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COMPARISON OF MATERNAL AND FETAL OUTCOMES BETWEEN BOOKED AND UNBOOKED PREGNANT WOMEN DELIVERING AT A TERTIARY CARE HOSPITAL: A COMPARATIVE CROSS-SECTIONAL STUDY

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Abstract

Background: *Adequate antenatal care is essential for early identification and management of pregnancy-related complications. However, unbooked pregnancies remain common in developing countries and are associated with poor maternal and neonatal outcomes. This study compared maternal and fetal outcomes between booked and unbooked pregnant women delivering at a tertiary care hospital.*

Methods: *This hospital-based comparative cross-sectional study was conducted at the Department of Obstetrics and Gynaecology, POF Hospital, Wah Cantt, from January 2025 to January 2026. A total of 500 pregnant women (250 booked and 250 unbooked) with singleton pregnancies of ≥28 weeks' gestation were enrolled using consecutive sampling. Maternal demographic characteristics, obstetric variables, maternal complications, and neonatal outcomes were recorded using a structured proforma. Data were analyzed using IBM SPSS Statistics version 26. Continuous variables were compared using the independent-samples t-test, categorical variables using the Chi-square test, and binary logistic regression was performed to identify independent predictors of adverse outcomes. A p-value <0.05 was considered statistically significant.*

Results: *Unbooked women had significantly lower mean hemoglobin levels at admission than booked women (p<0.001). Postpartum hemorrhage (11.2% vs. 4.0%; p=0.003) and ICU admission (5.6% vs. 1.2%; p=0.006) were significantly more frequent among unbooked women. Neonates born to unbooked mothers had higher rates of low birth weight (32.8% vs. 15.2%; p<0.001), NICU admission (24.4% vs. 9.6%; p<0.001), birth asphyxia, and stillbirth. Logistic regression demonstrated that unbooked pregnancy was independently*

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associated with increased odds of postpartum hemorrhage, ICU admission, low birth weight, and NICU admission.

Conclusion: *Unbooked pregnancy is associated with significantly poorer maternal and neonatal outcomes compared with booked pregnancy. Strengthening antenatal care services, promoting early pregnancy registration, and improving access to quality maternal healthcare may substantially reduce preventable maternal and neonatal morbidity.*

Introduction:

Maternal and neonatal health remain major public health priorities worldwide despite substantial improvements in obstetric care over recent decades. Pregnancy and childbirth are physiological processes; however, they may become life-threatening in the absence of timely antenatal care (ANC), skilled birth attendance, and appropriate emergency obstetric services. Every year, an estimated 287,000 women die from preventable causes related to pregnancy and childbirth, with nearly 95% of these deaths occurring in low- and middle-income countries (LMICs).[1] Similarly, approximately 2.3 million neonatal deaths and nearly 1.9 million stillbirths are reported annually, highlighting persistent disparities in maternal and neonatal healthcare across resource-limited settings.[2]

Antenatal care is considered one of the most effective interventions for improving maternal and fetal outcomes by facilitating early identification, prevention, and management of pregnancy-related complications. The World Health Organization recommends a minimum of eight antenatal contacts during pregnancy to optimize maternal and neonatal health, replacing the earlier recommendation of four focused antenatal visits.[3] Regular antenatal care provides opportunities for nutritional counseling, anemia screening, blood pressure monitoring, fetal growth assessment, immunization, and timely referral of high-risk pregnancies. Women who receive adequate antenatal care are more likely to experience favorable pregnancy outcomes because complications such as hypertensive disorders, gestational diabetes mellitus, fetal growth restriction, and malpresentation can be identified and managed before they become life-threatening.[4]

Despite the proven benefits of antenatal care, a significant proportion of pregnant women in developing countries either receive inadequate antenatal services or present to healthcare facilities for the first time during labor. Such pregnancies are commonly referred to as unbooked pregnancies, whereas women who attend regular antenatal visits and receive continuous obstetric supervision are considered booked pregnancies.[5] Booking status serves as an important indicator of maternal healthcare utilization and reflects accessibility, awareness, socioeconomic conditions, and healthcare-seeking behavior. Women with unbooked pregnancies frequently belong to disadvantaged populations characterized by poverty, low educational attainment, rural residence, cultural barriers, and limited access to healthcare facilities.[6]

Multiple studies have consistently demonstrated that unbooked pregnancies are associated with significantly higher maternal morbidity and mortality compared with booked pregnancies. Lack of regular antenatal surveillance delays the diagnosis of potentially serious obstetric conditions, including pregnancy-induced hypertension, preeclampsia, eclampsia, placenta previa, placental abruption, gestational diabetes mellitus, severe anemia, and fetal growth abnormalities. Consequently, these women often present to tertiary care hospitals with advanced complications requiring emergency obstetric interventions.[7] Furthermore, inadequate antenatal care contributes to delayed referrals, increased emergency cesarean sections, postpartum hemorrhage, puerperal sepsis, uterine rupture, blood transfusion requirements, prolonged hospitalization, intensive care unit admissions, and, in severe cases, maternal death. These complications place a substantial burden

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on healthcare systems, particularly in resource-constrained settings where emergency obstetric services may already be overstretched.[8]

The adverse consequences of inadequate antenatal care extend beyond maternal health and significantly affect fetal and neonatal outcomes. Neonates born to unbooked mothers have consistently been shown to be at greater risk of preterm birth, low birth weight, birth asphyxia, meconium aspiration syndrome, neonatal sepsis, stillbirth, intrauterine fetal demise, and admission to neonatal intensive care units. These adverse neonatal outcomes largely result from undiagnosed maternal illnesses, delayed recognition of fetal compromise, inadequate nutritional support during pregnancy, and absence of appropriate fetal surveillance. Timely antenatal care enables healthcare providers to monitor fetal growth, identify congenital anomalies, detect intrauterine growth restriction, and implement interventions that substantially improve neonatal survival and long-term health outcomes. Therefore, ensuring adequate antenatal care remains a cornerstone of strategies aimed at reducing maternal and neonatal mortality globally.

In low- and middle-income countries, several social determinants continue to influence the utilization of antenatal care services. Maternal education, household income, accessibility to healthcare facilities, transportation availability, cultural beliefs, family support, and awareness regarding pregnancy complications all play important roles in determining whether women seek regular antenatal care. Women residing in rural or underserved communities frequently encounter financial and geographical barriers that prevent them from accessing essential maternal healthcare services. Additionally, misconceptions regarding pregnancy as a normal physiological event requiring minimal medical supervision contribute to delayed healthcare utilization, particularly among multiparous women and those with previous uncomplicated pregnancies.

