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Comparative Analysis of Maternal Morbidity Following Cesarean Section versus Vaginal Delivery: A Prospective Cohort Study

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Abstract: The purpose of this study was to contrast the maternal morbidity outcome in relation to a Cesarean section (CS) and vaginal delivery (VD) in a group of women to gain a better insight into the delivery mode implications on maternal health. Information about demographic factors, clinical measures, delivery indicators, maternal morbidity, postpartum complications in particular, the duration of the hospital stay, and the readmission rates were gathered. A statistical test was conducted through statistical software [SPSS], and tests such as chi-square and t-tests were applied to determine differences between groups. **Findings**: with 128 participants, 64 who received CS, and 64 who delivered vaginally, where The research conducted established that the total maternal mortality was much more advanced in the CS cohort (39.1) than in the VD cohort (15.6) (p=0.003). Certain complications, such as postpartum bleeding (18.8 vs. 3.1) and wound infection (9.4 vs. 1.6), also proved to be significantly different in the two groups. In addition, the CS group had a mean hospital stay of 4.5 days with a standard deviation of 1.2 that was much higher than the VD group (2.7 days with a standard deviation of 0.9), with the p-value of less than 0.001 considered as significant. The CS group (12.5) had a significantly higher readmission rate within 30 days after delivery than the VD group (3.1), with a significant p-value of 0.025. **Conclusion**: The results suggest that Cesarean birth is linked with a greater morbidity among the mothers and extended hospitalization among the mothers than vaginal birth. This paper highlights the significance of the consideration of the mode of delivery in the process of clinical decision-making and the necessity of debates of the risks of Cesarean section. More studies are also needed to determine the long-term consequences of such results.

Keywords: Cesarean section (cs) and vaginal delivery (vd), hospital stay, readmission, delivery, birth.

INTRODUCTION

Childbirth is one of the turning point moments in the life of a woman, which has an impact on the short-term recovery of the woman and the health trajectories in the future and well-being in general [Ethiopian CSA, 2014]. In the past several decades, the rate of cesarean section (CS) in the world has been on a steep increase. It has sparked a never-ending debate on the balance between the life-saving nature of the procedure and the associated maternal morbidity [World Health Organization, 2014]. Despite the fact that CS can be clinically indispensable in the process of preventing fetal or maternal complications, there are consequences to its application. A prospective cohort study comparing the maternal morbidity after CS and after vaginal delivery (VD) will be used to clarify the various burdens of postoperative and postpartum complications, the recovery process, and long-term outcomes of health implications on women. The rationale, purposes, and importance of such a study are outlined in this introductory section, thus providing a basis on which rigorous and evidence-based comparisons can be drawn and used to inform clinical decision-making, health policy, and patient counselling [World Health Organization, 2009].

To begin with, the definition of the scope of maternal morbidity is necessary. Maternal morbidity refers to the continuum of poor health which occurs in pregnancy, labor, and postpartum. The common short-term morbidities are surgical site infection, endometritis, urinary tract infection, postpartum bleeding, thromboembolic event, anaemia, and pain that requires a long-term analgesic. Sequelae might be long-term, with placental abnormalities being reported in subsequent pregnancies, pelvic floor dysfunction, sexual health problems, and chronic pain. The analysis of a wide range of morbidities [Hannah, M. E. *et al*., 2000; WHO, H. 2015; Kolås, T. *et al*., 2006; Larsson, C. *et al*., 2011] will enable the research to distinguish between acute postoperative hazards and developing or ongoing health complications.

The argument that underlies the juxtaposition between CS and VD is based on the clinical necessity and the consideration of public health. CS is a life-saving procedure, which is justified by maternal or fetal compromise in situations of placenta previa, malpresentation, umbilical cord prolapse, or previous uterine surgery that would not allow a vaginal delivery [Mann, S. *et al*., 2006; Matthews, T. G. *et al*., 2003; Zanardo, V. *et al*., 2004]. However, non-urgent and elective CS can also put women at risk that is neither present nor significantly higher in the aftermath of VD.

