 and 21 March 2021, 56.8% were delivered in public hospitals, 20.2% in private hospitals, and 23% in other hospitals. Funnel plots presented in the figure show CS rate variations at the medical university level by hospital peer group for the largest contributing Robson groups. There was a significant variation in CS rates among the three types of hospitals. The CS rates in public and other peer groups were almost within the national mean (Confidence Interval; 95% and 99%) for Robson groups 1, 2, 3, 4, and 10. However, most private hospitals had a CS rate almost greater than 3 SD above the national mean (Confidence Interval; 95% and 99%) for Robson groups 1, 2, 3, 4, and 10. For Robson group 5, a vast majority of the peer group hospitals had CS rates within the national mean.

Discussion

The current study analyzed 2322500 in-hospital deliveries in Iran and categorized them using the Robson classification system to describe and compare cesarean section rates.

Between 21 March 2019 and 21 March 2021, the CS rate was 51.63% in Iran, which is considerably higher than many countries as well as the WHO recommended rates. The rate of cesarean sections in

nulliparous women in Iran in two consecutive years was 52.4%. Although Robson group 5 was the largest contributing group to the total CSs (47.1%), the government's approach is to reduce the CS rate in nulliparous women based on Natural Birth Promotion program(14, 15). Given that 31.3% of all cesarean deliveries were belonged to groups 1 and 2, the application of the Robson classification system provides a better understanding of the CS rates and population variations among maternity units across provincial and national levels. Our study showed that Robson groups 1 to 4 accounted for about 63.9% of the obstetric population in Iran. Such that 37.6 % of the population was attributed to nulliparous women with a singleton, term, cephalic pregnancy, and no previous cesarean delivery (Robson Groups 1 and 2).

The Nordic countries such as Netherlands, Iceland, and Norway are reported to have low CS rates across all groups of Robson with high quality of obstetric care resulting in good perinatal outcomes (16). In the Netherlands, for instance, 39.9% of the total deliveries contribute to Robson group 1 and 2, which is similar to the population of the same groups in Iran. However, the CS rates in these groups vary significantly between the two countries. That is to say, CS rates in groups 1 and 2 in the Netherlands are 9.6%, and 28.9% (within the WHO recommended ranges), while the corresponding proportions are 33.07% and 63.23%, respectively, in Iran (17). Iceland implemented a CS auditing program using the Robson classification in 2000 which had led to a significant decrease in CS rate by the end of 2011 (16). This is an evidence-based example of achieving positive results by benchmarking and implementing a monitoring program to reduce cesarean deliveries.

In a Canadian study using the Robson classification, group 5 was the largest contributing group to the overall cesarean deliveries (36.6%), and groups 2 and 1 ranked as the second-and third-largest contribution (15.7% and 14.1%, respectively) (18), the same pattern was identified in our study. Given that in Iran, the majority of the obstetric population attributes to Robson groups 1 and 2, reducing CSs among nulliparous women would be highly effective in reducing the total national CS rate, as these women will contribute to group 5 population in the future. This could be achieved through quality improvement strategies focused on interventions such as auditing the hospitals by the use of the Robson classification system, review of patient records for CS indications, feedback for the health providers, revision and monitoring of labour and delivery management guidelines, and application of benchmarking and best practices.

The results of the present study show that the private sector plays an important role in the rise of CS rates in Robson groups 1, 2, 3, 4, and 10. A similar situation has been observed in Brazil's private sector (19). Precursors of the high CS rate in the private sector to increase hospital income are the lack of adherence to the national guideline for elective CS, the low use of induction, and abuse of the unconscious interest in CS among new mothers. Eyi et al. reported the same pattern in Turkey (20). Robson groups 5, 3, 2, 1, 4, and 10, identified as the main contributors to the CS rate, were targeted for interventions. Authors suggested commercialization of the health care system as a public policy directed at the private sector, where CS indication seems not to be driven by medical reasons.

Iran's national health policy for Natural Birth Promotion program (3, 14, 15) is to reduce the CS rate through reducing nulliparous cesareans. To achieve this goal, the Iranian Ministry of Health should set its goals on the Robson classification system in auditing the CS rates at the hospital level for Robson groups 1 and 2. This would make an appropriate benchmarking process to compare the obstetrics and perinatal quality of care among maternity units and improve management of normal labour and birth.

