

Socioeconomic, Maternal, Neonatal and Health System Determinants of the Choice of Delivery Mode in Tehran Province: A Cross-sectional Study

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ARTICLE INFO	ABSTRACT
Article Type: Original article	Background & aim: Cesarean section (CS) is a life-saving intervention in specific obstetric situations, yet it has become one of the most frequently performed surgical procedures, globally. This study investigated socioeconomic, maternal, neonatal, and health system determinants influencing the choice of delivery mode in Tehran Province between March 2023 to March 2024.
Article History: Received: 14-Apr-2025 Accepted: 24-Feb-2026	Methods: The study included 400 mothers who had given birth during the study period, with participants selected using stratified sampling based on urban and rural population distribution. This study was conducted in healthcare facilities across Tehran Province. Data were collected using a researcher-developed questionnaire. The questionnaire included questions on participants' demographic, socioeconomic, maternal, and obstetric characteristics, as well as their mode of delivery. The questionnaire was completed by eligible mothers after obtaining informed consent. Given the binary nature of the outcome (delivery mode), data were analyzed using Chi-square and Mann-Whitney U tests, followed by penalized binary logistic regression in Stata 17.
Key words: Cesarean Section Natural Childbirth Maternal Health Prenatal Care Socioeconomic Factors	Results: The overall CS rate was 62%. Penalized logistic regression analysis showed that women aged >31 years had significantly higher odds of cesarean delivery (OR = 4.02; 95% CI: 1.49–10.87; P = 0.006). Maternal employment in the public sector was also associated with increased odds of CS (OR = 4.50; 95% CI: 1.66–12.22; P = 0.003), as was having supplementary health insurance (OR = 2.01; 95% CI: 1.10–3.68; P = 0.023). In contrast, a history of stillbirth (OR = 0.06; 95% CI: 0.01–0.48; P = 0.008), participation in prenatal birth-preparation classes (OR = 0.41; 95% CI: 0.24–0.69; P = 0.001), and delivering in public hospitals or at home compared to private hospitals (OR = 0.30; 95% CI: 0.16–0.56; P < 0.001) were associated with lower odds of cesarean delivery.
	Conclusion: These findings highlight the multifactorial nature of maternal choice of delivery mode and underscore the importance of strengthening maternal education, improving access to supportive prenatal services, and developing evidence-based policies to promote appropriate delivery practices.

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Introduction

The birthing process encompasses various physical, emotional, psychological, social, and

cultural dimensions and may result in different modes of delivery depending on individual

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circumstances, most commonly vaginal birth or cesarean section. Vaginal delivery is defined as the birth of a fetus through the vaginal canal following spontaneous or assisted labor, without surgical incision of the abdominal wall or uterus. This mode of delivery may occur with or without the use of obstetric interventions such as induction of labor, episiotomy, or instrumental assistance (1). Cesarean section is defined as a surgical procedure in which incisions are made through the abdomen and uterus to deliver the fetus when vaginal delivery is contraindicated or poses a risk to the mother and/or fetus (2).

Cesarean delivery is significantly associated with increased maternal and perinatal complications and can also affect future pregnancies. Therefore, the World Health Organization recommends that cesareans must be performed only when medically indicated and has discouraged their overuse (3). The World Health Organization suggests that the acceptable cesarean rate for a country should range between 10% and 15%. However, recent reports indicate that cesarean rates have surpassed this range, with a rapid increase in cesarean deliveries over the past two to three decades, despite the immediate risks and long-term effects (4). A study of 150 countries found that developed regions such as the Americas and Europe have the highest cesarean rates, followed by Asia, Africa, and other developing regions (5). For instance, cesarean rates have been reported at 40.5% in Latin America and the Caribbean, 25% in Europe, 19.2% in Asia, and 48% in Iran (6-7).

