

Modifiable Risk Factors and their Individual Contribution to Caesarean Delivery

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ABSTRACT

Objective: To determine the frequency of modifiable factors and identify their associated determinants among women undergoing caesarean section.

Study design and setting: A cross-sectional study conducted at Ziauddin hospital, Karachi.

Methodology: Consecutive women undergoing Caesarean section (CS) were included. Modifiable factors leading to CS such as maternal request, obesity and advanced maternal age were recorded. Chi-square test was used to measure associations between modifiable factors and sociodemographic factors. The multivariate logistic regression analysis was conducted to reveal independent predictors. A p-value =0.05 was considered statistically significant.

Results: The leading modifiable factor observed was obesity (40.7%) followed by advanced maternal age (18%) and maternal request (12.0%). Higher educational status, family income, antenatal care visits and booking status were significantly linked to maternal request ($p<0.05$). Family income and parity was significantly associated with obesity and advanced maternal age was linked with education, income and booking status. In multivariate analysis, increased antenatal care visits were independent predictors of maternal request (AOR=2.97, $p=0.039$), whereas increased family income was an independent predictor of advanced maternal age (AOR=1.99, $p=0.027$).

Conclusion: Modifiable factors contribute substantially to Caesarean delivery. The use of the antenatal care and socioeconomic status are vital and point to the necessity of specific counseling and preventive measures.

Keywords: Advanced maternal age; Antenatal care; Caesarean section; Maternal request; Obesity

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INTRODUCTION

Caesarean section (CS) is a life-saving obstetric invasive procedure, if indicated as per standard guidelines. But the fast-growing prevalence around the world has become a major issue of growing concern for the global community. The rate of Caesarean delivery has increased significantly over the last few decades both in developed and developing nations. Betran et al.¹ found that there was a significant increase in CS rates worldwide, both above the recommended level of 10-15 percentage points, and without a proportionate decrease in maternal and neonatal deaths. The trend brings up issues about overutilization of surgical delivery and complications that accompany it both in the short and long term. Similarly, de Vries et al.² found that alterations in maternal demographics, obstetric practices and healthcare delivery systems have all played a role in the rising rates of Caesareans over the years.

The increase in CS rates is multidimensional and can be explained by a complex interaction between clinical, socioeconomic, and healthcare system determinants. Although Caesarean delivery medically necessary for maternal and fetal outcomes is crucial, non-medical issues have become increasingly influential in decision-making. Sayed et al.³ pointed out that maternal education, socioeconomic status, and healthcare accessibility have a

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significant influence on the probability of Caesarean births. Moreover, Pavlidou et al.⁴ indicated that maternal modifiable characteristics and behavioral factors have a significant role in shaping mode of delivery and this have contributed to differences in Caesareans among various populations.

The modifiable determinants include maternal factors, namely obesity, older maternal age, and maternal request, which are increasingly being considered. These not only affect obstetric outcomes but also are potential intervention targets. Specifically, obesity has been linked to faulty physiological processes, such as poor uterine contractility, long labor duration, and high risk of complications including fetal distress and inability to induce labor. Brizan et al.⁵ in a systematic review reported that maternal obesity significantly increases the likelihood of Caesarean delivery, especially in low-resource settings. Moreover, maternal factors such as body mass index and obstetric history have been found as powerful predictors of emergency Caesarean by Tun et al.⁶ highlighting the relevance of risk stratification in early infancy.

Large-scale epidemiological studies have also shown the additive effect of various determinants on Caesarean delivery rates beyond individual level factors. In a study of millions of deliveries, Alonso-Colon et al.⁷ affirmed the importance of both modifiable and non-modifiable factors driving the rising trend of Caesarean worldwide. Likewise, Giang et al.⁸ found that urbanization, maternal preference, and provider practices play a crucial role in Caesarean delivery rates especially in developing nations with rapid healthcare transition. These results indicate that distinguishing between necessary and potentially avoidable Caesareans should be made to optimize obstetric care.