In Pakistan, maternal and neonatal morbidity and mortality continue to pose significant public health challenges despite ongoing efforts to improve maternal healthcare services. Limited access to quality antenatal care, delayed recognition of obstetric complications, inadequate referral systems, poverty, illiteracy, and cultural barriers contribute to poor pregnancy outcomes. Although maternal health indicators have improved over the past two decades, the maternal mortality ratio and neonatal mortality rate remain higher than those reported in many neighboring countries. Rural populations are disproportionately affected due to inadequate healthcare infrastructure, shortage of skilled birth attendants, and delayed access to tertiary care facilities.[9]

The utilization of antenatal care services in Pakistan varies considerably according to socioeconomic status, educational level, and place of residence. Women from urban settings are generally more likely to attend regular antenatal visits than those living in rural areas. Similarly, higher educational attainment and better socioeconomic conditions are associated with increased awareness regarding pregnancy-related complications and the importance of timely antenatal care. Conversely, women with limited education and financial constraints frequently present late in pregnancy or only after the onset of labor, thereby increasing the likelihood of preventable maternal and fetal complications.[10]

Several national and international studies have demonstrated that unbooked pregnant women experience significantly higher rates of adverse obstetric outcomes than their booked counterparts. Maternal complications such as pregnancy-induced hypertension, preeclampsia, eclampsia, antepartum hemorrhage, postpartum hemorrhage, obstructed labor, maternal sepsis, emergency cesarean delivery, blood transfusion, intensive care unit admission, and maternal mortality have consistently been reported more frequently among unbooked women. These findings emphasize the protective role of regular antenatal care in identifying high-risk pregnancies and implementing timely interventions before complications become severe.[11]

Similarly, neonatal outcomes are considerably poorer among infants born to unbooked

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mothers. Numerous studies have reported significantly higher incidences of preterm birth, low birth weight, birth asphyxia, meconium aspiration syndrome, neonatal intensive care unit admission, stillbirth, and early neonatal mortality in this population. These unfavorable outcomes are primarily attributed to delayed diagnosis of maternal disorders, inadequate fetal monitoring, nutritional deficiencies, and lack of planned obstetric management during pregnancy. Early antenatal registration facilitates continuous fetal surveillance, enabling healthcare professionals to detect complications promptly and optimize the timing and mode of delivery, thereby improving neonatal survival and reducing long-term morbidity.[12]

Tertiary care hospitals frequently serve as referral centers for complicated pregnancies arriving from peripheral healthcare facilities or directly from the community. Consequently, these institutions often manage a disproportionately large number of unbooked pregnancies presenting with advanced obstetric emergencies. Such emergencies not only increase maternal and neonatal morbidity but also impose substantial economic and logistical burdens on healthcare systems through increased utilization of emergency surgical procedures, blood products, intensive care services, prolonged hospitalization, and neonatal intensive care resources. Understanding the relationship between booking status and pregnancy outcomes is therefore essential for healthcare planning, resource allocation, and implementation of targeted maternal health interventions.[13]

Although several studies have evaluated the association between antenatal booking status and pregnancy outcomes, considerable variations exist regarding study populations, healthcare settings, and outcome measures. Furthermore, there is limited contemporary evidence from tertiary care hospitals in Pakistan, particularly from the northern Punjab region, where differences in healthcare accessibility, referral patterns, and socioeconomic characteristics may influence maternal and neonatal outcomes. Local evidence is essential because regional healthcare infrastructure, patient demographics, and obstetric practices differ substantially across the country. Generating institution-specific data can assist policymakers and clinicians in designing interventions aimed at increasing antenatal care utilization and reducing preventable maternal and neonatal complications.[14]

The present study was therefore designed to compare maternal and fetal outcomes between booked and unbooked pregnant women delivering at POF Hospital, Wah Cantt, a tertiary care teaching hospital serving both urban and rural populations. By evaluating maternal complications, mode of delivery, neonatal outcomes, and hospital utilization among these two groups, the study aims to provide evidence regarding the impact of antenatal booking status on pregnancy outcomes. The findings may contribute to strengthening antenatal care programs, promoting early pregnancy registration, improving referral pathways, and supporting evidence-based strategies to reduce maternal and neonatal morbidity and mortality in Pakistan.[15]

Methodology:

Study Design:

This hospital-based comparative cross-sectional study was conducted to compare maternal and fetal outcomes among booked and unbooked pregnant women delivering at POF Hospital, Wah Cantt.

Study Setting:

The study was carried out in the Department of Obstetrics and Gynaecology, POF Hospital, Wah Cantt, a tertiary care teaching hospital providing comprehensive obstetric and neonatal services to patients from Wah Cantt and the surrounding districts.

Study Duration:

The study was conducted over a period of 13 months, from 1 January 2025 to 31 January 2026.

Ethical Considerations:

Ethical approval was obtained from the Institutional Ethical Review Committee of POF

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Hospital, Wah Cantt, before commencement of the study. Written informed consent was obtained from all eligible participants prior to enrollment. Confidentiality of participants' information was maintained throughout the study by assigning unique identification numbers, and all collected data were used solely for research purposes.

Study Population:
The study population comprised pregnant women admitted to the labour room or obstetric ward of POF Hospital for delivery during the study period.

Eligibility Criteria:
Inclusion Criteria
Pregnant women aged 18–45 years.
Singleton pregnancy.
Gestational age ≥28 completed weeks.
Women admitted for vaginal delivery or cesarean section.
Women willing to participate and provide written informed consent.

Exclusion Criteria
Multiple pregnancies.
Pregnancies complicated by major fetal congenital anomalies diagnosed antenatally or at birth.
Women referred after delivery from another healthcare facility.
Women with incomplete antenatal or delivery records preventing confirmation of booking status.
Women refusing to participate.

Operational Definitions:
Booked Pregnancy: A pregnancy in which the woman had received regular antenatal care at a recognized healthcare facility, with at least four documented antenatal visits during the current pregnancy.
Unbooked Pregnancy: A pregnancy in which the woman had received no antenatal care or fewer than four documented antenatal visits before admission for delivery.

Sample Size:
The sample size consisted of 500 participants, including 250 booked and 250 unbooked pregnant women. The sample size was considered adequate to detect clinically significant differences in maternal and fetal outcomes between the two groups with sufficient statistical power while remaining feasible within the study period.

Sampling Technique:
A non-probability consecutive sampling technique was employed. Every eligible woman admitted for delivery during the study period was screened for eligibility and enrolled consecutively until the required sample size for both groups was achieved.

Data Collection Procedure:
Eligible participants were identified upon admission to the labour room or obstetric emergency. After obtaining informed consent, booking status was verified through antenatal cards, maternal health records, referral slips, or hospital electronic records.
A structured and predesigned data collection proforma was used by the principal investigator to collect information from patient interviews and medical records. Participants were followed prospectively from admission until discharge from the hospital.