Although cesarean delivery is necessary in certain medical conditions such as severe hemorrhage, prolonged labor, and multiple pregnancies, a combination of social, cultural, and economic factors has significantly contributed to the rising cesarean rates. Several factors reported to increase cesarean prevalence include advanced maternal age at first childbirth (8), social pressure and fear of labor pain (9), previous childbirth experiences and interactions with healthcare providers (10), physician recommendations (11) and the influence of private healthcare facilities driven by financial incentives (12).

Previous studies have reported higher cesarean rates among women with higher socioeconomic status compared to those from lower socioeconomic groups (13). Specifically, urban women with higher education levels and higher socioeconomic status were more likely to have a Cesarean delivery than their rural counterparts (14-15). This disparity may be partly attributed to the higher costs associated with cesarean delivery, which can limit access for women in lower-middle-income groups (16). Despite the known risks and long-term consequences, cesarean rates have continued to rise sharply in recent years (17-18).

Although numerous Iranian studies have in Iran. Considering the substantial changes in healthcare access, economic conditions, and maternal decision-making during this period, updated evidence is needed (19-21). This study addresses this gap by analyzing recent data and assessing the combined effects of socioeconomic status, insurance coverage, and maternal characteristics on delivery mode. Accordingly, this study aimed to evaluate the socioeconomic, maternal, neonatal, and health system determinants influencing delivery mode choice in Tehran Province, to inform policy and design educational interventions that promote maternal physical, psychological, and social well-being. The findings may also support healthcare professionals and the public in making informed decisions regarding delivery methods.

Materials and Methods

This population based cross-sectional study was conducted in Tehran province, Iran, between March 2023 to March 2024

The study population consisted of mothers who gave birth during the study period and provided informed consent. Mothers with incomplete questionnaires or who declined participation were excluded.

The sample size was calculated using a single-proportion formula, assuming a cesarean delivery prevalence of 60% based on prior studies in Iran (22), a z-statistic of 1.96, and a margin of error of 0.05. This calculation yielded 368 participants. To account for potential non-response or data loss, a total of 400 mothers were included. Stratified sampling was employed, with strata defined according to the

proportion of urban and rural populations, to ensure the sample was representative of the population distribution.

Stratified sampling was conducted proportional to the urban-rural population distribution in Tehran province. According to the 2023 report from the Statistics Center of Iran, 94% of the population resided in urban areas and 6% in rural areas of Tehran province. Accordingly, 376 participants were recruited from urban areas and 24 from rural areas. This ensured representativeness of the overall population.

Data were collected using a structured questionnaire developed by the researchers. Content validity was confirmed through expert consultation in epidemiology, health services management, health economics, obstetrics, gynecology, and midwifery. Reliability was assessed via a test-retest method with 40 individuals, resulting in a correlation coefficient of 0.89.

The questionnaire included demographic, socio-economic, maternal, and neonatal variables. The outcome variable was the type of delivery (vaginal vs. cesarean). Household income was measured as a continuous variable in Iranian Rials and later converted to USD for reporting. Participants reported their total monthly household income, which was then categorized into quintiles for descriptive analyses. Income quintiles were determined by ranking all participants' reported incomes from lowest to highest and dividing the sample into five equal groups (Q1–Q5), with Q1 representing the lowest 20% and Q5 the highest 20% of household income. This approach allowed for comparison of socioeconomic effects on delivery mode. Neonatal birth weight was recorded in grams as a continuous variable based on hospital records immediately after birth. For descriptive purposes, birth weight was further categorized into three groups: low weight (<2500 g), normal weight (2500–4000 g), and macrosomia (>4000 g). Maternal underlying diseases refer to pre-existing chronic medical conditions diagnosed before pregnancy, including hypertension, diabetes, cardiovascular disease, thyroid disorders, and autoimmune diseases. Participants self-reported these

conditions, and we verified them through medical records when available.