South Asian countries such as Pakistan have registered a significant rise in Caesarean rates regionally. According to Amjad et al.⁹ there has been a drastic increase in CS rates in Pakistan, from 3.2% in 1990 to about 20% in 2018. This upward trend indicates changing reproductive behavior, more institutional births, and changing healthcare practices. Local research also affirms the influence of modifiable factors in this regard. Shifa et al.¹⁰ showed that maternal obesity, advanced maternal age and maternal request are major factors leading to Caesarean deliveries in Pakistani populations. Likewise, Haider et al.¹¹ found that maternal request and other relative indicators remain significant factors leading to Caesarean in tertiary care hospitals, and the impact of non-medical factors is increasing.

Although evidence on this issue is available globally and regionally, there is a dearth of statistics narrowed down to the individual contribution of modifiable factors in the local Pakistani context. Most studies have assessed Caesarean delivery compositely without separating the independent effects of factors like obesity, high maternal age, and maternal request. Understanding the relative contribution of these

modifiable determinants is essential to develop targeted interventions to reduce unnecessary Caesareans. Thus, this research was carried out to determine the prevalence of modifiable factors and their determinants in women undergoing caesarean section in a tertiary care environment in Karachi, Pakistan.

METHODOLOGY

It was a cross-sectional study in a tertiary care facility located in the labour room and emergency obstetric triage area of Dr. Ziauddin University Hospital, Karachi, which serves a mixed urban/peri-urban population with a wide socioeconomic range. The cross-sectional design was selected due to the ability to estimate prevalence of modifiable risk factors of Caesarean section at a given point in time and the time frame was six months, which is manageable. Data collection was done over six months, May 20, 2025, through December 20, 2025, to capture seasonal changes in obstetric admissions.

Before starting any activity in the study, the Ethical Review Committee of Ziauddin University was consulted and gave permission (Reference No. 11731225SRGYN). The protocol of ethical approval involved the consideration of the study protocol, data collecting tools, informed consent forms, and confidentiality protection. Written information was provided to all eligible women in Urdu and English explaining the purpose of the study and nature of voluntary participation, precautions taken to ensure confidentiality of the data and a clear promise that refusal to participate or dropping out at any point would not in any way jeopardize her clinical care. Informed consent was obtained from all eligible participants before an interview, chart review, or physical examination.

Raosoft software, which is an online calculator of cross-sectional studies, was used to compute the sample size. It was calculated with a proportion of Caesarean section done on the request of the mother taken as 12.5% as reported by Haider and colleagues¹¹ in a similar tertiary care facility in Pakistan, confidence level 95% and absolute precision of 5%. Assuming a large target population, the estimated sample size was approximately 167 pregnant women. The sampling technique was consecutive where all women who were eligible were approached throughout the study period and recruited until the sample size of interest was met, reducing the chances of selection bias.

Inclusion criteria was purposely wide to depict the actual obstetric population in the field. These included women aged 18-40 years, singleton pregnancy as established by ultrasound, one or more parities (including primipara and multipara), gestational age of 28 weeks and above, and having either elective or emergency Caesarean section. Exclusion criteria was used to minimize confounding and ensure homogeneity of the study population. In particular, women containing fetal malformations were not included,

as the latter have a separate effect on delivery, and might not be a result of the modifiable maternal factors. Patients with pre-existing maternal systemic diseases, including chronic hypertension and renal disease, were excluded to minimize potential confounding by chronic medical conditions. Diabetes mellitus (type 2 and gestational diabetes) was eliminated because it had a strong independent relationship with Caesarean section independent of obesity. It was ruled out a macrosomic fetus, which is a fetal weight estimated to be greater than 4,000 grams, since fetal size alone is a risk factor of Caesarean. Smoking history was not considered as it is not common among pregnant Pakistani women and its inclusion would not contribute generalizable information.

The on-call obstetric team identified eligible participants on admission to the labour room or emergency triage. Each woman was obtained with a detailed clinical history by use of a structured proforma. The following were sociodemographic variables: maternal age in years, residential status (urban or rural based on permanent address), educational status (up to matriculation (10 years of schooling) and college and above), occupation (housewife or working woman), and family monthly income in Pakistani rupees. The family income was divided into three categories: low ($\leq 30,000$ PKR), middle (30,001 to 80,000 PKR) and high ($> 80,000$ PKR) according to the national poverty levels and local purchasing power.

