

# Evaluation Of Outcomes For Pregnant And Postpartum Women In ICU: A One-Year Study

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## Abstract

### Objective:

This study aimed to evaluate the indications for hospitalization and the outcomes of pregnant and postpartum mothers admitted to the Intensive Care Unit (ICU) at Imam Reza Teaching Hospital in Mashhad, Iran, from April 2022 to April 2023.

### Methods & Materials:

This descriptive-analytical study included pregnant and postpartum mothers referred to Imam Reza Hospital due to the need for specialized care. Data were collected over one year using a researcher-designed checklist and analyzed statistically.

### Results:

Among obstetric-related cases, postpartum hemorrhage (56%) was the leading cause of ICU admission, with uterine atony accounting for 34% and retained placenta or genital tract lacerations contributing 22%. Hypertensive disorders were present in 24% of cases, including preeclampsia (12%), HELLP syndrome (8%), and eclampsia (4%). Septic conditions were diagnosed in 8% of patients, predominantly due to septic abortion (6%). Pulmonary thromboembolism was identified in 2% of cases. Non-obstetric-related causes (10% of cases) included pulmonary disorders (42%), cardiac conditions (32%), gastrointestinal and hepatic issues (12%), renal disorders (8%), and other causes (6%). The overall mortality rate was 2%.

### Conclusion:

The study highlights postpartum hemorrhage and pregnancy-induced hypertensive disorders as major causes of ICU admissions among pregnant and postpartum mothers. Early detection and improved management at primary healthcare centers are essential to reduce the need for ICU referrals and associated healthcare costs.

**Keywords:** Pregnancy, ICU, Postpartum Hemorrhage, Hypertensive Disorders, Maternal Mortality

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## I. Introduction

Pregnancy and childbirth, while generally natural physiological processes, can be accompanied by complications necessitating advanced medical care. Admissions to the Intensive Care Unit (ICU) for pregnant and postpartum mothers, although relatively uncommon, represent critical situations often associated with severe maternal morbidity and mortality, necessitating comprehensive care. Studies estimate ICU admissions range from 0.07 to 2.6 per 1,000 deliveries, with mortality rates between 3.4% and 21% in such cases. This highlights the need for comprehensive care and timely intervention to mitigate adverse outcomes.

The physiological changes during pregnancy often mask or exacerbate underlying conditions, presenting unique challenges for clinicians. Disorders such as postpartum hemorrhage, hypertensive complications, and sepsis are among the most common reasons for ICU admissions. The timely identification and management of these conditions are paramount to improving maternal outcomes and reducing healthcare burdens.

The need for special care and ICU admission in pregnant and postpartum mothers is not very common, as they generally belong to a young and mostly healthy group of patients [1-3]. The prevalence of ICU admission for pregnant and postpartum mothers ranges from 0.07 to 2.6 per 1000 deliveries [4], and their mortality rate in

these cases ranges from 3.4% to 21% [2, 3]. Hospitalization of pregnant patients with medical complications in the ICU poses a significant challenge for obstetricians and anesthesiologists and often requires multidisciplinary teamwork to achieve optimal outcomes [5, 6].

Obstetric complications are the most common reason for ICU admission in pregnant and postpartum patients, ranging from 47% to 93% [7-9]. Among these complications, postpartum hemorrhage and hypertensive disorders are the most significant [10]. Unfortunately, few studies have detailed the ICU stay of pregnant and postpartum patients, resulting in limited information on the prevalence, indications for ICU transfer, disease progression, and outcomes of these patients [11-13].

Other core challenges of consideration in the distinct care of critically ill pregnant and postpartum mothers span a wide range of aspects and issues. One leading concern is awareness of physiological changes occurring with pregnancy, especially those of the cardiovascular and respiratory systems, and differentiating them from pathological conditions. It is important to know the standard laboratory variations in pregnancy to avoid misinterpretation.[14, 15]

It must be taken into account that certain drugs taken during pregnancy can be contraindicated in order to maintain the safety of the mother and that of the fetus. The presence of fetal monitoring equipment in the ICU is also an important consideration to aid fetal assessment and appropriate intervention. The mode of delivery for certain critically ill mothers should be chosen with careful consideration of maternal and fetal conditions and should be according to some clear guidelines on pregnancy termination in life-threatening situations.[16, 17]

It is imperative to avoid unnecessary admissions to the ICU and nontherapeutic occupancy of beds so that limited resources are well allocated. Adequate resuscitation should be performed prior to the transfer of a patient to the intensive care unit and the patient should be sufficiently stabilized. Also very important is to have equipment available both for vaginal delivery and cesarean section inside a unit so that interventions can take place on time. Clarifying the roles of obstetricians-whether as primary physicians or as consultants-facilitated by the criteria for ICU admission, could enhance coordination of care.[18, 19]

