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EXPLORING THE INTERPLAY OF CESAREAN SECTION RATES, RISK FACTORS, AND CT PELVIMETRY IN THE THIRD TRIMESTER OF PREGNANCY A STUDY AT KHYBER TEACHING HOSPITAL PESHAWAR PAKISTAN

Original Research

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ABSTRACT

Background: Childbirth is a complex physiological process that may be complicated by cephalopelvic disproportion and other maternal or fetal factors, leading to cesarean section (CS). Obstetric pelvimetry, including CT-based assessments, plays a crucial role in evaluating pelvic capacity and predicting delivery outcomes. Rising CS rates globally and regionally necessitate better understanding of demographic, socioeconomic, and anatomical factors influencing delivery choices, particularly in resource-limited settings.

Objective: The study aimed to evaluate demographic, socioeconomic, and pelvic characteristics associated with cesarean section deliveries using CT pelvimetry among women in Peshawar, Pakistan.

Methods: This cross-sectional study was conducted in the Radiology Department of Khyber Teaching Hospital, Peshawar, from January 1, 2021, to December 31, 2022. A total of 71 women aged 17–40 years who underwent CT pelvimetry before delivery and delivered through CS were included. Women with significant comorbidities or deformities were excluded. Data were collected through structured questionnaires covering maternal age, height, weight, nutritional status, educational and professional background, socioeconomic status, husband's occupation, obstetric history, and CT pelvimetry parameters. Fetal characteristics such as presentation and number of fetuses were also recorded. Data were analyzed using SPSS version 25, with results expressed as frequencies and percentages.

Results: Among the 71 patients, 77.4% were between 21–30 years, 18.3% were under 20 years, and 4.2% were above 30 years. A majority (71.8%) had below-average height, while 84.5% had average weight. Only 21.9% were educated, and 78.1% were uneducated. Most belonged to middle-class families (80%), 74.6% had husbands working as laborers, and 94.3% were housewives. More than half (53.3%) had undergone previous CS. Indications included cephalopelvic disproportion (69%), fetal distress (22%), and cord around the neck (7%). Fetal presentations were predominantly cephalic (94.3%), with 98.6% singleton pregnancies. CT pelvimetry revealed abnormalities in outlet anteroposterior diameter in 97%, mid-cavity anteroposterior diameter in 60%, greater transverse diameter in 57%, and interspinous diameter in 54%. Urban women accounted for 76% of CS deliveries compared to 23.9% from rural areas.

Conclusion: The study highlighted that demographic, socioeconomic, and pelvic parameters significantly influence CS deliveries, with cephalopelvic disproportion being the leading indication. Strengthening maternal education, addressing healthcare disparities, and using CT pelvimetry as a predictive tool may help reduce unnecessary surgical interventions and improve obstetric outcomes.

Keywords: Cesarean Section, CT Pelvimetry, Demographic Factors, Obstetric Outcomes, Pregnancy, Risk Factors, Socioeconomic Status.

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INTRODUCTION

Childbirth is one of the most critical events in a woman's life, but it can be complicated by cephalo-pelvic disproportion, a condition in which the fetal head and maternal pelvic dimensions are mismatched, thereby influencing the route and safety of delivery (1). Accurate assessment of pelvic capacity is therefore central to obstetric practice. Pelvimetry, the measurement of pelvic dimensions, has historically been conducted through clinical examination, conventional radiography, computerized tomography (CT), or magnetic resonance imaging (MRI), each with varying degrees of precision, accessibility, and safety (2,3). Clinical pelvimetry, performed manually, provides useful information but often fails to account for the mixed anatomical variations encountered in practice, limiting its reliability for decision-making (4). The true pelvis plays a pivotal role in labor and delivery, and its classification into anthropoid, platypelloid, gynecoid, and android types has long informed obstetric predictions. Yet, such categorical classification is frequently inadequate because most women present with overlapping features rather than neatly defined pelvic types (2,4). Radiographic techniques emerged more than half a century ago to refine this assessment, with X-ray pelvimetry initially establishing baseline thresholds for safe vaginal delivery. However, X-rays carry limitations, including poor resolution and the inability to capture soft tissue involvement, while also exposing both mother and fetus to ionizing radiation (5). Modern imaging modalities have sought to overcome these challenges. CT pelvimetry delivers accurate bony measurements with a relatively lower radiation dose compared to abdominal CT scans and requires minimal patient preparation (6).