Categorical variables were analyzed using the Chi-square test, while continuous variables were compared using the Mann-Whitney U test due to non-normal distribution (assessed by Shapiro-Wilk test). Variables with $P < 0.2$ in univariate analysis were entered into a multivariate logistic regression model to identify determinants of cesarean delivery. Variables with a P -value < 0.20 in the univariable analysis were considered for inclusion in the multivariable logistic regression model. Due to sparse data and small cell counts in some categorical variables, penalized logistic regression using Firth's correction was applied to reduce bias in parameter estimates and obtain more reliable odds ratios with 95% confidence intervals. Statistical significance was set at $P < 0.05$. Statistical analyses were performed using Stata version 17.

Results

The results obtained from demographic variables, categorized by age, mother's education, and husband's education, are presented in Table 1.

As shown in Table 1, cesarean delivery was more common among older mothers, particularly those aged 26–35 years, while vaginal delivery predominated in younger age groups. The mean maternal age was significantly higher in the cesarean group ($P < 0.001$). Cesarean delivery was also more frequent among mothers and husbands with higher educational levels, indicating a significant association between parental education and delivery type ($P < 0.001$).

The results from the socioeconomic variables of the study population are presented in Table 2.

As shown in Table 2, cesarean delivery was more prevalent among urban residents, those living in Tehran, and Iranian nationals. Mothers employed in the public sector and those with higher household income and supplementary insurance were significantly more likely to undergo cesarean delivery ($p < 0.001$). Additionally, cesarean births were more frequent among families covered by social security insurance, while vaginal deliveries were

more common among housewives and low-income households.

Table 1. Frequency distribution of demographic variables in the study population

Variable	Vaginal delivery Frequency (%)	Cesarean Frequency (%)	P-Value*
Maternal Age (years)			
15-20	18 (12)	10 (4)	0.000
21-25	42 (28)	23 (9)	
26-30	45 (30)	87 (35)	
31-35	36 (24)	68 (27)	
36-40	4 (3)	52 (21)	
>40	7 (5)	8 (3)	0.000
Age (Mean ± SD)	28±5.88	31±5.63	
Mother's education			
Illiterate	10 (7)	1 (0.5)	0.000
Primary	16 (11)	13 (5)	
Lower Secondary	34 (22)	22 (9)	
Upper Secondary	54 (35)	80 (32.5)	
University	38 (25)	132 (53)	
Husband's Education			
Illiterate	12 (8)	4 (2)	0.000
Primary	10 (7)	11 (4)	
Lower Secondary	35 (23)	29 (12)	
Upper Secondary	54 (35)	79 (32)	
University	41 (27)	125 (50)	
Total	152 (100)	248 (100)	

*P-values calculated using the Chi-square test for categorical variables and the Mann-Whitney U test for quantitative variables

Table 2. Frequency distribution of socioeconomic variables in the study population

Variable	Vaginal delivery Frequency (%)	Cesarean Frequency (%)	P-Value*
Residence			
urban	139(91)	237(96)	0.092
rural	13(9)	11(4)	
Place of Residence			
Tehran city	87(57)	169(68)	0.027
Other city	65(43)	79(32)	
Nationality			
Iranian	132(87)	240(97)	0.000
Non-Iranian	20(13)	8(3)	
Ethnicity			
Fars	48(32)	99(40)	0.062
Turk & Azari	38(25)	71(29)	
Kurd	19(13)	18(7)	
Lor & Bakhtiari	19(13)	34(14)	
Other	28(17)	26(10)	
Mother's occupation			
Housewife	126(82)	163(65)	0.000
Public Sector	7(5)	57(23)	
Private Sector	12(8)	14(6)	
Other	7(5)	14(6)	
Husband's Occupation			
Unemployed	6(4)	9(4)	0.000
Self-employed	94(61)	106(42)	
Public Sector	19(13)	77(31)	