To our knowledge, this is the first Iranian study to assess CS rates using the Robson classification system based on the national birth registry database. We used a registry database at the national level, as well as a standard classification system, providing a logical comparison with other nations. Another strength of the present study is the comprehensive database of the IMaN that provides information at the hospital, medical university, and national level. This information are vital in implementing strategies and auditing the outcomes at local and national's levels. This study had several limitations. One limitation of the study is that we did not analyze the maternal and neonatal outcomes in each Robson group. Therefore, the associations between higher CS rates and obstetric outcomes were lacking. Moreover, the Robson criteria on the IMaN registry database were not available before 21 March 2019. It is recommended that future studies focus on maternal and perinatal outcomes and CS rate trends of consecutive years using Robson classification.

Conclusions

The present study showed that Robson groups 2 and 1 were the second and third largest contributing groups to overall cesarean sections, suggesting the need for further attention and audit. Additionally, there were significant variations in CS rates by hospital peer-group, especially for private maternity units. The results of this study help identify effective strategies to reduce the CS rate in Iran, focusing on the groups that have the main impact on the total CS rate. It also provides appropriate benchmarking to compare obstetric care with other countries with better maternal and perinatal outcomes.

List Of Abbreviations

Cesarean Section (CS)

World Health Organization (WHO)

Iranian Maternal and Neonatal (IMaN)

Declarations

Acknowledgments

Not applicable.

Funding

Not applicable.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

Mohammad Heidarzadeh as the corresponding author and director of the Neonatal Health Office at Iran Ministry of Health and Education is responsible for analyzing the national maternal and neonatal data in the Qlikview platform of the IMaN registry database. This study was a sub-analysis of data from the IMaN national registry and did not require ethics approval. The informed consent was not applicable in this study due to the second-hand availability of data in the national registry database.

Authors' contributions

MP, MH, MT, and HE were involved in study design, acquisition, analysis and interpretation of data, and drafting of the article. NT was involved in study data analysis. FB and LG were involved in the critical revision of the article. All authors approved the final version for publication.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Tables

Table 1
The Robson Classification.

Group	Obstetric Population
1	Nulliparous women with a single cephalic pregnancy, ≥ 37 weeks gestation in spontaneous labour
2	Nulliparous women with a single cephalic pregnancy, ≥ 37 weeks gestation who had labour induced or were delivered by CS before labour
2a	Labour induced
2b	Pre-labour CS
3	Multiparous women without a previous CS, with a single cephalic pregnancy, ≥ 37 weeks gestation in spontaneous labour
4	Multiparous women without a previous CS, with a single cephalic pregnancy, ≥ 37 weeks gestation who had labour induced or were delivered by CS before labour
4a	Labour induced
4b	Pre-labour CS
5	All multiparous women with at least one previous CS, with a single cephalic pregnancy, ≥ 37 weeks gestation
6	All nulliparous women with a single breech pregnancy
7	All multiparous women with a single breech pregnancy including women with previous CS(s)
8	All women with multiple pregnancies including women with previous CS(s)
9	All women with a single pregnancy with a transverse or oblique lie, including women with previous CS(s)
10	All women with a single cephalic pregnancy < 37 weeks gestation, including women with previous CS(s)

World Health Organization. Robson Classification: Implementation Manual. 2015

Due to technical limitations, table 2 is only available as a download in the Supplemental Files section.

Table 3

Cesarean Sections by the Robson classification system in Iran, 21 March 2019–21 March 2021.

Group	Number of CS in group	Number of women in group	Obstetric population ¹ (%)	CS rate ² (%)	Absolute contribution ³ (%)	Relative contribution ⁴ (%)
1	129245	390791	16.83	33.07	5.56	10.78
2	246619	366822	15.79	67.23	10.62	20.57
2a	56913	172737	7.44	32.95	2.45	4.75
2b	189706	194085	8.36	97.74	8.17	15.82
3	34807	553021	23.81	6.29	1.50	2.90
4	40504	174464	7.51	23.22	1.74	3.38
4a	11778	140322	6.04	8.39	0.51	0.98
4b	28726	34142	1.47	84.14	1.24	2.40
5	564782	574218	24.72	98.36	24.32	47.10
6	35618	37419	1.61	95.19	1.53	2.97
7	21549	24347	1.05	88.51	0.93	1.80
8	30974	35175	1.51	88.06	1.33	2.58
9	4414	4574	0.20	96.05	0.19	0.37
10	90579	161669	6.96	56.03	3.90	7.55
Total	1199091	2322500	100	51.63	51.63	100

1. Obstetric Population (%) = n of women in the group / total N women delivered in the hospital ×100
2. CS rate (%) = n of CS in the group / total N of women in the group ×100
3. Absolute contribution (%) = n of CS in the group / total N of women delivered in the country × 100
4. Relative contribution (%) = n of CS in the group / total N of CS in the country × 100

Table 4
Comparison of the CS rate and relative contribution of each group of the Robson classification by hospital peer-group in Iran, 21 March 2019–21 March 2021.