Gravida was defined as the total number of times a woman had been pregnant, irrespective of the pregnancy outcome. Parity was defined as the number of pregnancies that reached the age of viability, regardless of whether the fetus was born alive or stillborn. Women with one previous viable pregnancy were classified as primiparous, while those with two or more previous viable pregnancies were classified as multiparous and the status of the booking (booked, when a woman had more than three antenatal visits in any facility, and unbooked, when she had less than three) and the history of previous Caesarean section (yes or no) were used as obstetric factors.

All the participants were subjected to a standard physical examination in a private space in the labour room. Calibration of the instruments was done weekly to ascertain their accuracy during anthropometric measurements. The kilograms were measured with a digital weighing scale with the participant standing on her bare feet and wearing light clothes. A stadiometer was mounted on the wall, head held on the Frankfort horizontal plane and measured the height in meters. Body mass index (BMI) was calculated as the weight/height squared given in kg/m^2 . The definition of obesity was based on BMI of over 30 kg/m^2 and participants were categorized as normal weight ($18.5\text{--}24.9 \text{ kg/m}^2$), overweight ($25\text{--}29.9 \text{ kg/m}^2$) and obese (30 kg/m^2 and above) following the standardized classification of World Health Organization.

Mother request, obesity and advanced maternal age were

the three modifiable factors that were studied in this analysis. Advanced maternal age was characterized as an age over 35 years of age at birth. Maternal request was considered as any Caesarean section that was done without a strict medical or obstetric indication but was done based on the desire of the patient as recorded in the clinical record and confirmed by directly inquiring the patient during the interview. Obese women were defined as having a body mass index of more than 30 kg/m^2 .

Hospital medical records provided additional clinical and obstetric data including the primary indication for Caesarean categorized as maternal (e.g., obstructed labor, pre-eclampsia), fetal (e.g., non-reassuring fetal status), or other (e.g., placental abnormalities), mode of Caesarean classified as elective (pre-planned) or emergency (performed after onset of labor), antenatal complications such as hypertensive disorders or antepartum hemorrhage, and neonatal birth weight in grams. Data on whether the patient was counseled on mode of delivery and the reason provided on why the patient requested in the first place was also documented where necessary so as to classify the patient properly. Since the frequency of modifiable factors could be caused by more than one, multiple response analysis was employed to characterize the frequency of modifiable factors.

The principal investigator monitored data collection on a daily basis. It involved a structured proforma that was pre-designed and all data were recorded by the trained data collectors after inter-observer reliability test. Before data entry, completeness and accuracy checks were done and any missing/ambiguous entries went back to the source document to be verified. The data were entered and analyzed with the help of SPSS 24. To determine the normality of quantitative variables, the Shapiro-Wilk test was used. Quantitative variables were presented by mean and standard deviation and qualitative variables by frequencies and percentages. The Chi-square test was used to analyze categorical variables to identify associations and the Fisher exact test was used when the number of expected cells in any cell was less than five. Multivariate logistic regression was used to identify the independent effect of the chosen variables on the three modifiable variables: maternal request, obesity, and advanced maternal age. In bivariate analysis, the regression model used variables that had a p-value of 0.20 and below or variables of clinical interest irrespective of p-value. Odds ratios, adjusted, with 95% confidence intervals were given. A p-value of 0.05 or lower was a statistically significant p-value.

RESULTS

There were 167 women enrolled who were undergoing Caesarean section. The mean age of the participants was 29.2 ± 5.3 years. The mean BMI was $28.7 \pm 3.1 \text{ kg/m}^2$ which meant that there are many overweight and obese individuals in the study population. This is a clinically relevant finding

because uterine contractility and prolonged labor that is known to be caused by overweight and obesity are known to be impairments. The average gestation period was 37.5 weeks $\pm$ 1.5 with mean birth weight of the infants being 3.1 $\pm$ 0.4 kg at birth, and most of the births were at term with the fetus being well developed.