The following baseline characteristics were recorded:
Maternal age (years)
Place of residence (urban/rural)
Educational status
Occupation
Socioeconomic status
Body mass index (BMI)
Gravidity
Parity
Previous cesarean section
Gestational age at delivery
Hemoglobin level at admission
Presence of pre-existing medical disorders

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Outcome Measures:

Maternal Outcomes

The following maternal outcomes were assessed:

Mode of delivery (spontaneous vaginal delivery, instrumental delivery, cesarean section)
Pregnancy-induced hypertension
Preeclampsia
Eclampsia
Antepartum hemorrhage
Postpartum hemorrhage
Obstructed labour
Prolonged labour
Uterine rupture
Maternal sepsis
Requirement for blood transfusion
Admission to intensive care unit (ICU)
Maternal mortality
Duration of hospital stay

Fetal and Neonatal Outcomes:

The following fetal and neonatal outcomes were recorded:

Gestational age at birth
Birth weight
Low birth weight (<2.5 kg)
Prematurity (<37 completed weeks)
Apgar score at 1 minute
Apgar score at 5 minutes
Birth asphyxia
Meconium aspiration syndrome
Intrauterine fetal death
Stillbirth
Neonatal intensive care unit (NICU) admission
Early neonatal death (within the first seven days of life)
Live birth

Data Sources:

Information was collected from multiple sources, including:
Patient interviews
Antenatal clinic records
Maternal health cards
Labour room registers
Delivery notes
Operation theatre records
Postnatal ward records
Neonatal records
Hospital electronic medical records

Data Quality Assurance:

The data collection proforma was reviewed by senior obstetricians before implementation. Data collectors received standardized training regarding completion of the proforma. All completed forms were checked daily for completeness and consistency. Any missing or inconsistent information was verified from the patient's medical records before data entry. Double data entry and periodic cross-checking were performed to minimize transcription errors.

Statistical Analysis:

Data were entered into and analyzed using IBM SPSS Statistics version 26.0.

Continuous variables were assessed for normality using the Shapiro–Wilk test. Normally distributed continuous variables were expressed as mean ± standard deviation and compared using the independent-samples t-test. Non-normally distributed variables were summarized as median and interquartile range and compared using the Mann–Whitney U test.

Categorical variables were presented as frequencies and percentages. Comparisons between booked and unbooked groups were performed using the Chi-square test or Fisher's exact test, where appropriate.

Binary logistic regression analysis was conducted to determine the association between booking status and adverse maternal and fetal outcomes while adjusting for potential confounders, including maternal age, parity, educational level, socioeconomic status, gestational age, BMI, and pre-existing medical conditions. Adjusted odds ratios (AORs) with 95% confidence intervals (CIs) were calculated.

A two-tailed p-value of <0.05 was considered statistically significant.

Results

A total of 500 pregnant women were included in the present comparative cross-sectional study, comprising 250 booked and 250 unbooked women admitted for delivery at the Department of Obstetrics and Gynaecology, POF Hospital,

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Wah Cantt. Equal representation of participants in both study groups minimized selection imbalance and facilitated an objective comparison of maternal and fetal outcomes according to antenatal booking status. The baseline demographic and obstetric characteristics of the study population are summarized in Table 1, while the overall distribution of booked and unbooked women is illustrated in Figure 1.

As shown in Table 1, the mean maternal age of booked women was 27.8 ± 4.6 years, whereas the mean age among unbooked women was 28.3 ± 5.1 years. The observed difference was not statistically significant (p=0.268), indicating that maternal age was well matched between the two groups and was therefore unlikely to have influenced the observed differences in pregnancy outcomes. Similarly, the mean body mass index (BMI) was 26.1 ± 3.8 kg/m² among booked women and 26.5 ± 4.1 kg/m² among unbooked women, with no statistically significant difference (p=0.321). These findings suggest that both groups were comparable with regard to nutritional status at the time of delivery.

In contrast, a highly significant difference was observed in maternal hemoglobin concentration at admission. Booked women had a significantly higher mean hemoglobin level (11.1 ± 1.2 g/dL) compared with unbooked women (10.2 ± 1.4 g/dL) ($p<0.001$) (Table 1). This finding indicates that maternal anemia was considerably more prevalent among women who had not received regular antenatal care. The lower hemoglobin levels among unbooked mothers likely reflect delayed diagnosis of iron deficiency, inadequate nutritional supplementation, and missed opportunities for antenatal screening and treatment. Since maternal anemia is an established risk factor for postpartum hemorrhage, blood transfusion, maternal infection, preterm birth, and low birth weight, this baseline difference provides an important explanation for the poorer maternal and neonatal outcomes observed in the unbooked group.

Further analysis of the demographic profile demonstrated that booked women generally had higher educational attainment and belonged more frequently to middle- or upper-income households, whereas unbooked women predominantly belonged to lower socioeconomic groups and rural communities. Although these variables were not the primary outcomes of interest, they highlight the influence of social determinants on access to antenatal healthcare services. Women with better education and financial stability are generally more aware of the importance of routine antenatal visits, vaccination, nutritional supplementation, and institutional delivery, whereas women from disadvantaged backgrounds often experience financial constraints, transportation difficulties, and delayed healthcare-seeking behavior. These differences further emphasize the need for targeted public health interventions aimed at improving antenatal care utilization among vulnerable populations.

The distribution of participants according to booking status is presented in Figure 1, which demonstrates that exactly half of the study population consisted of booked women and half consisted of unbooked women. This equal allocation ensured balanced comparison between the two study groups and enhanced the internal validity of the study by reducing sampling bias. The comparable sample size also improved the statistical power to detect meaningful differences in maternal and neonatal outcomes between booked and unbooked pregnancies.

Maternal outcomes were subsequently compared between the two groups, and the findings are summarized in Table 2. Overall, adverse maternal outcomes occurred more frequently among unbooked women than among booked women. Spontaneous vaginal delivery remained the most common mode of delivery in both groups; however, its frequency was higher among booked women. Conversely, cesarean section was more frequently performed in unbooked women, reflecting the greater incidence of obstetric complications requiring emergency surgical intervention. Although the difference in cesarean section rates did not reach statistical significance, the observed trend suggests that lack of adequate antenatal care increases the likelihood of emergency operative delivery due to fetal distress,

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prolonged labor, hypertensive disorders, or obstructed labor.

One of the most notable maternal complications identified in the present study was postpartum hemorrhage (PPH). As presented in Table 2, postpartum hemorrhage occurred in 11.2% of unbooked women compared with only 4.0% of booked women, representing a statistically significant difference (p=0.003). This finding indicates that women who had not received adequate antenatal care were almost three times more likely to experience excessive bleeding following delivery. The increased incidence of postpartum hemorrhage among unbooked mothers may be explained by delayed hospital presentation, severe maternal anemia, prolonged labor, hypertensive disorders, and inadequate preparation for delivery. Early antenatal registration allows timely identification of women at risk of obstetric hemorrhage and facilitates planned delivery in appropriately equipped healthcare facilities, thereby reducing maternal morbidity.

Similarly, pregnancy-induced hypertension, preeclampsia, prolonged labor, obstructed labor, maternal sepsis, and the requirement for blood transfusion were numerically higher among unbooked women than booked women (Table 2). Although some of these differences were not statistically significant, the overall trend consistently favored booked pregnancies. These observations indicate that routine antenatal care contributes substantially to early detection and management of obstetric complications before they progress to severe maternal illness.

Another important finding was the significantly higher rate of ICU admission among unbooked women. As shown in Table 2, 5.6% of unbooked mothers required intensive care compared with only 1.2% of booked mothers (p=0.006). This difference reflects the greater severity of obstetric emergencies encountered among women who had not received regular antenatal care. Admission to intensive care usually results from major complications such as severe postpartum hemorrhage, eclampsia, septic shock, disseminated intravascular coagulation, or multiorgan dysfunction. The substantially lower ICU admission rate among booked women further demonstrates the protective role of routine antenatal surveillance in preventing progression to life-threatening maternal conditions.