Variable	Vaginal delivery Frequency (%)	Cesarean Frequency (%)	P-Value*
Private Sector	26(17)	47(19)	0.241
Other	7(5)	9(4)	
Housing Type			
Rented	103(68)	147(60)	0.241
Parental	11(7)	16(6)	
Owned	34(22)	79(32)	
Caretaker & Institutional	4(3)	6(2)	0.000
Income Quintile			
First	48(31)	35(14)	
Second	38(25)	77(31)	0.000
Third	33(22)	47(19)	
Fourth	15(10)	44(18)	
Fifth	18(12)	45(18)	0.000
Income± SD (\$)	3,137.29±2258	3,741.91±2282	
Insurance Type			
No Insurance	24(16)	19(8)	0.000
Health Insurance	35(23)	27(11)	
Social Security	79(52)	161(65)	
Medical Services	5(3)	12(5)	0.000
Armed Forces	4(3)	23(9)	
Other	5(3)	6(2)	
Supplementary Insurance			0.000
No	121(80)	138(56)	
Yes	31(20)	110(44)	
Total	152(100)	248(100)	

*P-values calculated using Chi-square test for categorical variables

The results obtained from the maternal and infant variables, categorized by infant gender, infant's weight, twinning, history of stillbirth, history of abortion, pregnancy complications, and maternal underlying diseases, are reported in Table 3.

Attendance at childbirth classes was associated with a lower rate of cesarean delivery ($p=0.006$). Delivery setting was strongly associated with delivery type ($p<0.001$), with cesarean deliveries more frequent in private hospitals, while vaginal deliveries predominated in public hospitals. Home and other locations had low frequencies in both groups.

As shown in Table 5, according to the penalized logistic regression model, several socio-demographic and obstetric factors were associated with the mode of delivery. Variables with $P < 0.2$ in univariate analyses were entered into the multivariate logistic regression model. The model was fitted using a stepwise method, and odds ratios with 95% confidence intervals were reported. Variables with $P < 0.05$ in the

final model were considered statistically significant.

Mothers aged over 31 years had significantly higher odds of cesarean delivery compared with those aged ≤ 20 years (OR = 4.02, 95% CI: 1.49–10.87, $P = 0.006$). Government-employed mothers were more likely to undergo cesarean section than housewives (OR = 4.50, 95% CI: 1.66–12.22, $P = 0.003$). The presence of supplementary insurance was also positively associated with cesarean delivery (OR = 2.01, 95% CI: 1.10–3.68, $P = 0.023$). Conversely, mothers with a history of stillbirth (OR = 0.06, 95% CI: 0.01–0.48, $P = 0.008$), those attending birth preparation classes (OR = 0.41, 95% CI: 0.24–0.69, $P = 0.001$), and those who delivered in public hospitals or at home (OR = 0.30, 95% CI: 0.16–0.56, $P < 0.001$) had significantly lower odds of cesarean section. Other variables, including husband's education, ethnicity, and income quintile, were not statistically significant predictors in the adjusted model.

Table 3. Frequency distribution of maternal and infant variables in the study population

Variable	Vaginal delivery Frequency (%)	Cesarean Frequency (%)	P-Value*
Neonatal gender (Male)	85(56)	133(54)	0.655
Birth weight			
Low Weight (<2500g)	6(4)	24(10)	0.404
Normal (2501-4000g)	139(91)	219(88)	
Macrosomia (> 4000 g)	7(5)	4(2)	
birth weight(gr) Mean ± SD	3142 ± 406.5	3103±461.3	0.888
Twin Pregnancy			
No	151(99)	239(96)	0.065
Yes	1(1)	9(4)	
History of Stillbirth			
No	146(96)	247(100)	0.009
Yes	6(4)	1(0.4)	
History of Abortion/Miscarriage			
No	135(89)	204(82)	0.007
Yes	17(11)	44(18)	
Pregnancy Complications			
No	128(84)	207(83)	0.845
Yes	24(16)	41(17)	
Underlying Disease**			
No	142(93)	227(92)	0.493
Yes	10(7)	21(8)	
Total	152(100)	248(100)	