Regarding sociodemographic variables, majority of the respondents had reached matric or lower education levels with a lower proportion obtaining college level or higher. A higher number of women were from rural areas and most of them were housewives. In terms of the socioeconomic status, most of the participants belonged to the middle-income group, and then low-income and high-income groups. The average number of antenatal care visits revealed moderate use of antenatal care, with almost half of the respondents having 4–7 visits during pregnancy. Regarding obstetric aspects, women were mostly multiparous and multigravida, which is representative of a population with a history of reproductive life. Booked cases consisted of a huge number of respondents, which implied that they had previous experience with prenatal care services. The most common cause of Caesarean section was maternal indications followed by fetal indications meaning that clinical factors were the main determinant of Caesarean section in this population. Elective Caesarean section was a little more prevalent than emergency Caesarean section.

The distribution of modifiable factors among women undergoing Caesarean section is presented in Figure 1. Obesity was the most common followed by advanced maternal age and lastly maternal request. This top-down dispersion indicates that biological (obesity and age) and patient-based (request) are more widespread causes of Caesarean birth in this context. The higher education status, higher family income, more visits to antenatal care, and the status of booking were significantly associated with maternal request of Caesarean section in the bivariate analysis. More educated women were more oriented towards maternal request and there was a progressive rise in maternal request with higher income groups. Similarly, increased frequency of maternal request was linked to increased number of antenatal visits. Women who had been booked were more likely to insist on Caesarean delivery as opposed to women who had not been booked. On the other hand, occupation, residential status and parity with maternal request had no statistically significant relationship.

Bivariate analysis revealed that there was significantly different correlation between obesity and family income and parity. There was a higher prevalence of obesity among women in middle and high-income groups and among multiparous women. Nonetheless, there was no strong association between obesity and educational status, occupation, residential status, antenatal care visits, or booking status. Advanced maternal age had a strong correlation with higher levels of education status, family income, and booking

status. Women with increased education and income levels had a higher percentage of advanced maternal age. Equally, booked women had higher chances of being of advanced maternal age as compared to unbooked women. Occupation, residential status, antenatal care visits, and parity were not significantly correlated.

When it comes to multivariate analysis of logistic regression, the frequency of the antenatal care visit was the sole independent predictor of maternal request. Females with a

Table 1: Baseline demographic and clinical characteristics (n=167)

Variable	Mean $\pm$ SD / n(%)
Age (years)	29.2 $\pm$ 5.3
Gestational age (weeks)	37.5 $\pm$ 1.5
Birth Weight (kg)	3.1 $\pm$ 0.4
BMI (kg/m²)	
Educational status	28.7 $\pm$ 3.1
Up to Matric	121 (72.5)
College or above	
Residential Status	46 (27.5)
Rural	66 (39.5)
Urban	
Occupation	101(60.5)
House Wife	103(61.7)
Working Women	
Family Monthly Income	64 (38.3)
Low (=30k per month)	58 (34.7)
Middle (30,001 to 80,000)	69 (41.3)
High (>80,000)	40 (24.0)
ANC Visits	5.6 $\pm$ 2.5
= 3	40 (24.0)
4-7	85 (50.9)
8 or more	
Gravida	42 (25.1)
Primigravida	31 (18.6)
Multigravida	
Parity	136 (81.4)
Primipara	45 (26.9)
Multipara	
Booking status	122 (73.1)
Booked	127(76.0)
Unbooked	
Indications for CS	40(24.0)
Fetal Indications	38 (22.7)
Maternal Indications	125 (74.9)
Others	4 (2.4)
Previous C section	
Mode of CS	39 (23.4)
Elective	91 (54.5)
Emergency	76 (45.5)
Antenatal Complications	20 (12.0)

Table 2: Association of Sociodemographic and Clinical Factors with Modifiable Factors