Increased vigilance in regard to deteriorating clinical and laboratory parameters that require ICU referral is of great importance. Moreover, it is important to prevent medical errors by ensuring that obstetricians provide the proper documentation regarding the orders of consultation before rewriting them. The importance of daily multidisciplinary rounds is key to the total management of the patient, while close collaboration between anesthesiologists and obstetricians helps to make decisions and create treatment strategies for the critically ill mother.[5]

Family engagement during the care process, addressing concerns, and involving them in a shared decision-making process can provide emotional support and improve patient outcomes. Forming crisis committees and regular group consultations for critically ill patients can speed up the decision-making process further. Determining accurately the level of special care required for the transfer of a patient to the ICU allows health resources to be allocated efficiently. Awareness of pregnant and postpartum patients about critical warning signs such as bleeding, labor pain, decreased fetal movements, uterine contraction, and vision disturbances and epigastric pain would aid in early detection and timely intervention.

Furthermore, postpartum complications such as abnormal uterine bleeding, uterine atony, incision site infections, breast engorgement, and breastfeeding difficulties need close monitoring. Increasing staff awareness of imaging considerations during pregnancy can prevent delays in important diagnostic examinations. Similarly, improving obstetricians' and midwives' knowledge and skills to initiate monitoring and resuscitative care for critically ill mothers is important.[20, 21]

Finally, supporting rooming in with critically ill mother's newborns nurtures bonding while psycho-emotional support and having an informed companion supports maternal well-being. Use of prolonged bed rest and catheterization in ICU for pregnant and postpartum patients' needs reconsideration given that doing so bears certain significant risks. Using a multidisciplinary team approach and thorough guidelines to resolve this issue, according to the objectives set forth, could significantly improve the health outcomes of critically ill mothers and their newborns.[22]

Pregnancy and childbirth may be accompanied by complications that lead to ICU admission. Hypertensive disorders in pregnancy are one of the main and significant causes of maternal and neonatal morbidity and mortality. Specifically, hypertensive disorders occurring during pregnancy are common and, along with bleeding and infection, are considered three major killers. These factors are responsible for a significant portion of maternal deaths and complications, with preeclampsia being one of the most important [11, 12, 14, 15, 17]. Preeclampsia, with a prevalence of over 5% to 10% of all pregnancies, especially in the second and third trimesters, is one of the most common, dangerous, and unpredictable complications of pregnancy [17]. Women with preeclampsia in developing countries, like ours, experience more adverse outcomes and higher mortality rates. Preeclampsia can be classified based on gestational age into early-onset (before 34 weeks) and late-onset (after 34 weeks). The prevalence of severe preeclampsia before 34 weeks is 0.3%, and after that, it is 2.7%. Additionally, the neonatal mortality rate in early-onset preeclampsia is ten times higher, and in late-onset, it is

twice as high as in mothers without preeclampsia [16, 18-20]. This disorder is associated with high maternal, fetal, and neonatal complications. Maternal complications of preeclampsia include renal necrosis, pulmonary edema, liver necrosis, hemolysis, elevated liver enzymes, thrombocytopenia, and cerebrovascular accidents. Neonatal complications include stillbirth, neonatal death, intraventricular hemorrhage, hypoxic-ischemic encephalopathy, low Apgar score at 5 minutes, neonatal seizures, respiratory distress syndrome, pneumothorax, and necrotizing enterocolitis [18, 19]. The definitive treatment for preeclampsia and other hypertensive disorders in pregnancy is delivery and placental removal. However, early delivery poses risks that are not entirely mitigated even with corticosteroid use 24 to 48 hours before delivery. On the other hand, pregnant women with early-onset preeclampsia face severe outcomes and even death. Therefore, it is essential to identify preventable risk factors and create conditions to prevent dangerous complications [11, 14-17]. Several factors, including infertility, molar pregnancy, twin pregnancy, obesity and insulin resistance, previous preeclampsia, antiphospholipid syndrome, family history of preeclampsia or eclampsia, fetal aneuploidy, and very young or very old maternal age, are considered risk factors for this disease [11, 14, 15]. There is substantial evidence that the hospitalization of high-risk pregnant and postpartum mothers reduces their mortality.

The importance of managing these patients in the ICU is due to the physiological changes associated with pregnancy and the need for simultaneous fetal health assessment compared to non-pregnant patients [23, 24]. Patients are often admitted to the ICU to achieve the following goals:

- Closer monitoring to detect complications earlier.
- Invasive monitoring.
- Respiratory support.

However, ICU admission also involves many issues, such as high hospitalization costs, patient activity limitations, deprivation of mother-infant contact, inability to have effective companionship, and psychological stress for mothers. It is crucial to carefully transfer pregnant and postpartum patients to the ICU and prevent transfers without proper and scientific indications [25, 26]. By increasing the skills of obstetricians and midwives in caring for critically ill mothers and providing the necessary equipment for monitoring, cases that are transferred to the ICU solely for vital signs monitoring can be reduced [27, 28].