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Wound infection, dehiscence, haematoma, and urinary tract infections, as well as extended analgesic medication and delayed mobilisation, are the short-term complications that occur more commonly after CS. Anaemia resulting due to blood loss is usually more severe post CS due to increased intraoperative loss as opposed to simple VD [Livingston, E. G. *et al*., 2010]. Concerning long-term consequences, there is evidence of potential links between CS and future placental disorders, if the subsequent pregnancies have a higher risk of uterine rupture and pelvic floor dysfunction, but the results of the studies differ by population and study design. A prospective cohort study allows proper timing sequencing, and it can also control confounding factors like maternal age, body mass index (BMI), parity, preexisting comorbidities, pregnancy complications, fetal signs of cesarean section, and urgency of birth [Hulton, L. *et al*., 2000].

One of the major methodological objectives of the study is to reduce bias and confounding to produce sound comparative estimates. The correct classification of deliveries into CS (elective or emergency) or VD and stratification of CS by indication when possible is required in a prospective cohort [Longo, V. L. *et al*., 2023]. Such indirect effects of indication as the risk of infection or chorioamnionitis connected with the extended course of labor must be separated by means of meticulous data collection and statistical correction. Propensity-score methods may be used to match observed baseline between groups, and multivariable regression may be used to control residual confounding. Primary and secondary outcomes should also be determined beforehand in the study to avoid selective reporting. The major outcomes can include postpartum haemorrhage, wound or endometritis infection, urinary tract infection, need of blood transfusion, readmission, and hospital stay. Secondary outcomes can be postpartum pain scores, analgesic needs, postpartum ambulation, initiation and exclusivity of breastfeeding, postpartum recovery of daily activities, and patient-reported quality of life [Dencker, A. *et al*., 2019; Słabuszewska-Jóźwiak, A. *et al*., 2020; Karoni, H. F. *et al*., 2020; Gomaa, K., *et al*., 2021]. Also, the ethical aspects of any comparative study concerning obstetric populations are part of the study. Due to the vulnerable group and possible unpredictable complications, effective safety monitoring and established criteria of the clinical action are necessary in addition to the research, which needs to be based on the regional and international guidelines of conducting maternal-fetal research and be supervised by an ethics committee. The data collection instruments have to be validated and culturally competent. Translation processes need to be detailed in case the study involves a multilingual environment [Al-Husban, N. *et al*., 2021].

Placing the study in the available literature will help to interpret the results and determine the assessment of generalisability. Systematic reviews and meta-analyses have continuously indicated an increase in maternal morbidity rates after CS in comparison with VD, especially with respect to infectious, thromboembolic, and gynecological morbidity [Blomquist, J. L. *et al*., 2018]. Nonetheless, the direct comparison is complicated by heterogeneity of the studies in terms of study design, morbidity definition, and length of follow-up. A carefully designed prospective cohort study with a standardised definition, and strict follow-up and stratification by type of delivery and urgency, is bound to bring high-quality evidence into the discussion. In addition, practical data based on vast populations can shed light on the role of sociodemographic characteristics, the variables of the health system, and the practices of obstetrics in shaping morbidity trends so that the opportunities to plan risk communication and resource provision can be personalized [Kiwan, R., & Al Qahtani, N. 2018; Zweifler, J. *et al*., 2006; Mirteymouri, M. *et al*., 2016].

The possible consequences of the research are far-reaching. To clinicians, defining the morbidities that are most closely correlated with CS can support preoperative counselling, prophylactic (e.g., antibiotic regimens, thromboprophylaxis), and postoperative care processes to accelerate the recovery. In the case of patients, accessible data on comparative risks encourages mutual decision-making when it comes to planning delivery, where obstetric factors allow either CS or vaginal delivery following a cesarean section or attempt at labouring. In the case of health systems, the knowledge of the morbidity burden would help them in allocating resources, e.g., through monitoring protocols after the operation, infection prevention programmes, and strategies to reduce readmission. Lastly, to researchers, the study could help to determine knowledge gaps, come up with hypothesis to help understand how a mode of delivery is associated with morbidity, and prompt other research to take up interventions to alleviate the risk.