*P-values calculated using the Chi-square test for categorical variables and the Mann-Whitney U test for quantitative variables

** Underlying diseases include pre-existing chronic conditions such as hypertension, diabetes, cardiovascular, thyroid, and autoimmune disorders

Table 4. Frequency Distribution of Healthcare System Variables in the study population

Variable	Vaginal delivery Frequency (%)	Cesarean Frequency (%)	P-Value*
Attendance at Birth Preparation Classes			
No	88(58)	177(71)	0.006
Yes	64(42)	71(29)	
Delivery Setting			
Private Hospital	26(17)	119(48)	0.000
Public Hospital	122(80)	118(48)	
Home & Other	4(3)	11(4)	
Total	152(100)	248(100)	

*P-values calculated using Chi-square test for categorical variables

Table 5. Odds ratios for determinants of the choice of delivery mode

Variable	Odds Ratio	Std. Err	z	P-Value	95% Confidence Interval
Maternal Age (years) RC*: ≤20 years					
21-30	1.65	0.79	1.04	0.297	0.64 – 4.24
>31	4.02	2.04	2.74	0.006	1.49 – 10.87
Husband's Educational Level RC:					
Illiterate					

Variable	Odds Ratio	Std. Err	z	P-Value	95% Confidence Interval
Primary	2.15	1.75	0.95	0.344	0.44 – 10.56
Secondary	1.22	1.05	0.23	0.816	0.23 – 6.63
High school	1.75	1.50	0.65	0.514	0.33 – 9.40
College	1.31	1.15	0.31	0.758	0.24 – 7.30
Maternal Occupation					
RC: Housewife					
Gov. employee	4.50	2.29	2.95	0.003	1.66 – 12.22
Private	0.37	0.19	-1.89	0.058	0.13 – 1.04
Other	0.98	0.53	-0.03	0.977	0.34 – 2.84
Husband's Occupation					
RC: Unemployed					
Self-employed	0.94	0.55	-0.11	0.912	0.29 – 2.99
Gov. employee	0.96	0.65	-0.06	0.953	0.25 – 3.62
Private Sector	0.50	0.35	-1.00	0.315	0.13 – 1.94
Other	0.53	0.44	-0.76	0.448	0.10 – 2.72
Residence (Urban/Rural)	0.95	0.47	-0.10	0.920	0.36 – 2.53
City of Residence (Tehran)	0.68	0.19	-1.34	0.181	0.39 – 1.19
Nationality (Non-Iranian)	0.50	0.39	-0.88	0.378	0.11 – 2.30
Ethnicity					
RC: Fars					
Turkic / Azari	1.83	0.62	1.78	0.074	0.94 – 3.56
Kurd	0.89	0.39	-0.27	0.784	0.37 – 2.12
Lor & Bakhtiari	1.16	0.45	0.38	0.701	0.54 – 2.49
Other	1.44	0.69	0.76	0.445	0.56 – 3.67
Basic Health Insurance					
RC: Not insured					
Health Insurance	0.42	0.23	-1.61	0.108	0.15 – 1.21
Social Security	0.92	0.48	-0.16	0.873	0.33 – 2.56
Medical Services	0.69	0.55	-0.47	0.639	0.14 – 3.28
Armed Forces	1.50	1.20	0.50	0.615	0.31 – 7.24
Other	0.97	0.78	-0.04	0.972	0.20 – 4.64
Supplementary insurance (Yes)	2.01	0.62	2.28	0.023	1.10 – 3.68
History of Stillbirth (Yes)	0.06	0.06	-2.65	0.008	0.01 – 0.48
History of abortion (Yes)	1.49	0.58	1.02	0.307	0.70 – 3.17
Attendance at Birth Preparation	0.41	0.11	-3.34	0.001	0.24 – 0.69
Classes (Yes)					
Delivery Setting					
RC: Private Hospital					
Public Hospital and Home	0.30	0.10	-3.76	0.000	0.16 – 0.56
Household Income Quintile RC:					
Q1					
Q2	1.68	0.58	1.50	0.133	0.85 – 3.30
Q3	1.05	0.41	0.14	0.892	0.49 – 2.26
Q4	2.00	0.91	1.52	0.128	0.82 – 4.90
Q5	1.64	0.73	1.11	0.265	0.69 – 3.90
Cons	1.12	1.33	0.09	0.925	0.11 – 11.43