MRI, in contrast, has become the gold standard where available, offering excellent visualization of both bone and soft tissue structures without ionizing radiation, making it safer for both mother and fetus (5,7). Despite these advantages, MRI remains costly and inaccessible in many healthcare settings, restricting its universal adoption. Thus, the choice of technique often depends on institutional resources, clinical indication, and maternal-fetal safety considerations. In parallel with developments in pelvimetry, there has been a sharp rise in cesarean section (CS) rates worldwide, raising concerns about medical necessity versus elective preference. While CS remains a life-saving intervention when medically indicated, its increasing use without clear clinical justification poses significant challenges (8-10). Since 1990, cesarean deliveries have risen across nearly all regions, with the most dramatic increases observed in Eastern and Western Asia as well as Northern Africa. By 2030, global CS rates are projected to reach 28.5%, ranging from just over 7% in Sub-Saharan Africa to more than 60% in East Asia (11,12). Many women now request CS for non-medical reasons, including convenience, avoidance of labor pain, or cultural influences that normalize surgical birth, despite the associated maternal and neonatal risks. Addressing this issue requires a balanced approach that integrates accurate obstetric assessment, including reliable pelvimetry, with evidence-based decision-making and patient education. Understanding the true role and limitations of pelvimetry in predicting delivery outcomes is critical in guiding safe obstetric care and in reducing unnecessary surgical interventions. Therefore, this study aims to evaluate the role of pelvimetry—across its various modalities—in determining the mode of delivery, and to explore its relevance in the context of rising cesarean section rates, thereby contributing to strategies for rational and safe obstetric practice.

METHODS

The study was designed as a cross-sectional investigation conducted in the Radiology Department of Khyber Teaching Hospital (KTH), Peshawar, Pakistan, which serves as a primary teaching affiliate of Khyber Medical College and is one of the country's largest tertiary-care hospitals. Data were collected over a two-year period, from January 1, 2021, to December 31, 2022. The study population consisted of pregnant women between 17 and 40 years of age who underwent computed tomography (CT) pelvimetry before delivery. Women with known comorbidities, such as chronic medical illnesses or significant pelvic deformities, were excluded to minimize confounding factors. The final sample comprised 71 women who subsequently delivered through cesarean section following CT pelvimetry. A structured data collection sheet and questionnaire were used to record demographic and clinical information. Variables included maternal age, height, weight, nutritional status, educational level, professional status, socioeconomic background, and husband's occupation. Clinical history was also obtained regarding parity, number of pregnancies, previous deliveries, and history of cesarean section. Presence of diabetes mellitus, hypertension, or other relevant comorbidities was documented. Obstetric parameters such as fetal presentation, number of fetuses, and the CT pelvimetry measurements were recorded. It was noted that Khyber Teaching Hospital lacked a pelvic coil for magnetic resonance (MR) pelvimetry, and CT pelvimetry was therefore employed as the preferred alternative imaging modality in

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this setting. Data analysis was performed using the Statistical Package for the Social Sciences (SPSS, version 25). Descriptive statistics were generated to summarize demographic and clinical characteristics, while continuous variables were presented as means and standard deviations, and categorical variables as frequencies and percentages. Where appropriate, inferential statistics, including chi-square tests, were applied to examine associations between selected variables. Ethical approval was obtained from the institutional review and ethics committee of Khyber Teaching Hospital prior to commencement of data collection. Administrative permissions were secured from the departments of Radiology and Gynecology. Written informed consent was obtained from all participants after the study objectives and procedures were explained in detail. Participation was voluntary, and those who declined were excluded. Confidentiality and anonymity of participant data were ensured throughout the research process.