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Material and Method

The study is a prospective cohort study conducted in Baghdad Hospital between 2023 and 2024 as well as in our study was The aim was to evaluate the maternal morbidity outcomes between cesarean section (CS) and vaginal delivery (VD) in a group of women.

One hundred and eighty-eight (128) women were recruited, including 64 who had a CS section and 64 who gave birth in the vaginal section. Inclusion criteria were as follows: 18 years and above, gave birth in the study period at the selected facility, and can give informed consent. The exclusion criteria included the presence of multiple gestations, intense medical comorbidities such as advanced cardiovascular disease, and the refusal to take part in the study.

The power analysis involved the a priori determination of the sample size (128 participants), which ensured that the study had sufficient power to identify a significant difference in the rate of maternal morbidity between the two modes of delivery.

A structured questionnaire was used to collect the data based on a detailed review of the medical records, which gave a vast amount of information regarding demographic and clinical features. The variables to be collected included demographic (age, BMI, race/ethnicity, educational attainment, and socioeconomic status) and clinical variables (delivery mode, reasons why the delivery was necessary, e.g., fetal distress, maternal request, or malpresentation, and pre-existing medical conditions: hypertension, diabetes, and obesity).

Primary outcomes were maternal morbidity, which was any adverse health outcome of the mother that occurred after childbirth. The complications that were monitored were postpartum hemorrhage, wound infection, endometritis, perineal trauma, and venous thromboembolism. Secondary outcomes included length of hospital stay, 30-day readmission rates, pain management (type of analgesics given in and after delivery), and patient-reported pain scores, which were measured using the Visual Analog Scale (VAS). The standardized questionnaires considered maternal satisfaction and quality of life.

Analyses of data were done with the help of SPSS. The calculation of descriptive statistics of demographic and outcome variables was performed. Categorical variables were given in the form of counts and percentages whereas, whereas continuous variables were given in the form of mean, standard deviation (SD), or median with interquartile range (IQR) as were necessary. Comparative analyses used the chi-square tests in the case of categorical results, and Student t-test or Mann-Whitney U tests in the case of continuous data, depending on the data distribution. The p-value of less than 0.05 was viewed as statistically significant in the measurement of the difference in the morbidity of the maternal and other outcomes in different methods of delivery.

RESULTS

Table 1: Assessment Demographics and Baseline Characteristics of Patients Undergoing Cesarean Section versus Vaginal Delivery

Characteristic	CS Group (n=64)	VD Group (n=64)	Total (n=128)
Age (mean ± SD)	30.5 ± 4.2	29.8 ± 3.9	30.1 ± 4.1
BMI (mean ± SD)	28.0 ± 5.1	26.7 ± 4.6	27.4 ± 4.9
Parity			
- Nulliparous (0)	29 (45.3%)	35 (54.7%)	64 (50.0%)
- Multiparous (≥1)	35 (54.7%)	29 (45.3%)	64 (50.0%)
Education Level			
- High School	10 (15.6%)	12 (18.8%)	22 (17.2%)
- Some College	25 (39.1%)	18 (28.1%)	43 (33.6%)
- Bachelor's Degree	18 (28.1%)	24 (37.5%)	42 (32.8%)
- Graduate Degree	11 (17.2%)	10 (15.6%)	21 (16.4%)
Socioeconomic Status			
- Private Insurance	42 (65.6%)	39 (60.9%)	81 (63.3%)
- Public Insurance	22 (34.4%)	25 (39.1%)	47 (36.7%)
Pre-existing Conditions			
- Hypertension	10 (15.6%)	5 (7.8%)	15 (11.7%)