This study evaluates the indications and outcomes of ICU admissions for pregnant and postpartum mothers in a tertiary care setting, aiming to identify trends and areas for improvement in maternal care.

## II. Method

This study was conducted in the ICU at Imam Reza Teaching Hospital, a tertiary care center in Mashhad, Iran, from April 2022 to April 2023. It employed a descriptive-analytical design to investigate pregnant and postpartum women admitted to the ICU.

This study has received ethical approval from the Institutional Review Board at Mashhad University of Medical Sciences, and all stages of the study have been conducted based on the specified ethical protocols. The patients' consent to participate in the study was obtained, and written informed consent forms were collected from them to enter the study.

The ethical committee approval code is IR.MUMS.MEDICAL.REC.1400.680, and it was obtained on 2021-11-30.

Data collection involved a structured checklist that included demographic details, clinical indications, comorbidities, and outcomes. Special attention was given to the use of validated scoring systems, such as the Acute Physiology and Chronic Health Evaluation (APACHE) and Maternal Early Obstetric Warning System (MEOWS), to assess the severity of patient conditions and predict outcomes.

The APACHE scoring system was used to evaluate the overall severity of illness and predict mortality. This comprehensive system incorporates vital signs, laboratory values, and clinical data to provide an objective measure of the patient's health status upon ICU admission. Higher APACHE scores indicate a greater likelihood of mortality, aiding clinicians in prioritizing care and resources.

Table 1: APACHE Score [A]

	4	3	2	1	0	1	2	3	4
Body Temp. (°C)	≤29.9	30–31.9	32–33.9	34–35.9	36–38.4	38.5–38.9		39–40.9	≥41
Mean BP (mmHg)	≤49		50–69		70–109		110–129	130–159	160–179
Pulse (/min)	≤39	40–54	55–69		70–109		110–139	140–179	≥180
Respiratory Rate (/min)	≤5		6–9	10–11	12–24	25–34		35–49	≥50
A-a DO <sub>2</sub> (FiO <sub>2</sub> ≥0.5)					≤200		200–349	≥500	
PaO <sub>2</sub> /FiO <sub>2</sub> (≤0.5)	≤55	55–60		61–70	>70				

Arterial blood pH No ABG data; HCO <sub>3</sub> -	≤7.1 5 ≤15	7.15– 7.24 15–17.9	7.25– 7.32 18–21.9		7.33– 7.49 22–31.9	7.50– 7.59 32–40.9		7.60– 7.69 41–51.9	≥7.70 ≥52
Serum sodium (mmol/L)	≤11 0	111– 119	120– 129		130– 149	150– 154	155– 159	160–179	≥180
Serum potassium (mmol/L)	≤2.5		2.5–2.9	3–3.4	3.5–5.4	5.5–5.9		6–6.9	≥7.0
Serum creatinine (mg/dL)			<0.6		0.6–1.4		1.5– 1.9	2–3.4	≥3.5
Hematocrit (%)	<20		20–29.9		30–45.9	46–49.9	50– 59.9		≥60
WBC (×10 <sup>3</sup> /mm <sup>3</sup> )	<1		1–2.9		3–14.9	15–19.9	20– 39.9		
Glasgow coma scale	15								

Table 2: APACHE Score [B]

Age	Score
≤44	0
45-54	1
55-64	2
65-74	3
≥75	4

Table 3: APACHE Score [C]

Chronic organ insufficiency And non operative And emergent postoperative And elective postoperative	Score
	5
	5
	2

APACHE II score = [A] APS + [B] Age points + [C] CHP[29]

MEOWS, a specific tool for obstetric patients, was employed to monitor early warning signs of deterioration. This system uses thresholds for parameters such as heart rate, respiratory rate, blood pressure, temperature, and mental status to trigger timely interventions. The implementation of MEOWS was critical in identifying patients at risk of complications and guiding clinical decision-making.[30]

Table 4: Modified Early Obstetric Warning Score (MEOWS)

MEO Score	3	2	1	0	1	2	3
O2 saturation %	≤85	86-89	90-95	96≤	-	-	-
Respiratory Rate	-	<10	-	10-14	15-20	21-29	30≤
Heart Rate	-	<40	41-50	51-100	101-110	110-129	130≤
Systolic blood pressure	≤70	71-80	81-100	101-139	140-149	150-159	160≤
Diastolic blood pressure	-	-	≤49	50-89	90-99	100-109	110≤
Diuresis	0	≤20	≤35	35-200	200≤	-	-
Central nervous system level	-	-	Agitated	Alert/ awake	Response only to verbal stimuli	Response only to pain stimuli	unresponsive
temperature	-	≤35	35-36	36-37.4	37.5-38.4	38.5≤	-
Meows 0-1	Normal						
Meows 2-3	Abnormal but stable report finding to health care provider the same day						
Meows 4-5	Abnormal and unstable to be evaluated by medical doctor within 30 minutes						
Meows ≥=6	Abnormal and critical to be evaluated by medical doctor within 10 minutes						

#### Inclusion Criteria:

- Pregnant or postpartum women requiring ICU care.
- Patients referred from primary and secondary healthcare centers.