RESULTS

The study analyzed 71 pregnant women who underwent cesarean section following CT pelvimetry. The age distribution revealed that 18.3% of cesarean deliveries occurred in women under 20 years, 77.4% between 21 and 30 years, and only 4.2% in those older than 30 years. Maternal anthropometry demonstrated that 71.8% of women had a height below the average of 5 feet 2 inches, while only 2.8% exceeded this threshold. With respect to weight, 84.5% of women undergoing cesarean section fell within the average range of 53.8 kg, while 15.5% were underweight and no cases of overweight were reported. Socio-demographic analysis showed that 78.1% of cesarean sections were performed on uneducated women, compared with 21.9% among educated women. Regarding socioeconomic background, 80% belonged to the middle class, 19.7% to the lower class, and none to the upper class. Nutritional status was classified as good in 76% of women, poor in 19.7%, and better in only 4.2%. Professional distribution indicated that 94.3% of cesarean sections were among housewives, while 5.6% occurred in employed women. Analysis of the husband's occupation revealed that 74.6% of cesarean cases involved laborers, whereas 25.3% were from educated or professional backgrounds. Obstetric history demonstrated that 53.3% of women undergoing cesarean section had a previous cesarean delivery, while 46.4% had previously delivered vaginally. The main indications for cesarean section were cephalopelvic disproportion (69%), fetal distress (22%), and cord around the neck (7%). Fetal presentation showed that 94.3% of cases were cephalic, 4.2% breech, and 1.4% transverse. Nearly all cases involved single fetuses (98.6%), with only 1.4% having twin gestation. In terms of gravidity, 46.4% were first pregnancies, 43% second, 8.4% third, and 1.4% higher-order pregnancies. Only one patient (1.4%) had diabetes mellitus, while no cases of hypertension or pelvic deformities were reported.

CT pelvimetry findings revealed a high frequency of abnormal pelvic measurements. Abnormalities were most prevalent in the outlet anteroposterior diameter, which was reduced in 97% of cases, followed by mid-cavity anteroposterior diameter (60%), greater transverse diameter (57%), and interspinous diameter (54%). The true conjugate anteroposterior dimension was abnormal in 35% of women. Geographical distribution showed that 76% of cesarean sections were among women from urban areas, compared with 23.9% from rural areas. Statistical testing of categorical predictors demonstrated significant differences in the distribution of cesarean section patients across demographic and socioeconomic variables. Age showed a highly significant skew towards women between 21–30 years (χ^2=64.3, $p<0.001$), while educational status revealed that uneducated women were disproportionately represented (χ^2=23.7, $p<0.001$). Socioeconomic class was also strongly associated, with most cesarean sections occurring among middle-class women (χ^2=74.6, $p<0.001$). Nutritional status showed similar trends, as women with "good" nutrition accounted for the majority (χ^2=60.9, $p<0.001$). Husband's profession was significantly linked, with a predominance of laborers' wives undergoing cesarean section (χ^2=17.3, $p<0.001$). Professional status was also unevenly distributed, with housewives comprising the overwhelming majority (χ^2=55.9, $p<0.001$). These results indicate that socio-demographic and nutritional factors demonstrated significant associations with cesarean deliveries in this cohort.