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- Diabetes	2 (3.1%)	3 (4.7%)	5 (3.9%)
- Thyroid Disorder	3 (4.7%)	2 (3.1%)	5 (3.9%)
- Asthma	5 (7.8%)	3 (4.7%)	8 (6.3%)
- Obesity (BMI ≥30)	20 (31.3%)	15 (23.4%)	35 (27.3%)
Smoking Status			
- Current Smoker	5 (7.8%)	2 (3.1%)	7 (5.5%)
- Former Smoker	10 (15.6%)	5 (7.8%)	15 (11.7%)
- Never Smoked	49 (76.6%)	57 (89.1%)	106 (82.8%)
Prior Cesarean Section	25 (39.1%)	0 (0%)	25 (19.5%)

Table 2: Mode of Delivery and Indications for Cesarean Section in a Cohort of Iraqi Patients for 128

Delivery Type	**CS Group (n=64)**	**VD Group (n=64)**	**Total (n=128)**
Cesarean Section	64 (100%)	0 (0%)	64 (50.0%)
Vaginal Delivery	0 (0%)	64 (100%)	64 (50.0%)
Indications for CS:			
- Fetal distress	25 (39.1%)	-	25 (19.5%)
- Maternal request	18 (28.1%)	-	18 (14.1%)
- Malpresentation	12 (18.8%)	-	12 (9.4%)
- Other	9 (14.1%)	-	9 (7.0%)

Table 3: Assessment findings according to Incidence of Overall Maternal Morbidity Following Cesarean Section and Vaginal Delivery

Maternal Morbidity	**CS Group (n=64)**	**VD Group (n=64)**	**Total (n=128)**
Yes	25 (39.1%)	10 (15.6%)	35 (27.3%)
No	39 (60.9%)	54 (84.4%)	93 (72.7%)
p-value	-	-	0.003

Table 4: Findings based on Postpartum Complications Among Patients Undergoing Cesarean Section and Vaginal Delivery for 128, Infection Type, Length of Stay (days)

Complication	**CS Group (n=64)**	**VD Group (n=64)**	**Total (n=128)**
Postpartum Hemorrhage	12 (18.8%)	2 (3.1%)	14 (10.9%)
Wound Infection	6 (9.4%)	1 (1.6%)	7 (5.5%)
Endometritis	3 (4.7%)	0 (0%)	3 (2.3%)
Perineal Trauma	0 (0%)	4 (6.3%)	4 (3.1%)
Venous Thromboembolism (VTE)	1 (1.6%)	0 (0%)	1 (0.8%)
Infection Rates			
Infection Type	**CS Group (n=64)**	**VD Group (n=64)**	**Total (n=128)**
Wound Infection	6 (9.4%)	1 (1.6%)	7 (5.5%)
Endometritis	3 (4.7%)	0 (0%)	3 (2.3%)
Urinary Tract Infection (UTI)	2 (3.1%)	1 (1.6%)	3 (2.3%)
Puerperal Sepsis	1 (1.6%)	0 (0%)	1 (0.8%)
Group	**Length of Stay (days)**		
CS Group (n=64)	4.5 ± 1.2		
VD Group (n=64)	2.7 ± 0.9		
p-value	<0.001		

Table 5: Readmission within 30 days

Readmission within 30 days	**CS Group (n=64)**	**VD Group (n=64)**	**Total (n=128)**
Yes	8 (12.5%)	2 (3.1%)	10 (7.8%)
No	56 (87.5%)	62 (96.9%)	118 (92.2%)
p-value	-	-	0.025

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Table 6: Subgroup Analysis (Age) and Maternal Satisfaction and Quality of Life, Analgesia and Pain Management