* RC: Reference Category, Gov. Employee: Government employee

Discussion

Cesarean delivery is one of the most common major abdominal surgeries, and the recent increase in the cesarean rate in Iran is notable. In the present study, we assessed various socioeconomic, demographic, and healthcare-

related factors that influence the choice of delivery type and contribute to the high cesarean rate in Tehran Province. Our findings indicated that as maternal age increases, the likelihood of cesarean delivery increases compared with the reference group (≤ 20 years). Studies by Manyeh et al. (2018) and Ahmad et

al. (2023) also reported an association between maternal age and cesarean delivery (23-24). which is consistent with the results of this study. Older women may face increased pregnancy-related risks and may therefore be more likely to opt for cesarean delivery. Additionally, maternal age at marriage was positively associated with cesarean delivery. As the age at marriage increases, the age at first pregnancy typically increases, which may reduce the mother's physical capacity for vaginal delivery. Therefore, higher age at marriage may increase the probability of choosing cesarean delivery, indicating a positive relationship between this variable and delivery type.

In our study, mothers employed in the public sector were more likely to choose cesarean delivery compared with housewives, whereas women employed in the private sector had a lower likelihood of cesarean delivery. Other occupational groups also showed lower odds of cesarean delivery than housewives, although these associations were not statistically significant. These findings align with Manyeh et al. (2018), who reported that employment status plays a role in the decision to undergo cesarean delivery (23). Employed women often have higher household income and greater financial capacity to afford cesarean delivery, which may contribute to the higher cesarean rates observed among this group.

Regarding ethnicity, Lor & Bakhtiari, Azeri and Turkish-speaking people and other ethnic groups were more likely to choose cesarean delivery compared with Fars women, although this association was not statistically significant. Okwandu et al. (2022) also found that race/ethnicity significantly affected the odds of cesarean delivery, with all racial and ethnic groups having higher odds compared to white women, and black women, in particular, had higher odds of not tolerating labor (25). Carlson et al. (2023) similarly found that white women had a reduced likelihood of unplanned cesarean deliveries compared to black or Hispanic women (26). These findings further emphasize the influence of ethnicity on the choice of delivery type and are consistent with our study's results.

The higher likelihood of cesarean delivery among certain ethnic groups may reflect

cultural, social, and behavioral differences that influence childbirth preferences. Ethnicity can shape attitudes toward medical interventions, perceptions of labor pain, and trust in healthcare providers, leading some groups to prefer cesarean delivery as a safer or more controlled option. Furthermore, community norms and familial expectations within certain ethnic groups may support elective cesareans. These cultural and psychosocial factors may operate independently of clinical risk, making ethnicity a relevant predictor of delivery type in this population.