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Table 1: Maternal Age, Height, and Weight Distribution among Cesarean Section Patients

Age	**Under 20 Y**	**21 to 30 Y**	**Over 30 Y**
	13 pt.	55 pt.	3 pt.
	18.3 %	77.4 %	4.2 %
Height	Less than normal height	Normal height 5 feet 3 inches to 5 feet 5 inches	Over then normal height
	51 pt.	18 pt.	2 pt.
	71.83 %	25.3 %	2.81 % %
Weight	Under weight	Normal average weight 53.81 kg	Over weight
	11 pt.	60 pt.	Nil
	15.5 %	84.5 %	0 %

Table 2: Socioeconomic, Nutritional, and Professional Characteristics of Cesarean Section Patients

	No. of c/ section	**Percentage**	**Total Percentage**
Educated	15 pt.	21.9 %	
Un-educated	56 pt.	78.1 %	
Economics status	Upper class	Middle class	Lower class
	0 pt.	57 pt.	14 pt.
	0 %	80 %	19.7 %
Nutrition	Better	Good	Poor
	3 pt.	54 pt.	14 pt.
	4.2 %	76 %	19. 7 %
Husband Profession	Laborers	Educated	
	53 pt.	18 pt.	
	74.6 %	25.3 %	
Professional status	House wife	Job	
	67 pt.	4 pt.	
	94.3 %	5.6 %	

Table 3: Obstetric History, Clinical Indications, and Fetal Characteristics among Cesarean Section Patients

Total c-Sections 71			
Previous mode of delivery	c/section	Normal	
	38 pt	33 pt	
	53.3 %	46.4%	
Indications	Cord around neck	Fetal distress	CPD
	5 pt	16 pt	49 pt

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Total c-Sections 71				
	7 %	22 %	69 %	
Presentation of fetuses	Cephalic	Breech	Transverse	
	67 pt	3 pt	1 pt	
	94.3 %	4.2 %	1.4 %	
No. of fetus	Single	Twins	More than two	
	70 pt	1 pt	Nil	
	(98.6%)	(1.4%)		
No. of pregnancy	1st pregnancy	2nd pregnancy	3rd pregnancy	More than it
	33 pt	31 pt	6 pt	1 pt
	46.4 %	43 %	8.4 %	1.4 %
Diabetics	1 pt			
	1.4 %			
Hypertension	0			
Deformities	0			

Table 4: CT Pelvimetry Measurements and Abnormal Pelvic Dimensions among Cesarean Section Patients

Ranges of CT-Pelvimetry				
Ct pelvimetry ranges	Normal Ranges	No of normal Ranges of pt	No of Abnormal ranges of pt.	Percentage of abnormal pt.
True Conjugate (A.P)	>11.0 cm	46 pt	25 pt	35 %
Mid-cavity A.P Diameter	>12.0 cm	28 pt	43 pt	60 %
Outlet-A. P diameter	>13.0 cm	2 pt	69 pt	97 %
Greater Transverse Diameter	>12.0 cm	30 pt	41 pt	57 %
Interspinous Diameter	>10.0 cm	32 pt	39	54 %

Table 5: Geographic Distribution of Cesarean Section Deliveries among Urban and Rural Women

No of Total C-section in urban/city women's	**54 pt**	**Percentage**	**76.0 %**
No of Total C-section in rural women's	17 pt	percentage	23.9 %

Table 6: Statistical Associations of Demographic and Socioeconomic Factors with Cesarean Deliveries

Variable	**Chi-Square (χ^2)**	**p-value**	**Significance**
Age	64.34	<0.001	Significant
Education	23.68	<0.001	Significant
Socioeconomic Class	74.56	<0.001	Significant

Variable	Chi-Square (χ^2)	p-value	Significance
Nutrition	60.87	<0.001	Significant
Husband Profession	17.25	<0.001	Significant
Professional Status	55.90	<0.001	Significant