Group	CS Rate				Relative Contribution			
	Public (n = 602)	Private (n = 172)	Other Hospitals (n = 188)	P value	Public (n = 602)	Private (n = 172)	Other Hospitals (n = 188)	P value
	Mean ± SD	Mean ± SD	Mean ± SD		Mean ± SD	Mean ± SD	Mean ± SD	
1	28.9 ± 9.7 ^a	50.7 ± 18.4 ^b	26.8 ± 11.6 ^a	< 0.001	0.4 ± 0.3 ^a	0.3 ± 0.3 ^a	1 ± 1.2 ^b	< 0.001
2	46.7 ± 13.2 ^a	83.1 ± 14.6 ^b	53.5 ± 22 ^a	< 0.001	0.4 ± 0.3 ^a	1 ± 1.5	2.2 ± 3.4 ^b	< 0.001
3	6.4 ± 2.6 ^a	12.7 ± 8.9 ^b	4.8 ± 3.1 ^a	< 0.001	0.1 ± 0.1 ^a	0.03 ± 0.04 ^a	0.2 ± 0.3 ^b	< 0.001
4	19.5 ± 9 ^a	48.2 ± 19.5 ^b	26.8 ± 11.6 ^a	< 0.001	0.1 ± 0.1 ^a	0.1 ± 0.1 ^a	0.4 ± 0.6 ^b	< 0.001
5	97.7 ± 2.5 ^a	99.5 ± 0.3 ^b	98.7 ± 1.4 ^b	< 0.001	1.6 ± 1.4 ^a	1.3 ± 1.4 ^a	6.3 ± 7.5 ^b	< 0.001
6	96.3 ± 3.6 ^a	98.8 ± 0.9 ^b	97.3 ± 2.6	< 0.001	0.9 ± 0.8 ^a	0.6 ± 0.6 ^a	3.2 ± 3.9 ^b	< 0.001
7	91.8 ± 4.2 ^a	95.2 ± 3.7 ^b	93.5 ± 4.4	0.001	0.1 ± 0.1 ^a	0.03 ± 0.05 ^a	0.3 ± 0.4 ^b	< 0.001
8	87 ± 6.6 ^a	96.6 ± 2.4 ^b	89.4 ± 7.1 ^a	< 0.001	0.1 ± 0.1 ^a	0.07 ± 0.09 ^a	0.3 ± 0.3 ^b	< 0.001
9	97.6 ± 3.1 ^a	98.6 ± 2.8 ^a	97.6 ± 4.8 ^a	0.39	0.02 ± 0.02 ^a	0.01 ± 0.02 ^a	0.03 ± 0.04 ^b	< 0.001
10	51 ± 9.8 ^a	70.3 ± 11.6 ^b	49.6 ± 11 ^a	< 0.001	0.3 ± 0.3	0.1 ± 0.2 ^a	0.5 ± 0.7 ^b	0.001
a, b) Non-identical letters are significantly different (P value < 0.05).								

Table 5

Comparison of the CS indications by hospital peer-group in Iran, 21 March 2019–21 March 2021.

Indication	Public	Private	Other Hospitals	Total Hospitals
	n (%)	n (%)	n (%)	n (%)
Repeated CS	308701 (55.6)	162615 (44.1)	163522 (59.5)	634838 (52.9)
Fetal Distress	95218 (17.1)	34713 (9.4)	32935 (12)	162866 (13.6)
Dystocia	22063 (4)	14869 (4)	12555 (4.6)	49487 (4.1)
Placenta and Cord Conditions	11703 (2.1)	7311 (2)	3540 (1.3)	22554 (1.9)
Multiple Pregnancy	12430 (2.2)	5750 (1.6)	3963 (1.4)	22143 (1.8)
Malpresentation	38353 (6.9)	16425 (4.5)	14078 (5.1)	68856 (5.7)
Maternal Request	4153 (0.7)	53494 (14.5)	19847 (7.2)	77494 (6.5)
Undefined Indications	62692 (11.3)	73658 (20)	24503 (8.9)	160853 (13.4)
Total	555313 (100)	368835 (100)	274943 (100)	1199091 (100)
P value	< 0.001			

Figures

Figure 1

Distribution of Cesarean Section rate in Iranian Medical Universities by hospital peer-group in Robson groups 1, 2, 3, 4, 5, and 10, 21 March 2019 - 21 March 2021.

Supplementary Files

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