Regarding insurance, women with basic health insurance had lower odds of cesarean delivery compared with uninsured women, and this association was statistically significant. Other types of basic insurance did not significantly affect delivery choice. In contrast, having supplementary insurance was associated with a substantially higher likelihood of cesarean delivery, and this association was statistically significant. Overall, the findings indicated a higher probability of cesarean delivery among insured mothers compared with uninsured mothers (27). Hoxha et al. (2017), in a study in the form of a systematic review, reported that the overall chance of cesarean for privately insured women is on average 1.13 times higher compared to women covered by public insurance (28). In a recently conducted study, it has been reported that health insurance plays a role in Cesarean delivery among working mothers in Indonesia, and the probability of Cesarean delivery in insured working mothers was one and a half times higher than in uninsured working mothers. (29). These findings are consistent with our results. Basic and supplementary insurance may reduce the financial burden of cesarean delivery, thereby increasing the likelihood of choosing this mode of delivery. Moreover, transitioning from no basic insurance to Social Security Organization coverage may facilitate hospital admission due to better contractual arrangements and financial reimbursement, increasing the likelihood of cesarean delivery. In this way, both the type of basic insurance and the presence of supplementary insurance are positively associated with the probability of cesarean delivery.

Maternal-related variables can also play a significant role in the choice of delivery method. Mothers with a history of stillbirth had a lower chance of choosing a cesarean delivery compared to other mothers. O'Neill et al. (2013) found that cesarean delivery may increase the risk of stillbirth by up to 23% (30). Another recent study showed that for male fetuses, vaginal delivery reduced the stillbirth rate by 4.2%, while for both genders, vaginal delivery reduced the stillbirth rate by 4.7% (31). The lower likelihood of cesarean delivery among women with a history of stillbirth may reflect a preference for vaginal birth in subsequent pregnancies, possibly due to prior experience and counseling aimed at promoting safer delivery practices. Clinicians may encourage vaginal delivery when there are no current obstetric complications, as elective cesareans do not necessarily reduce stillbirth risk and may carry additional maternal and neonatal risks. Additionally, women with prior adverse obstetric outcomes may receive targeted prenatal counseling and enhanced monitoring in Tehran's public hospitals, which may encourage assisted vaginal delivery rather than elective cesarean. This finding is clinically unexpected, as a previous adverse pregnancy outcome may increase maternal anxiety and potentially contribute to a preference for or clinical decision toward cesarean delivery. However, only seven participants in our study reported a history of stillbirth, including six in the vaginal delivery group and one in the cesarean delivery group. Therefore, this estimate may be influenced by sparse-data effects, despite the use of Firth's penalized logistic regression. The finding should consequently be interpreted with caution and requires confirmation in studies with larger samples and a greater number of women with a history of stillbirth. Regarding healthcare system-related variables, participation in childbirth preparation classes was associated with lower odds of cesarean delivery. Women who attended these classes were significantly less likely to choose cesarean delivery. Milcent et al. (2018) showed that participation in pregnancy education varies by socioeconomic status, and women from lower socioeconomic backgrounds are more likely to undergo cesarean delivery and less likely to

participate in pregnancy education programs (32). This finding highlights the importance of pregnancy health education, particularly for low-income women, as a potential strategy to reduce unnecessary cesarean deliveries. Pregnancy education may improve women's knowledge about delivery methods, as several studies report that women are often unaware of the risks and benefits of different delivery options, leading some to choose cesarean delivery over vaginal birth (33-34).

Delivery setting was another important determinant. The likelihood of cesarean delivery was significantly lower in public hospitals and at home compared with private hospitals. One study reported that physicians may influence patients' decisions to undergo cesarean delivery, indirectly contributing to increasing cesarean rates (35). O'Donovan et al. (2018) found that fear of labor pain and concerns about childbirth-related injuries, such as pelvic floor damage, were common reasons for maternal requests for cesarean delivery (10). Therefore, examining cultural factors that shape women's preferences and their interactions with healthcare providers may help develop culturally appropriate interventions to address cesarean rates. Omani-Samani et al. (2017) reported a cesarean rate of 72% in their study population, with significantly higher rates in private hospitals compared with public hospitals, and an association between economic status and cesarean delivery (19). Similarly, a study in Brazil reported that the cesarean rate in private hospitals was 4.4 times higher than in public hospitals (36). Overall, women with higher socioeconomic status tend to prefer private maternity facilities, contributing to higher cesarean rates in private hospitals. It is also important to note that private hospitals may financially benefit from performing unnecessary cesarean deliveries.