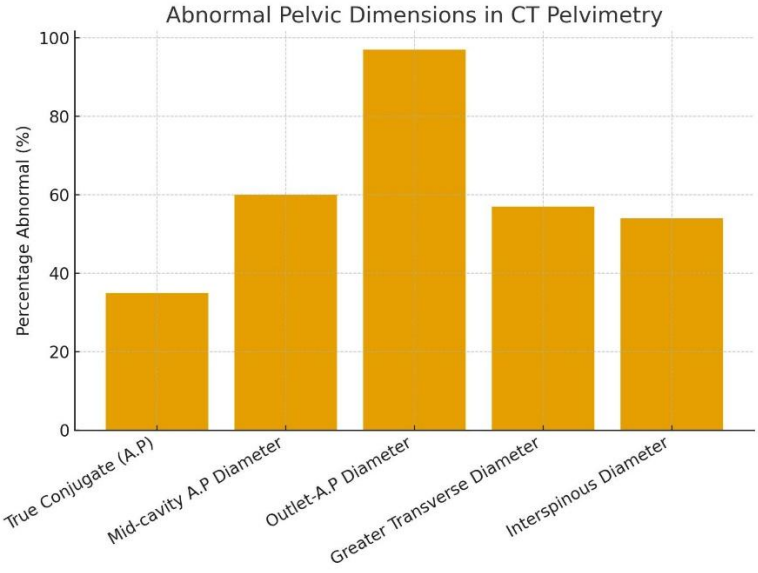

Figure 2 Abnormal Pelvic Dimensions in CT Pelvimetry

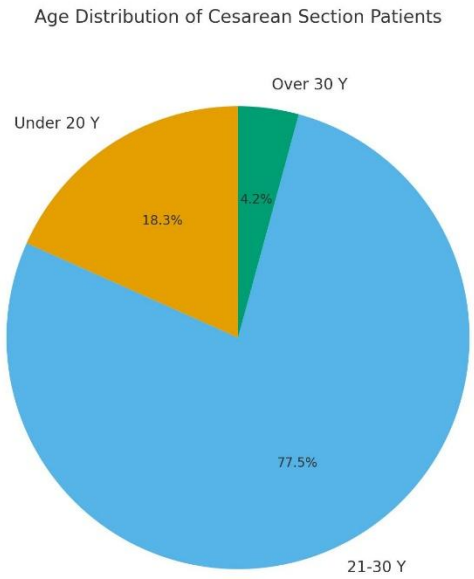

Figure 2 Age Distribution of Cesarean Section Patients

DISCUSSION

The present study assessed the association between demographic, anthropometric, and pelvic characteristics with cesarean section deliveries, providing insights into the multifactorial determinants of surgical birth. The findings indicated that maternal age had a significant effect, with the highest proportion of cesarean sections occurring among women aged 21 to 30 years. These results are in agreement with previous reports highlighting that, younger mothers, particularly those under 20 years, often experience lower rates of cesarean sections, while women in their twenties are more likely to require surgical intervention due to obstetric complexities and evolving clinical practices (11). Maternal height was also shown to be a relevant factor, as more than two-thirds of the women were shorter than the regional average, a feature often associated with cephalopelvic disproportion. This observation supports prior literature that links shorter stature with mechanical limitations of the pelvic canal and an increased risk of cesarean section (12,13). Interestingly, maternal weight in this cohort did not appear to play a strong role, as no overweight women were included and the majority had average weight. This absence of overweight participants may represent a limitation in capturing the impact of maternal obesity, which is widely reported as a risk factor for surgical delivery. Socio-demographic determinants also demonstrated important trends (14). Cesarean sections were more common among uneducated women, accounting for nearly four-fifths of cases. Lower educational attainment has consistently been associated with limited access to antenatal education and healthcare literacy, which may indirectly influence delivery outcomes. Similarly, middle-class households represented the majority of surgical births, suggesting that access to hospital-based services in this socioeconomic group increases the likelihood of operative delivery (15,16). At the same time, women from lower socioeconomic groups faced relatively fewer procedures, possibly due to barriers in healthcare accessibility. The predominance of housewives and the high proportion of women married to laborers emphasized the relationship between occupational and economic status with delivery practices, reflecting a broader influence of social determinants on obstetric outcomes.