Age Group	**CS Morbidity (n=32)**	**VD Morbidity (n=32)**	**Total (n=64)**
<35 years	10 (31.3%)	2 (6.3%)	12 (18.8%)
≥35 years	15 (46.9%)	8 (25.0%)	23 (35.9%)
p-value	-	-	0.045
Analgesia and Pain Management			
Pain Management	**CS Group (n=64)**	**VD Group (n=64)**	**Total (n=128)**
Epidural Analgesia	62 (96.9%)	35 (54.7%)	97 (75.8%)
Mean Pain Score (VAS)	4.2 ± 1.1	3.5 ± 0.9	-
Maternal Satisfaction and Quality of Life			
Satisfaction Measure	**CS Group (n=64)**	**VD Group (n=64)**	**Total (n=128)**
Satisfaction Score (mean ± SD)	3.8 ± 0.9	4.5 ± 0.7	-
Quality of Life Score (mean ± SD)	70 ± 12	85 ± 9	-

DISCUSSION

Baseline characteristics and representativeness. The CS and VD categories were well matched across the majority of demographic and baseline characteristics. There was no difference of age, BMI, parity distribution, education level, socioeconomic status, pre-existing conditions, smoking status, and previous history of cesarean section, with some slight deviations, which probably cannot entirely account for observed differences in results. The average age was approximately 30 years old in both groups, and the BMI of the CS group was slightly greater (28.0 vs 26.7 kg/m 2). Parity distributions were almost the reflection of each other; half of the sample was nulliparous, and half was multiparous, and provided the profile of obstetric diversity which is most suitable in comparative studies of delivery mode. The dissimilarity in the proportion of previous cesarean section between the CS group (39.1% vs 0) represents the pattern of clinical practice whereby previous CS is a strong predictor of repeat cesarean section, which by itself predisposes complication rates and resource usage [Durnwald, C. P., & Mercer, B. M. 2004; Young, C. B. *et al*., 2018].

Delivery mode and indications Like intended, all the participants of the CS group delivered through cesarean section, and all the VD group through vaginal delivery. Clues of CS in this cohort of Iraqis were spread over fetal distress (39.1), maternal request (28.1), malpresentation (18.8), and the rest of the justifications (14.1). This distribution highlights the combination of intrapartum and elective CS that is common in most environments and is consistent with the findings seen in other parts of the world that fetal distress and maternal choice are the most frequent causes of cesarean deliveries. Maternal morbidity. The overall maternal morbidity in the CS group (39.1) and VD group (15.6) was higher than the overall morbidity (27.3). The p-value of overall morbidity is reported as 0.003, which means that there is a statistically significant difference on the side of vaginal delivery in the number of maternal morbid events. This observation is widely in line with the literature, which has repeatedly demonstrated an increased probability of some complications following cesarean birth, including wound complications, endometritis, and blood loss, than following voluntarily vaginal births.

Precisely, the data indicates the increase of postpartum complications and infections in the CS group:
The incidence of postpartum bleeding was more common with CS (18.8) compared to VD (3.1), and this had a significant impact on the total morbidity among the CS group.

Wound infection occurred more frequently in CS (9.4) than in VD (1.6), which has always been the trend with surgical wound complications following cesarean delivery.

Only the CS had endometritis (4.7%), which once again indicates the risk of infection, in relation to uterine surgery and uterine incision.

Perineal trauma was only reported in the VD group (6.3%), where it should be observed based on the vaginal birth with possible injury of the perineum, but the specified issue does not seem to be as high as the infectious problems reported under CS.

Also, there was one case of venous thromboembolism in the CS group, which is in line with the thrombotic risk profile known after major abdominal surgery and long-term immobilization

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in the immediate postpartum. Numically better in CS (7/64) than in VD (3/64), overall infection rates, such as wound infection, endometritis, urinary tract infection (UTI), and puerperal sepsis, were more common in CS than in VD.

Length of stay Length of stay (LOS) significantly increased after CS (4.5 ± 1.2 days) as compared to VD (2.7 ± 0.9 days), and the p-value was less than 0.001. This significant variation has significant implications to resource utilization, bed occupancy, and throughput in the hospital. LOS is a long-standing phenomenon that is seen in numerous facilities and represents the integration of surgical recovery factors, wound care issues, and postoperative complications. The statistics support the claim that decreasing the number of non-medically indicated cesareans can bring significant benefits to hospital efficiency and patient throughput without affecting the well-being of the results of the born babies.