Household income quintile was also examined. The odds of cesarean delivery were higher in higher income quintiles compared with the lowest quintile, but this association was not statistically significant. Wyatt et al. (2021) reported that higher household wealth quintiles were positively associated with cesarean delivery (37). Another study also showed that the chance of higher Cesarean delivery among mothers from wealthy families is higher

compared to the middle class (27). Also, in the studies of Mohammad Beigi et al. (2009) and Dehghani et al. (2012), high income has been identified as the most important non-clinical variable that affects the rate of cesarean sections (38-39). This is consistent with the findings of the present study. Although household income was associated with delivery method in univariate analysis, it was not significant in the multivariate penalized logistic regression model, suggesting that its effect may be mediated by factors such as maternal education and insurance status.

The strengths of this study are, firstly, that it is a population-based study, and secondly, that it focuses on all social, economic, health, and medical levels and has been analyzed, which is one of the main priorities of global public health interventions in the field of choosing the type of delivery. This study has some limitations. First, as a cross-sectional study, causal relationships between predictors and delivery choice cannot be established. Second, information was obtained through self-reported questionnaires, which may be subject to recall or reporting bias. Third, although multiple socio-economic and health-related factors were considered, unmeasured confounding variables (such as cultural beliefs, physician preferences, or detailed obstetric history) may still affect the results. Fourth, although the sampling strategy reflected the actual urban-rural population distribution of Tehran Province, the limited rural sample size may have reduced the statistical power to detect differences between urban and rural residents. Therefore, comparisons related to place of residence should be interpreted with caution.

Conclusion

This study showed that the overall cesarean rate was 62%. The findings of this study reinforce evidence that the likelihood of cesarean delivery increases with increasing age, mother's occupation, supplementary insurance coverage, and delivery in a private hospital. A history of stillbirth and participation in prenatal preparation classes are other variables associated with cesarean delivery. Based on the findings, several practical recommendations can be made. Expanding childbirth preparation classes, especially targeting high-risk groups

such as highly educated mothers and women in private hospitals, may help reduce unnecessary cesarean deliveries. Health policymakers should implement stricter monitoring and auditing of private hospitals to prevent financial incentives from increasing cesarean rates. Insurance policies should be revised to reduce the gap in coverage between vaginal delivery and cesarean section, making vaginal delivery more affordable. Moreover, culturally tailored interventions are needed to address specific ethnic and socio-economic groups with higher cesarean rates. Strengthening public awareness campaigns about the risks and benefits of both delivery methods, combined with training programs for healthcare providers on evidence-based decision-making, could also help reduce unnecessary cesarean deliveries.

Declarations

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Conflicts of interest

The authors declared no conflicts of interest.

Ethical considerations

All procedures were conducted according to the Declaration of Helsinki and approved by the Health Research Ethics Committee. Before the study, prior to participation, all subjects were informed about the study's objectives. The confidentiality of the participants' personal information was strictly maintained, and the data were used solely for research purposes. Participants had the right to withdraw from the study at any stage without any consequences.

Code of Ethics

In this study, ethical approval was obtained from the Iran University of Medical Sciences (Approval Code: IR.IUMS.REC.1403.250).

Use of Artificial Intelligence (AI)

Artificial intelligence tools were used only to assist with language editing, grammar correction, and improvement of the clarity and readability of the manuscript. The study design, data analysis, interpretation of the findings, and scientific content were developed and verified by the authors. The authors take full responsibility for the accuracy, originality, and integrity of the submitted manuscript.

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Authors' contribution

All authors contributed to the conception and design of the study. NS and MHGH were responsible for data collection and initial analysis. SBF and MHGH contributed to data interpretation and manuscript drafting. FEFA supervised the research process and provided critical revisions. All authors reviewed and approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

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