The clinical indications for cesarean delivery further underscored the central role of cephalopelvic disproportion, which accounted for the majority of interventions. This finding aligns with established knowledge that disproportion between fetal head size and pelvic

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dimensions is one of the strongest drivers of surgical birth (17,18). Fetal distress emerged as the second most common indication, highlighting its importance as a clinical trigger for surgical intervention due to risks of fetal hypoxia and adverse perinatal outcomes. Cord entanglement accounted for a smaller proportion of cases, reflecting its sporadic but clinically significant role in emergency cesarean sections. Pelvimetry findings provided critical anatomical correlates to these outcomes. Abnormalities in pelvic dimensions, particularly the outlet anteroposterior diameter, were striking, with almost all patients demonstrating measurements below standard thresholds. The mid-cavity anteroposterior diameter also showed a high abnormality rate, supporting its established role as a determinant of obstructed labor. These findings suggest that CT pelvimetry remains a useful tool in identifying women at risk of cephalopelvic disproportion and obstructed labor, even though MRI is considered superior where available (19-21). The data reinforce the significance of objective imaging in guiding obstetric decisions, particularly in resource-limited settings where clinical judgment alone may not be sufficient. Geographical differences were also notable, with urban women demonstrating a significantly higher proportion of cesarean sections compared with rural counterparts. This disparity may reflect both increased access to healthcare facilities and cultural practices that favor surgical delivery in urban settings, as well as the persistence of traditional practices and reduced healthcare accessibility in rural populations. Such observations emphasize the importance of targeted interventions to address healthcare inequities between urban and rural communities.

The strengths of this study lie in its comprehensive assessment of demographic, socioeconomic, and pelvimetric factors, as well as the integration of radiological measurements with obstetric outcomes. However, certain limitations must be acknowledged. The study design included only women who ultimately underwent cesarean section, thereby excluding those who delivered vaginally. This limits the ability to compare predictors across delivery modes and restricts the generalizability of the findings. Furthermore, the absence of overweight participants reduces the ability to assess the role of maternal obesity. Another limitation was the lack of regression modeling or multivariate analysis, which could have identified independent predictors while controlling for confounding variables. Maternal and neonatal outcomes were also not assessed, which limits the clinical relevance of pelvimetric abnormalities to actual delivery safety. Future studies should incorporate a larger and more diverse population including vaginal delivery cases to enable a direct comparison of predictive factors (20,22). The inclusion of maternal comorbidities such as obesity, diabetes, and hypertension would provide further clarity on the interplay between health status and delivery outcomes. Advanced statistical modeling, including logistic regression, should be applied to identify independent predictors of cesarean section. Prospective multicenter studies could enhance generalizability and help establish standardized pelvimetric thresholds that guide evidence-based obstetric practice. In summary, the findings highlight the combined influence of demographic, socioeconomic, and pelvic factors on cesarean delivery rates. They emphasize the importance of addressing educational and socioeconomic disparities, improving antenatal care, and employing objective imaging modalities in obstetric assessment. While CT pelvimetry offers valuable information in resource-limited settings, broader clinical strategies are needed to reduce unnecessary cesarean sections while ensuring safe maternal and neonatal outcomes.

CONCLUSION

This study concluded that demographic characteristics, socioeconomic conditions, and pelvic factors collectively influence the likelihood of cesarean section deliveries. The findings emphasize the need for targeted maternal care, particularly for women who are younger or have limited educational backgrounds, as well as the importance of health education initiatives that highlight the risks and benefits of surgical delivery. By strengthening awareness, ensuring equitable access to quality antenatal services, and addressing disparities in healthcare utilization, unnecessary surgical interventions may be reduced. These insights contribute to a broader understanding of the determinants of cesarean section and underscore the importance of evidence-based strategies to promote safe and appropriate childbirth practices.

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AUTHOR CONTRIBUTION

Author	Contribution
Hanif Ullah Rabbani	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Mahasin Hassan*	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Sahar Fahim*	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published

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