Variable	Category	Maternal Request n (%)	P- value	Obesity n (%)	p-value	Advanced Maternal Age n (%)	p-value
Educational Status	Up to Matric	10 (8.3)	0.017	48 (39.7)	0.654	16 (13.2)	0.010
	College or above	10 (21.7)		20 (43.5)		14 (30.4)	
Family monthly income	Low	3 (5.2)	0.034	16 (27.6)	0.031	5 (8.6)	0.025
	Middle	8 (11.6)		31 (44.9)		13 (18.8)	
	High	9 (22.5)		21 (52.5)		12 (30.0)	
Occupation	House wife	14 (13.6)	0.414	38 (36.9)	0.202	19 (18.4)	0.837
	Working Women	6 (9.4)		30 (46.9)		11 (17.2)	
Residential status	Rural	5 (7.6)	0.157	27 (40.9)	0.968	13 (19.7)	0.637
	Urban	15 (14.9)		41 (40.6)		17 (16.8)	
ANC Visits	<3	1 (2.5)	0.002	14 (35.9)	0.198	3 (7.5)	0.142
	4-7	8 (9.4)		32 (37.6)		18 (21.2)	
	>8	11 (26.2)		22 (52.4)		9 (21.4)	
Parity	Primipara	5 (11.1)	0.834	11 (24.4)	0.009	5 (11.1)	0.161
	Multipara	15 (12.3)		57 (46.7)		25 (20.5)	
Booking Status	Booked	19 (15.0)	0.047*	54 (42.5)	0.399	27 (21.3)	0.048
	Unbooked	1 (2.5)		14 (35.0)		3 (7.5)	

Data presented as frequency (percentages), Chi square test applied for comparison, *Fisher's exact test applied where assumptions were violated, p = 0.05 considered statistically significant.

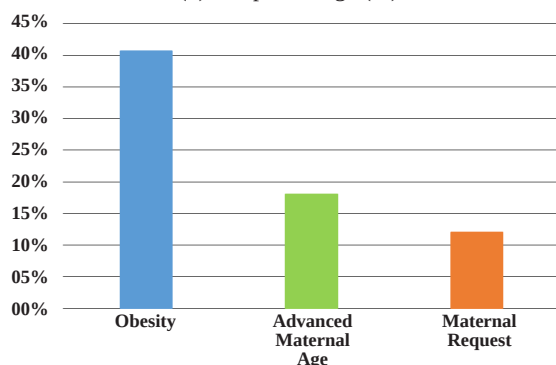
ANC: Antenatal clinic

Table 3: Multivariate Logistic Regression Analysis of Factors associated with Modifiable Factors

Modifiable factor	Variable	Category	Adjusted Odd Ratio (AOR)	95% CI	p-value
Maternal Request	ANC Visits	=3	1 (Ref)		
		4-7	—	—	—
		=8	2.97*	1.06–8.31	0.039*
	Educational Status	Up to Matric	1 (Ref)	—	—
		College or above	2.03	0.64–6.45	0.232
	Family Income	Low	1 (Ref)	—	—
		Middle	—	—	—
		High	1.24	0.52–2.96	0.624
	Booking Status	Unbooked	1 (Ref)	—	—
		Booked	1.08	0.08–14.48	0.951
Advanced Maternal Age	Family Income	Higher vs Lower	1.99*	1.08–3.65	0.027*
	Occupation	Working vs Housewife	0.68	0.29–1.62	0.384
	ANC Visits	Higher vs Lower	0.81	0.32–2.07	0.663
	Booking Status	Booked vs Unbooked	2.85	0.49–16.70	0.246
Obesity	Family Income	Higher vs Lower	1.61	1.00–2.60	0.052
	Occupation	Working vs Housewife	1.29	0.66–2.49	0.456
	ANC Visits	Higher vs Lower	1.48	0.68–3.22	0.325
	Booking Status	Booked vs Unbooked	0.56	0.16–1.99	0.367

ANC: Antenatal Clinic, CI: Confidence Interval, * statistically significant

Figure 1: Distribution of modifiable factors among women undergoing caesarean section. Values are presented as frequency (n) and percentage (%).



higher number of antenatal visits were also much more likely to have a maternal request as compared to those with less than five antenatal visits. Other factors did not have statistically significant after adjustment including educational status, family income and booking status probably because of confounding factors. In the instance of advanced maternal age, family income was found to be a significant independent predictor with women in high income groups being more likely to have advanced maternal age compared to those in lower income groups. However, the advanced maternal age was not significantly related to occupation, antenatal care visits, and booking status.

On the other hand, the adjusted model was not statistically significant in the independent association of all the variables studied with obesity. Although there was a borderline association between family income and obesity, it was not statistically significant. Similarly, after adjustment, occupation, prenatal care visits, and booking status lacked significant predictive value with regard to obesity.