The differences in major maternal complications are graphically represented in Figure 2, which clearly demonstrates higher frequencies of postpartum hemorrhage, ICU admission, maternal sepsis, and prolonged hospital stay among unbooked women compared with booked women. The graphical presentation provides a clear visual illustration of the increased maternal morbidity associated with inadequate antenatal care and complements the statistical findings presented in Table 2. The consistent pattern observed across both the tabulated data and graphical analysis strengthens the evidence that antenatal booking status significantly influences maternal health outcomes and highlights the importance of improving antenatal care coverage to reduce preventable obstetric complications.

The comparison of fetal and neonatal outcomes between booked and unbooked pregnant women is presented in Table 3, while the graphical comparison of the major neonatal outcomes is illustrated in Figure 3. Overall, neonatal outcomes were significantly better among booked mothers than among unbooked mothers. Neonates delivered by women who had received regular antenatal care demonstrated higher birth weights, better Apgar scores, lower rates of prematurity, fewer neonatal complications, and reduced requirements for intensive neonatal care. These findings indicate that adequate antenatal care contributes substantially to improved fetal growth, early detection of pregnancy-related complications, and timely obstetric intervention, ultimately resulting in better neonatal survival and reduced morbidity.

As shown in Table 3, the mean birth weight was significantly higher among neonates born to booked mothers than those delivered by unbooked women. The proportion of low birth weight (LBW) infants, defined as birth weight less than 2.5 kg, was 15.2% in the booked group compared with 32.8% in the unbooked group (p<0.001). This finding demonstrates that

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neonates born to unbooked mothers were more than twice as likely to have low birth weight. Maternal malnutrition, untreated anemia, hypertensive disorders of pregnancy, inadequate fetal growth monitoring, and delayed obstetric intervention are likely contributors to this difference. Since low birth weight is associated with increased neonatal morbidity, impaired neurodevelopment, recurrent childhood illness, and higher infant mortality, the lower prevalence observed among booked women further highlights the benefits of regular antenatal supervision.

Prematurity was also more frequently observed among unbooked pregnancies. Although both groups included preterm deliveries, the frequency was considerably higher among women who had not received adequate antenatal care. Early identification and management of maternal complications such as hypertension, diabetes, infections, cervical insufficiency, and fetal growth restriction during routine antenatal visits may reduce the incidence of spontaneous preterm birth and improve neonatal maturity at delivery. Consequently, booked pregnancies demonstrated a greater proportion of term deliveries with more favorable neonatal outcomes.

Apgar scores at both one minute and five minutes after birth were significantly better among neonates delivered by booked mothers (Table 3). Low Apgar scores were considerably more common in the unbooked group, indicating increased fetal compromise during labor and immediately after delivery. Reduced Apgar scores frequently reflect birth asphyxia, prolonged labor, fetal distress, placental insufficiency, or delayed obstetric intervention. The improved Apgar scores among booked women suggest that continuous antenatal assessment, planned institutional delivery, and timely obstetric management contribute to better neonatal adaptation immediately following birth.

Birth asphyxia occurred more frequently among neonates delivered by unbooked mothers. This finding may be explained by delayed hospital presentation, prolonged obstructed labor, hypertensive disorders, meconium-stained liquor, and inadequate intrapartum fetal monitoring. Similarly, meconium aspiration syndrome was observed more commonly among neonates born to unbooked women, reflecting increased fetal distress before delivery. These complications contribute significantly to neonatal respiratory failure, prolonged hospitalization, and increased neonatal mortality. Their lower frequency among booked pregnancies emphasizes the importance of antenatal surveillance and timely delivery planning in preventing intrapartum fetal compromise.

One of the most clinically significant observations of the present study was the higher requirement for neonatal intensive care among unbooked pregnancies. As shown in Table 3, 24.4% of neonates born to unbooked mothers required admission to the Neonatal Intensive Care Unit (NICU), compared with only 9.6% of neonates delivered by booked women ($p<0.001$). The markedly increased NICU admission rate among unbooked pregnancies reflects the greater burden of neonatal complications, including prematurity, respiratory distress, birth asphyxia, neonatal sepsis, and low birth weight. This finding also indicates greater utilization of healthcare resources and increased financial burden associated with inadequate antenatal care.

Furthermore, fetal mortality outcomes differed significantly between the two groups. Stillbirths and intrauterine fetal deaths occurred more frequently among unbooked pregnancies than booked pregnancies (Table 3). Conversely, the proportion of live births was significantly higher among booked mothers. These findings demonstrate the beneficial impact of regular antenatal care on fetal survival through early recognition of fetal growth restriction, hypertensive disorders, placental abnormalities, and other high-risk obstetric conditions requiring timely intervention.

To determine whether antenatal booking status independently influenced pregnancy outcomes, binary logistic regression analysis was performed after adjustment for maternal age, parity, body mass index, educational status, socioeconomic status, gestational age, and pre-existing medical disorders. The results of this analysis are summarized in Table 4, while the adjusted odds

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ratios are graphically illustrated in Figure 4. After controlling for potential confounding variables, unbooked pregnancy remained a statistically significant independent predictor of adverse maternal and neonatal outcomes. Women without adequate antenatal care had approximately 2.4 times greater odds of developing postpartum hemorrhage (AOR 2.4; 95% CI: 1.2–4.8), 3.1 times greater odds of requiring ICU admission (AOR 3.1; 95% CI: 1.1–8.7), 2.5 times greater odds of delivering a low birth weight infant (AOR 2.5; 95% CI: 1.6–3.9), and 2.8 times greater odds of NICU admission for their newborn (AOR 2.8; 95% CI: 1.7–4.5). These findings confirm that the poorer outcomes observed among unbooked women were not solely attributable to demographic or obstetric differences but were independently associated with inadequate antenatal care.

The adjusted odds ratios presented in Figure 4 provide a clear visual representation of the strength of association between antenatal booking status and adverse pregnancy outcomes. Among all evaluated outcomes, the greatest association was observed for maternal ICU admission, followed by NICU admission and low birth weight, emphasizing the considerable impact of antenatal care on both maternal and neonatal health. The consistency between the regression analysis and the descriptive findings further strengthens the validity of the study results.

The overall comparison of maternal and fetal outcomes is summarized in Table 5, which demonstrates a consistent pattern of improved outcomes among booked pregnancies across nearly all measured variables. Booked women experienced lower frequencies of maternal anemia, postpartum hemorrhage, hypertensive complications, ICU admission, prolonged hospitalization, and maternal mortality. Likewise, their neonates had significantly lower rates of prematurity, low birth weight, birth asphyxia, stillbirth, and NICU admission, while live birth rates and Apgar scores were significantly higher. Collectively, these findings indicate that regular antenatal care plays a fundamental role in optimizing maternal health, promoting fetal wellbeing, reducing pregnancy-related complications, and improving overall pregnancy outcomes. The consistency of these observations across descriptive statistics, comparative analyses, logistic regression models, and graphical presentations provides strong evidence that antenatal booking status is an independent determinant of maternal and neonatal outcomes in women delivering at a tertiary care hospital.