Readmission For 30 days, readmission was higher in CS (12.5) as compared to VD (3.1), with the p-value of 0.025 being statistically significant. The high post-CS readmission rates should be explained by the increased morbidity rates, such as wound complications and infection, and possible thromboembolic risks. These results point to another aspect of cost and resource utilization related to cesarean section and the necessity to provide close follow-up and patient education right after the operation to diagnose the onset of complications.

Analgesia, pain control, and postoperative pain. Analgesia and pain control were significantly different in the groups. The use of epidural analgesia was in 96.9% of CS and 54.7% of VD. This is in agreement with the normal practice of obstetric anesthesia of neuraxial anesthesia, where cesarean delivery is widely used to offer neuraxial anesthesia, which is an effective mode of analgesia in the postpartum period. The CS (4.2 ± 1.1) and VD (3.5 ± 0.9) were found to be higher in terms of mean pain score (VAS). This disparity could be due to the increased tissue damage and involvement of the abdominal wall in a cesarean operation, postoperative complications, and analgesic needs to heal wounds and the uterus. It also elevates the issues of pain management in CS, such as multimodal analgesia interventions, early mobility, and personalized pain management strategies in order to enhance comfort and recovery.

Patient-Centered outcomes: satisfaction and quality of life. Satisfaction and quality of life indicators demonstrate significant dissimilarities in modes of delivery. The VD group scored higher in terms of satisfaction (4.5 ± 0.7) than the CS group (3.8 ± 0.9). The scores of quality of life were also better after VD (85 ± 9) compared to the CS (70 ± 12). These findings are consistent with the clinical morbidity profile where the increased recovery time, complication rates, and length of stay with cesarean birth has the ability of reducing perceived quality of life and satisfaction during the early period of postpartum. Such patient-reported outcomes are essential, as they can take into account the factors of the birth experience that are not measured by clinical variables and are characterized by how delivery mode affects the maternal condition.

Clinical implications and practice considerations. The information above has a number of implications in obstetric care among these populations.

- Reduction and indications of non-medically indicated CS: The high prevalence of CS associated with fetal distress and maternal request, and a subgroup of malpresentation and other indications, suggests a potential area in which practice can be improved. The interventions to decrease elective cesarean without a decrease in safety, which may include increased intrapartum fetal monitoring, shared decision-making, and specific patient education, may have an impact on future cohorts to lower the rate of CS, and subsequent morbidity, LOS, and readmissions.
- Optimization of analgesia: A significant number of analgesic needs and increased pain post-CS indicate a possibility to optimize multimodal analgesia, such as non-opioid analgesics, regional interventions, and early mobilization. The personalization of analgesia based on the needs and sufficient pain management can help to increase the level of satisfaction and reduce the time of recovery.
- Patient education, including the identification of symptoms, early mobilization, and pharmacologic prophylaxis when needed are the key component of care.
- Strengths and limitations. Strengths of this analysis encompass a balanced comparison cohort with uniform data collection on two groups and a wide spectrum of clinically-

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relevant outcomes, including both objective morbidities and LOS, as well as patient-reported satisfaction and quality of life. Age-stratified morbidity has a certain nuance to the interpretation of risk profile and helps to approach counseling on an individual basis.

CONCLUSION

- Post-discharge planning and readmissions. The increased 30-day readmission rate following CS contributes to the significance of effective discharge planning, wound management, and infection symptom education, and available post-discharge services. Follow-up or pre-emptive early postoperative follow-up by telehealth could assist in dealing with complications in a timely manner and preventing readmission.

- Consideration of patient satisfaction and quality of life: Because there is an apparent disparity in patient satisfaction and quality of life between CS and VD, this illustrates the more general psychosocial and experiential aspects of mode of delivery. Thorough counseling with the discussion of possible benefits and risks of CS and VD, agreeing on plans in coordination with patient preferences and clinical signs, and provision of resources to receive help during the postpartum period can help enhance the perceived outcomes.

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