DISCUSSION

The current research assessed the contribution of the modifiable variables, such as maternal request, obesity, and advanced maternal age, in women undergoing caesarean section. The results showed that maternal indications are the most significant contributors with a significant proportion being maternal request. Obesity and advanced maternal age were prevalent among modifiable factors. Notably, antenatal care visits were independent predictors of maternal request and greater family income were independent predictors of advanced maternal age. Conversely, there were no independent predictors of obesity.

The rate of caesarean section has increased significantly in the past decades across the globe. According to Betran et al.¹ it was found that caesarean delivery has surpassed the recommended limits in most areas, mainly due to both clinical and non-clinical reasons. Likewise, de Vries et al.² revealed that cumulative maternal and obstetric risk factors

also play a significant role in this increase. Our study predominantly shows maternal indications, which are thus in line with these trends in the world, indicating the relevance of clinical decision-making in obstetric practice.

Nevertheless, greater focus has been given to socioeconomic and modifiable determinants. As pointed out by Pavlidou et al.⁴ maternal factors and use of healthcare services play a crucial role in determining the delivery mode. In our analysis, education and income had a strong relationship at the bivariate level but were not independent when adjusted. Confounding factors, especially the mediating effect of antenatal care utilization, may explain this difference.

Caesarean section requested by a mother is now becoming a significant factor. The increasing role of maternal preference in Pakistan has been supported by local evidence by Shifa et al.¹⁰ which is congruent with our findings. Likewise, Zeeshan et al.¹² and Majid et al.¹³ have indicated that socioeconomic status, the use of antenatal care and institutional practice are also the contributing factors to increased caesarean rates in Pakistan. Such similarities are probably echoes of similar healthcare systems, perceptions of patients and practices of providers in the local environment.

In addition to local findings, other regional studies also confirm these findings. Gyaase et al.¹⁴ found that in Ghana, maternal socioeconomic status and healthcare access had a significant impact on the rates of caesarean delivery, whereas Muhammad et al.¹⁵ found similar results in Bangladesh. These results indicate that in low- and middle-income environments, the financial ability and use of healthcare are key determinants of delivery mode.

An important result of this research was that there was independent relationship between maternal request and the antenatal care visits. Tun et al.⁶ and Alonso-Colon et al.⁷ demonstrated that the higher the interaction with healthcare providers is, the more the decisions about delivering the intervention are affected, and the more the intervention rates are related to the improved monitoring. These results also indicate that maternal perceptions and the chances of elective caesarean section can be influenced by repeated exposure during pregnancy.

The trend of increased family income and obesity observed in this study is in line with literature that has been conducted, but it was not found to be statistically significant when adjusted. Brizan et al.⁵ found that obesity is a significant factor of caesarean birth because it influences the course of labor and obstetric difficulties. Additionally, in line with this, Lubrano et al.¹⁶ highlighted that gestational weight gain and high BMI are significant factors that can be altered to cause poor obstetric outcomes.

Biologically, obesity causes caesarean section due to poor uterine contractility, augmented inflammatory reaction, and a greater risk of obstetric issues. The wider clinical implications of the maternal metabolic factors have also

been pointed out by Ramos et al.¹⁷ and Wang et al.¹⁸ which substantiates the mechanistic plausibility of the findings.

Conversely, high maternal age failed to show independent relationships with other variables of interest as compared to family income in multivariate analysis. Similar comments have been noted by Nedberg et al.¹⁹ and Dhakal-Rai et al.²⁰ who noted that the advanced maternal age is affected by the extended demographic changes such as the delayed child bearing and sociocultural changes. The socioeconomic status observed to be associated with our study could be due to the differences in reproductive planning and access to healthcare. The absence of relationship of occupation, residential status, and parity with modifiable factors in this study is contrary to the results in the study by Qureshi et al.²¹ and Alipour et al.²² where socioeconomic gradients affected caesarean rates. This deviation can be explained by the variations in the study population, the number of the samples, and the relative homogeneity of the current cohort.