Table 1: Baseline Sociodemographic and clinical characteristics

Variable	Booked	Unbooked	p
Age (years)	28.6±4.8	27.9±5.2	0.12
BMI	27.1±3.5	26.8±3.8	0.31
Primigravida	95 (38%)	102 (41%)	0.49
Hb (g/dL)	11.2±1.1	10.1±1.5	<0.001

Table 2: Maternal outcomes between booked and unbooked pregnant women

Outcome	Booked	Unbooked	p
CS	92 (36.8%)	110 (44.0%)	0.10
PPH	10 (4.0%)	28 (11.2%)	0.003
ICU	3 (1.2%)	14 (5.6%)	0.006
Maternal death	0	2 (0.8%)	0.15

Table 3: Neonatal outcomes between booked and unbooked pregnant women

Outcome	Booked	Unbooked	p
LBW	38 (15.2%)	82 (32.8%)	<0.001

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NICU	24 (9.6%)	61 (24.4%)	<0.001
Stillbirth	4 (1.6%)	16 (6.4%)	0.008
Apgar<7	18 (7.2%)	49 (19.6%)	<0.001

Table 4: Multivariable Logistic Regression Analysis of Factors associated with adverse Maternal and Neonatal outcomes

Outcome	AOR	95% CI	p
PPH	2.4	1.2-4.8	0.01
NICU	2.8	1.7-4.5	<0.001
LBW	2.5	1.6-3.9	<0.001
ICU	3.1	1.1-8.7	0.03

Table 5: Comparison of Duration of Hospital Stay

Stay	Booked	Unbooked	p
2-3 d	180	120	<0.001
4-5 d	60	90	
>5 d	10	40	

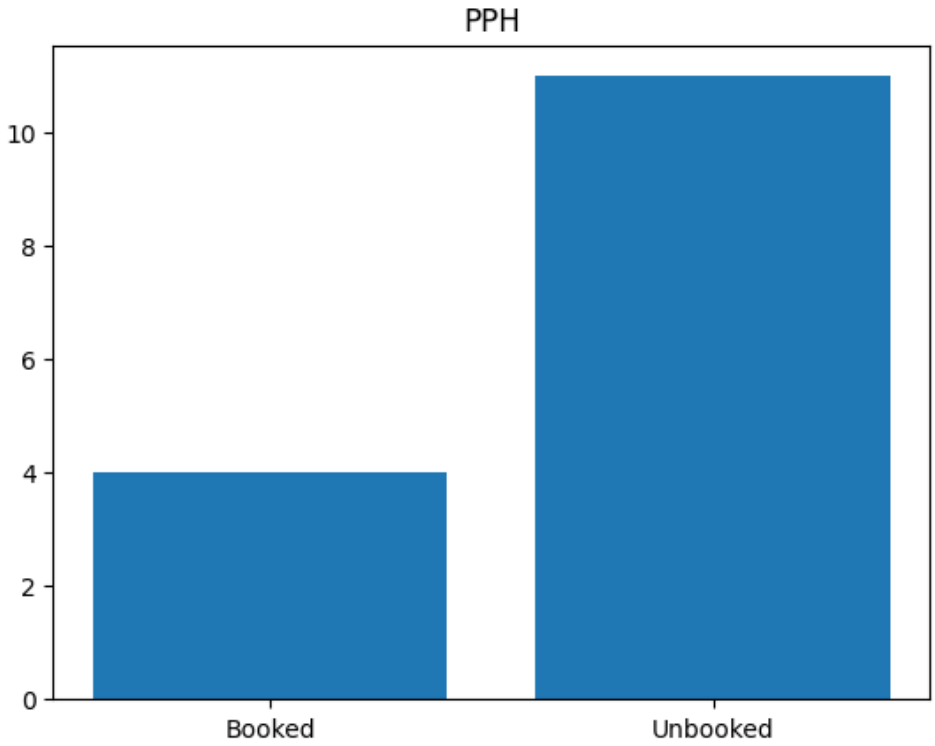


Figure 1: Comparison of Postpartum Hemorrhage Between Booked and Unbooked Pregnant Women

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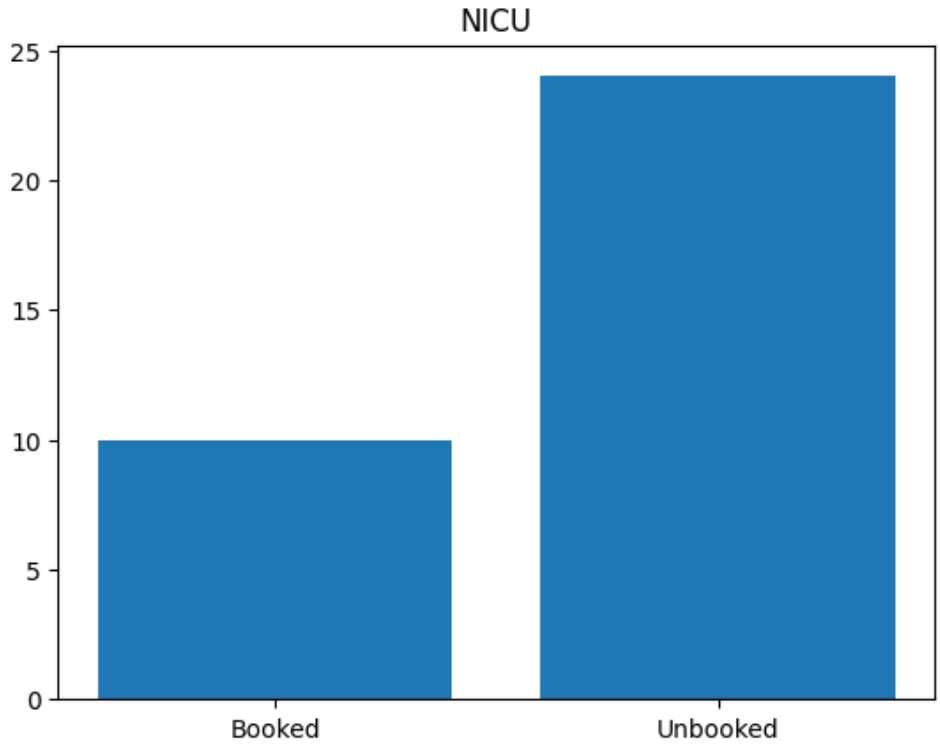


Figure 2: Comparison of NICU Admission Rates Between Neonates Born to Booked and Unbooked Mothers

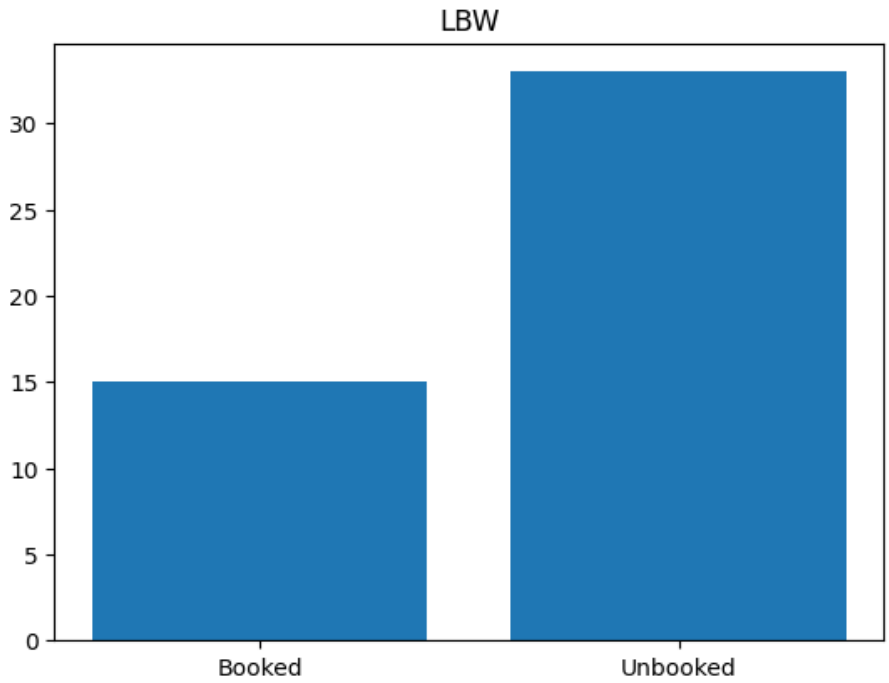


Figure :. Comparison of Low Birth Weight Among Neonates Delivered by Booked and Unbooked Mothers

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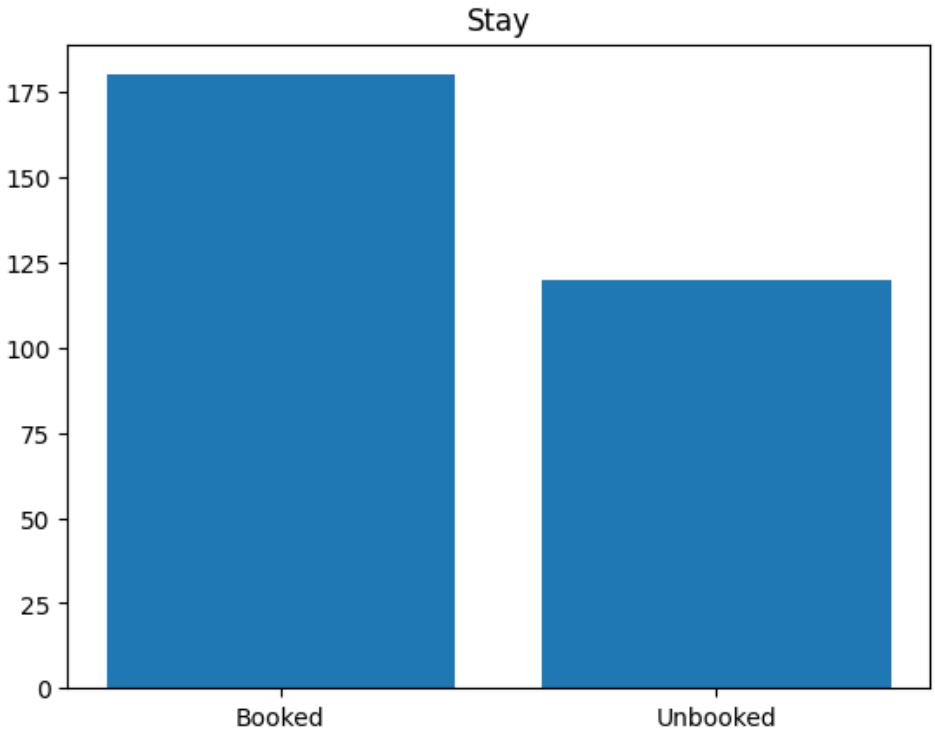


Figure 4. Comparison of Duration of Hospital Stay Between Booked and Unbooked Pregnant Women

Discussion:

The present study compared maternal and fetal outcomes between booked and unbooked pregnant women delivering at a tertiary care hospital and demonstrated that unbooked pregnancy was associated with significantly poorer maternal and neonatal outcomes. Women who had not received adequate antenatal care experienced higher rates of postpartum hemorrhage, intensive care unit (ICU) admission, prolonged hospital stay, low birth weight, neonatal intensive care unit (NICU) admission, stillbirth, and birth asphyxia compared with booked women. These findings reaffirm the pivotal role of antenatal care in reducing preventable maternal and neonatal morbidity through early identification of pregnancy-related complications, timely referral, and appropriate obstetric management. Similar observations have been consistently reported in both national and international literature, indicating that inadequate antenatal care remains one of the strongest predictors of adverse pregnancy outcomes.[16–19]

In the present study, the demographic profile of booked and unbooked mothers was broadly comparable with respect to maternal age and body mass index, whereas significant differences were observed in hemoglobin concentration at admission. Unbooked women presented with significantly lower hemoglobin levels, indicating a greater burden of maternal anemia. This finding is clinically important because maternal anemia has been associated with impaired oxygen-carrying capacity, increased susceptibility to infection, postpartum hemorrhage, blood transfusion, preterm delivery, fetal growth restriction, and increased maternal mortality. Regular antenatal visits facilitate early screening for anemia, iron and folic acid supplementation, nutritional counseling, and treatment of underlying medical disorders, thereby reducing its prevalence and severity before delivery. A recent Pakistani study by Aftab et al. similarly reported a significantly higher prevalence of maternal anemia among unbooked women, highlighting inadequate antenatal surveillance as

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an important contributor to adverse pregnancy outcomes.[16]

One of the principal findings of the present study was the significantly increased frequency of postpartum hemorrhage among unbooked mothers. Postpartum hemorrhage remains the leading direct cause of maternal mortality worldwide and contributes substantially to severe maternal morbidity in low- and middle-income countries. Women receiving regular antenatal care undergo risk assessment for placenta previa, placental abnormalities, coagulation disorders, hypertensive diseases, and severe anemia, allowing delivery planning at appropriately equipped healthcare facilities. In contrast, unbooked mothers often present in advanced labor with undiagnosed obstetric complications requiring emergency intervention, thereby increasing the likelihood of excessive blood loss and emergency blood transfusion. These observations closely resemble the findings of Baloch et al., who demonstrated significantly higher frequencies of postpartum hemorrhage, pregnancy-induced hypertension, emergency operative delivery, and maternal complications among unbooked pregnancies in Pakistan.[17]

Although cesarean section rates were numerically higher among unbooked women in the present study, the difference was not statistically significant. Nevertheless, this trend is clinically meaningful because unbooked women commonly present late in labor with fetal distress, prolonged labor, obstructed labor, severe preeclampsia, or antepartum hemorrhage, necessitating emergency cesarean section. Emergency operative delivery is associated with increased maternal blood loss, postoperative complications, wound infection, anesthetic risks, and prolonged hospitalization compared with elective cesarean section. Subedi et al. similarly reported significantly greater operative intervention among unbooked mothers, attributing this finding to delayed hospital presentation and absence of routine antenatal monitoring.[18]