Clinically, such results highlight the significance of specialized prenatal care. Women who attend the antenatal clinics frequently are also an important target population to be targeted, as false beliefs about caesarean section could be corrected through evidence based counseling programs. The availability of modifiable determinants like obesity and maternal request indicates the necessity of preventive measures, as seen through the prism of a public health perspective. Islam et al.²³ showed that healthcare system influences the outcome of surgery greatly and Grisbrook et al.²⁴ and Abuduxike et al.²⁵ highlighted the importance of behavioral, psychological and classification-based interventions in the explanation of caesarean delivery.

The strengths of this research are that it addresses modifiable factors, multivariate analysis, and presents locally relevant data. The study adds to the scanty literature discussing the distribution and determinants of modifiable factors in women having a caesarean section. Nevertheless, some limitations are to be considered. The cross-sectional nature restricts the ability to make causal inferences, and the single-center study might influence generalizability. Moreover, determinants of maternal request were not covered in terms of provider-related and psychological factors, which could have led to residual confounding.

Further studies should be based on multicenter prospective studies that will help to better comprehend the causal pathways and consider interventions that can be used to change factors that can be altered. Finally, this paper shows how the utilization of antenatal care and socioeconomic factors play a major role in determining modifiable factors in women having a caesarean section and that the clinical and public health interventions should be tailored.

CONCLUSION

The most common modifiable factors observed in this study were obesity, advanced maternal age and maternal request.

The bivariate analyses showed that higher education, income and antenatal care utilization were statistically significantly associated with maternal request and advanced maternal age. The results indicate that the preconception and antenatal interventions such as patient counselling about delivery method and timely pregnancy planning, and weight management intervention can help reduce the potentially avoidable caesarean section in Pakistan.

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Authors Contribution:

Shazia Rehman: Substantial contributions to the conception or design of work

Habiba Sharaf Ali: Supervision and project administration including oversight of the research activity planning and execution

Saima Hanan: Acquisition, analysis and interpretation of data methodology

Varisha Hussain: Interpretation of data and methodology

Laiba Bhurgaro: Drafting the manuscript or revising it critically for important intellectual content

Michelle Maria: Data collection

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. de Vries BS, Morton R, Burton AE, Kumar P, Hyett JA, Phipps H, McGeechan K. Attributable factors for the rising Caesareans delivery rate over 3 decades: an observational cohort study. *Am J Obstet Gynecol MFM*. 2022;4(2):100555. doi:10.1016/j.ajogmf.2021.100555
3. Sayed G, Salama H, Abumhara S, Al-Obaidly S, Al-Qubaisi M, Al-Rifai H. Review of socioeconomic risk factors for Caesareans births: a population-based study. *Acta Biomed*. 2023;94(3):e2023082. doi:10.23750/abm.v94i3.14825
4. Pavlidou E, Antasouras G, Papadopoulou SK, Alexatou O, Papandreou D, Mentzelou M, et al. Association of maternal risk factors with the prevalence of caesarean section deliveries: a cross-sectional study. *Med Sci*. 2023;11(4):66. doi:10.3390/medsci11040066
5. Brizan JB, Amabebe E. Maternal obesity as a risk factor for caesarean delivery in sub-Saharan Africa: a systematic review. *Life (Basel)*. 2022;12(6):906. doi:10.3390/life12060906
6. Tun MH, Chari R, Kaul P, Mamede FV, Paulden M, Lefebvre DL, et al. Prediction of odds for emergency Caesarean: a secondary analysis of the CHILd term birth cohort study. *PLoS One*. 2022;17(10):e0268229. doi:10.1371/journal.pone.0268229
7. Alonso-Colón M, Pérez-Gómez B, Ramis R. Determinants of Caesarean rates: A cross-sectional study of 4.9 million deliveries over 10 years. *Eur J Obstet Gynecol Reprod Biol*. 2025;312:114527. doi:10.1016/j.ejogrb.2025.114527