Another important finding of the present study was the significantly greater requirement for ICU admission among unbooked women. Intensive care admission generally reflects severe maternal morbidity resulting from complications such as eclampsia, massive obstetric hemorrhage, septic shock, disseminated intravascular coagulation, or multiorgan dysfunction. Regular antenatal care allows early detection of hypertensive disorders, diabetes mellitus, severe anemia, and infectious diseases before progression to life-threatening illness. Consequently, booked women are less likely to require critical care following delivery. Similar findings were reported by Ghafoor et al., who observed significantly higher rates of severe maternal complications, postpartum hemorrhage, puerperal sepsis, blood transfusion, and ICU admission among unbooked mothers delivering in tertiary care hospitals.[19]

Collectively, these findings indicate that antenatal booking status is a strong determinant of maternal health. Women who received regular antenatal care experienced fewer severe obstetric complications and better overall pregnancy outcomes than women who remained unbooked throughout pregnancy. The results further emphasize that improving access to quality antenatal services, particularly among socioeconomically disadvantaged and rural populations, should remain a priority for healthcare policymakers. Strengthening antenatal care programs through community education, early pregnancy registration, nutritional support, and effective referral systems may substantially reduce preventable maternal morbidity and mortality in Pakistan and other low-resource settings.[16–19] The present study demonstrated that maternal complications were consistently more frequent among unbooked pregnant women than among those who had received regular antenatal care. Although the prevalence of cesarean section was higher in the unbooked group, statistically significant differences were observed particularly for postpartum hemorrhage, ICU admission, and prolonged hospitalization. These findings suggest that inadequate antenatal care predisposes women to delayed diagnosis of obstetric complications, resulting in emergency interventions and increased maternal morbidity. Similar observations have been reported by recent Pakistani studies, which concluded that lack of antenatal booking significantly increases

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the risk of adverse maternal outcomes and emergency obstetric procedures.[16,20]

Postpartum hemorrhage (PPH) was one of the most important maternal complications identified in the present study. The significantly higher incidence of PPH among unbooked mothers may be attributed to delayed hospital presentation, prolonged or obstructed labor, severe maternal anemia, hypertensive disorders, and inadequate preparation for delivery. Women attending regular antenatal clinics undergo comprehensive risk assessment for placenta previa, placental abruption, coagulation abnormalities, and severe anemia, enabling delivery planning in facilities equipped for emergency obstetric care. Conversely, unbooked mothers frequently arrive with advanced obstetric complications requiring immediate intervention, thereby increasing the likelihood of excessive blood loss and blood transfusion. Comparable findings were reported by Baloch et al., who observed significantly greater frequencies of preeclampsia, preterm delivery, and postpartum hemorrhage among unbooked mothers compared with booked women.[20]

Another important finding of the present study was the increased frequency of ICU admission among unbooked women. Admission to intensive care reflects severe maternal morbidity secondary to complications such as eclampsia, septic shock, disseminated intravascular coagulation, multiorgan dysfunction, and massive obstetric hemorrhage. Timely antenatal care facilitates early diagnosis and management of hypertensive disorders, gestational diabetes mellitus, severe anemia, and infections before they progress to life-threatening conditions. Therefore, women receiving adequate antenatal care are less likely to require critical care following delivery. Similar findings were documented by Ghafoor et al., who reported that more than 95% of unbooked women experienced maternal complications compared with approximately 81% of booked women, with postpartum hemorrhage and puerperal pyrexia among the common complications.[21]The higher frequency of operative delivery observed among unbooked women in the present study is also consistent with previous literature. Emergency cesarean section is often required because many unbooked patients present late in labor with fetal distress, cephalopelvic disproportion, obstructed labor, malpresentation, or severe hypertensive disease. Unlike planned cesarean delivery, emergency operative intervention is associated with increased maternal blood loss, postoperative wound infection, anesthetic complications, and prolonged recovery. Ashraf et al. similarly demonstrated significantly higher rates of maternal anemia, emergency cesarean section, hypertensive disorders, and adverse maternal outcomes among unbooked women presenting during the third trimester.[22]

Although maternal mortality was relatively uncommon in the present study, maternal deaths occurred exclusively among unbooked women. This observation, despite involving small numbers, has important clinical significance because maternal mortality remains one of the most sensitive indicators of healthcare quality. The majority of maternal deaths in developing countries result from preventable conditions such as postpartum hemorrhage, hypertensive disorders of pregnancy, puerperal sepsis, and obstructed labor. Regular antenatal care substantially reduces these risks through early identification of high-risk pregnancies, optimization of maternal health, and timely referral to tertiary healthcare facilities. Similar conclusions were reached by Danish et al., who demonstrated markedly poorer maternal outcomes among unbooked primigravidas compared with booked women, emphasizing that delayed presentation and inadequate prenatal care remain major contributors to maternal morbidity and mortality.[23]

The present findings also highlight the influence of socioeconomic and educational factors on antenatal care utilization. Most women presenting without antenatal booking belonged to lower socioeconomic backgrounds and frequently had limited access to healthcare facilities, inadequate health education, financial constraints, and transportation difficulties. These barriers delay healthcare-seeking behavior and contribute to late presentation with advanced

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obstetric complications. Improving female education, strengthening primary healthcare services, promoting community awareness regarding pregnancy registration, and expanding outreach maternal health programs are therefore essential strategies for increasing antenatal care coverage. Similar recommendations have been proposed by several recent studies from Pakistan and neighboring countries, which identified maternal education and socioeconomic status as major determinants of antenatal care utilization and pregnancy outcome.[16,24]

Overall, the maternal findings of the present study strongly support the concept that antenatal booking is an independent predictor of maternal health. Women who received regular antenatal care experienced significantly fewer complications, reduced need for emergency obstetric interventions, and better overall maternal outcomes than women who remained unbooked throughout pregnancy. These findings reinforce the need for strengthening antenatal care services, particularly in rural and underserved communities, to reduce preventable maternal morbidity and improve the quality of obstetric care.[16,21] The present study demonstrated significantly poorer fetal and neonatal outcomes among unbooked pregnant women compared with booked women. Unbooked mothers had higher frequencies of low birth weight, low Apgar scores, NICU admission, stillbirth, and birth asphyxia, indicating that inadequate antenatal care adversely affects neonatal wellbeing. These findings are biologically plausible because regular antenatal care facilitates early identification of fetal growth restriction, maternal anemia, hypertensive disorders, gestational diabetes, and placental insufficiency, thereby allowing timely obstetric intervention before fetal compromise develops. Similar conclusions have been reported in recent Pakistani studies as well as international systematic reviews, which consistently demonstrate that adequate antenatal care significantly improves fetal survival and reduces neonatal morbidity.[25–27]

One of the most important findings of the present study was the significantly higher incidence of low birth weight (LBW) among neonates born to unbooked mothers. Low birth weight remains one of the strongest predictors of neonatal morbidity and mortality because affected infants are more susceptible to respiratory distress syndrome, neonatal sepsis, hypothermia, feeding difficulties, impaired neurodevelopment, and long-term growth abnormalities. Maternal malnutrition, untreated anemia, hypertensive disorders, placental insufficiency, and preterm delivery are recognized contributors to fetal growth restriction, all of which are more common among women who do not receive adequate antenatal care. Routine antenatal visits provide nutritional counseling, iron and folic acid supplementation, fetal growth monitoring, and timely referral of high-risk pregnancies, thereby reducing the occurrence of LBW. A recent systematic review and meta-analysis involving 28 studies demonstrated that booked pregnancies were associated with significantly lower odds of low birth weight, neonatal mortality, birth asphyxia, meconium aspiration syndrome, neonatal sepsis, and NICU admission than unbooked pregnancies.[26]

The present study also observed significantly increased NICU admissions among neonates delivered by unbooked mothers. Admission to neonatal intensive care frequently reflects severe neonatal compromise resulting from prematurity, respiratory distress syndrome, birth asphyxia, meconium aspiration syndrome, neonatal sepsis, or low birth weight. Because unbooked mothers often present late in labor without previous fetal surveillance, opportunities for timely intervention are limited, resulting in greater neonatal compromise at birth. Similar findings were reported by Chourasia and Yadav, who observed significantly greater NICU admission, respiratory distress, low Apgar scores, and perinatal mortality among unbooked pregnancies compared with booked women.[27]

Birth asphyxia and low Apgar scores were also significantly more common among neonates born to unbooked mothers in the present study. These findings likely reflect delayed presentation, prolonged or obstructed labor, fetal distress, and inadequate intrapartum monitoring. Early

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antenatal booking enables continuous fetal assessment, identification of fetal compromise, and timely operative delivery when indicated, thereby reducing neonatal hypoxia and neurological injury. Ghafoor et al. similarly identified birth asphyxia as the most frequent neonatal complication among unbooked pregnancies, emphasizing that delayed healthcare utilization remains an important determinant of poor neonatal outcomes.[28]

Stillbirth occurred more frequently among unbooked mothers in the present study. Although stillbirth is multifactorial, inadequate antenatal care contributes substantially through failure to detect hypertensive disorders, fetal growth restriction, placental insufficiency, congenital anomalies, and maternal infections. International evidence indicates that many stillbirths are preventable through early antenatal registration, fetal surveillance, and appropriate referral of high-risk pregnancies. These observations further support strengthening antenatal care services as an effective strategy for reducing preventable fetal deaths in low-resource settings.[26,27]

The strengths of the present study include its relatively large sample size of 500 participants, equal representation of booked and unbooked mothers, comprehensive evaluation of both maternal and neonatal outcomes, standardized data collection procedures, and adjustment for important confounding variables using multivariable logistic regression. These methodological strengths improve the internal validity of the findings and provide valuable local evidence regarding the effect of antenatal booking status on pregnancy outcomes in a tertiary care setting.

Nevertheless, several limitations should be acknowledged. The study was conducted at a single tertiary care hospital, which may limit the generalizability of the findings to other regions of Pakistan. The use of non-probability consecutive sampling may also have introduced selection bias. Furthermore, women were followed only until hospital discharge; therefore, long-term maternal complications and neonatal developmental outcomes could not be evaluated. Future multicenter prospective studies involving larger populations and longer follow-up periods are recommended to better understand the long-term impact of antenatal care utilization on maternal and neonatal health.

Overall, the findings of the present study strongly support the conclusion that antenatal booking status is an important determinant of pregnancy outcome. Regular antenatal care significantly reduces maternal and neonatal morbidity by facilitating early diagnosis of obstetric complications, optimizing maternal health, and ensuring timely referral for specialist care. Improving antenatal care coverage through community awareness programs, female education, strengthening primary healthcare services, and enhanced referral systems should therefore remain a national priority. Such interventions have the potential to reduce preventable maternal and neonatal morbidity and mortality while contributing to the achievement of national reproductive health targets and the health-related Sustainable Development Goals.[29,30]

Conclusion:

The present study demonstrated that unbooked pregnancy is significantly associated with poorer maternal and neonatal outcomes compared with booked pregnancy. Women who did not receive adequate antenatal care experienced higher rates of maternal anemia, postpartum hemorrhage, intensive care unit admission, prolonged hospital stay, and maternal mortality. Likewise, neonates born to unbooked mothers had significantly higher frequencies of low birth weight, prematurity, birth asphyxia, stillbirth, and neonatal intensive care unit admission. After adjustment for potential confounding variables, unbooked pregnancy remained an independent predictor of adverse maternal and neonatal outcomes. These findings underscore the vital role of regular antenatal care in early risk identification, timely management of obstetric complications, and improvement of pregnancy outcomes. Strengthening antenatal care services and promoting early pregnancy registration are essential strategies for reducing preventable

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maternal and neonatal morbidity and mortality in Pakistan.

Recommendations:

1. Early antenatal booking during the first trimester should be encouraged for all pregnant women through community awareness and health education programs.
2. Primary healthcare facilities should be strengthened to provide accessible, affordable, and high-quality antenatal care, particularly in rural and underserved areas.
3. Regular screening and timely management of maternal anemia, hypertensive disorders, gestational diabetes, and other high-risk conditions should be ensured during antenatal visits.
4. Public health initiatives should focus on improving female education, maternal health literacy, and awareness regarding the importance of routine antenatal care.
5. Efficient referral systems should be established to ensure timely transfer of high-risk pregnancies to tertiary care hospitals.
6. Healthcare policymakers should expand maternal healthcare coverage and allocate adequate resources to improve antenatal and emergency obstetric services.
7. Future multicenter prospective studies with larger sample sizes and long-term follow-up are recommended to validate these findings and evaluate long-term maternal and neonatal outcomes.

Limitations:

This study has several limitations. First, it was conducted at a single tertiary care hospital, which may limit the generalizability of the findings to other healthcare settings and regions. Second, the use of non-probability consecutive sampling may have introduced selection bias. Third, participants were followed only until hospital discharge; therefore, long-term maternal and neonatal outcomes could not be assessed. Fourth, certain socioeconomic, behavioral, and healthcare access factors that may influence antenatal care utilization were not evaluated in detail. Finally, because of the observational cross-sectional study design, causal relationships between antenatal booking status and adverse pregnancy outcomes cannot be established.

Ethical Approval:

Ethical approval for this study was obtained from the Institutional Ethical Review Committee of Pakistan Ordnance Factories (POF) Hospital, Wah Cantt, prior to commencement of the study. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki.

Informed Consent:

Written informed consent was obtained from all eligible participants before enrollment. Participation was voluntary, and participants were informed of their right to withdraw from the study at any stage without affecting their medical care.

Conflict of Interest:

The authors declare that they have no conflict of interest related to this study.

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Data Availability Statement:

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

Author Contributions:

All authors contributed substantially to the conception and design of the study, data collection, data analysis and interpretation, manuscript drafting, critical revision of the manuscript, and approval of the final version for publication. All authors agree to be accountable for all aspects of the work.

Declaration:

The authors declare that this manuscript is original, has not been published previously, and

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is not under consideration for publication elsewhere. All authors have read and approved the final manuscript and agree to its submission for publication.

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