8. Giang HT, Duy DT, Hieu LT, Vuong NL, Ngoc NT, Phuong MT, et al. Factors associated with the very high caesarean section rate in urban areas of Vietnam. *PLoS One*. 2022;17(8):e0273127. doi:10.1371/journal.pone.0273127
9. Amjad A, Imran A, Shahram N, Zakar R, Usman A, Zakar MZ, et al. Trends of caesarean section deliveries in Pakistan: secondary data analysis from Demographic and Health Surveys, 1990–2018. *BMC Pregnancy Childbirth*. 2020;20:753. doi:10.1186/s12884-020-03355-8
10. Shifa N, Bari A, Bukhari NA, Hayat Z, Jabeen R, Tabassum H. Identify Modifiable factors and their individual contribution to caesarean delivery. *J Soc Obstet Gynaecol Pak*. 2024;14(2):244-8.
11. Haider G, Zehra N, Munir AA, Haider A. Frequency and indications of caesarean section in a tertiary care hospital. *Pak J Med Sci*. 2009;25(5):791-6.
12. Zeeshan M, Iqbal A, Rasul S, Shahzad I, Ashraf S, Akbar A. Prevalence and associated factors of caesarean section in Punjab. *Pak J Med Res*. 2021;60(2):62-8.
13. Majid E, Kulsoom S, Fatima S, Zuberi BF. Rising caesarean section rates using Robson classification: A tertiary care study. *Pak J Med Sci*. 2022;38(7):2021-26. doi:10.12669/pjms.38.7.2021
14. Gyaase D, Enuameh YA, Adjei BN, Mensah KB, Adu-Gyamfi R, Owusu-Agyei S, et al. Determinants of caesarean section among women in Ghana. *BMC Pregnancy Childbirth*. 2023;23:286. doi:10.1186/s12884-023-05586-5
15. Muhammad T, Srivastava S, Kumar P, Singh SK, Singh A, Parasuraman S, et al. Socioeconomic and demographic predictors of caesarean section in Bangladesh. *BMC Pregnancy Childbirth*. 2022;22:512. doi:10.1186/s12884-022-04883-7
16. Lubrano C, Locati F, Parisi F, Giannini D, Risi R, Vassallo C, et al. Gestational weight gain and pre-pregnancy BMI in relation to obstetric outcomes. *Nutrients*. 2025;17(4):736. doi:10.3390/nu17040736
17. Ramos SZ, Lewkowitz AK, Lord MG, Friedman AM, Ananth CV, Gyamfi-Bannerman C, et al. Predicting Caesareans delivery in high-risk pregnancies: Clinical implications. *Am J Obstet Gynecol*. 2023;229(5):549.e1-549.e8. doi:10.1016/j.ajog.2023.06.032
18. Wang R, Liang X, Su XY. Maternal risk factors and obstetric outcomes: A clinical review. *World J Psychiatry*. 2024;14(10):1448-58. doi:10.5498/wjp.v14.i10.1448
19. Nedberg IH, Lazzerini M, Mariani I, Ekerhovd E, Skalkidou A, Essén B, et al. Maternal risk factors and trends in Caesareans delivery: A population-based study. *PLoS Med*. 2021;18(11):e1003764. doi:10.1371/journal.pmed.1003764
20. Dhakal-Rai S, van Teijlingen E, Regmi P, Bhandari N, Simkhada P, Raja EA, et al. Caesarean section trends and determinants in South Asia: A systematic review. *Asian J Med Sci*. 2022;13(3):143-74.
21. Qureshi FU, Sohail S, Jabeen S, Ahmed R, Khan MA, Ali S, et al. Patterns and determinants of caesarean section in a tertiary care hospital. *J Rawalpindi Med Coll*. 2025;29(1):2-7.
22. Alipour A, Hantoushzadeh S, Hessami K, Shafaghi A, Ghaffari S, Jamali S, et al. Socioeconomic inequalities and Caesarean rates. *BMC Pregnancy Childbirth*. 2022;22:821. doi:10.1186/s12884-022-05168-9
23. Islam N, Thalib L, Mahmood S, Al-Hadithi T, Al-Dabbagh B, Hussain S, et al. Risk factors associated with surgical outcomes in obstetrics: A meta-analysis. *Intensive Crit Care Nurs*. 2025;89:103951. doi:10.1016/j.iccn.2024.103951
24. Grisbrook MA, Dewey D, Cuthbert C, Letourneau N, McDonald S, Tough S, et al. Psychological outcomes following Caesareans delivery. *Int J Environ Res Public Health*. 2022;19(9):4900. doi:10.3390/ijerph19094900