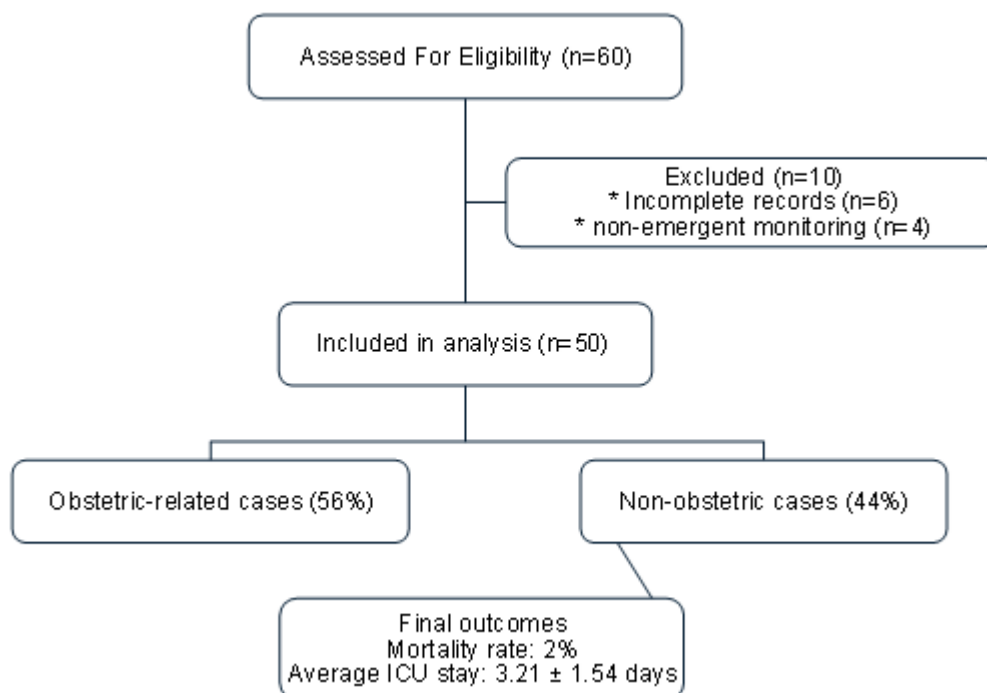
#### Exclusion Criteria:

- Patients with incomplete medical records.
- Those admitted for non-emergent monitoring.

The collected data were statistically analyzed using SPSS software (version 23). Descriptive statistics summarized the findings, while comparative analyses evaluated associations between clinical parameters and outcomes.

Subsequently, the study details and flow are presented in the CONSORT flow diagram.

# CONSORT 2010 Flow Diagram



## III. Results

### Demographic Characteristics

A total of 50 patients were included in the study. The mean maternal age was  $30.35 \pm 3.58$  years, ranging from 17 to 46 years. The majority of patients (34%) were aged 26–30 years, while 20% were between 17–25 years. Regarding residential status, 46% of patients resided in urban areas, while 44% were from rural regions.

Parity distribution showed that 24% of patients were nulliparous, 46% had one prior delivery, 20% had two deliveries, and 8% had three or more.

The mean ICU length of stay (LOS) was  $3.21 \pm 1.54$  days (range: 1–17 days). Regarding mode of delivery, 54% of patients had a vaginal delivery, while 40% underwent cesarean section (C-section), and 6% had a spontaneous abortion.

**Table 5: Demographic Characteristics of the Study Population**

Characteristic	N	Percentage (%)
Age		
17–25	10	20
26–30	17	34
31–35	11	22
36–40	7	14
41–46	5	10
Residence		
Urban	28	46
Rural	22	44
Parity		
0 (Nulliparous)	12	24
1	23	46
3	4	8
4	1	2
Mode of Delivery		
Vaginal Delivery	27	54
Cesarean Section	20	40
Spontaneous Abortion	3	6

### Indications for ICU Admission

The most common indication for ICU admission was postpartum hemorrhage (PPH), affecting 56% of patients. Among these, 34% were due to uterine atony, and 22% were attributed to retained placenta, membranes, or genital tract lacerations.

Hypertensive disorders of pregnancy (HDP) accounted for 24% of admissions, with preeclampsia (12%), HELLP syndrome (8%), and eclampsia (4%) identified as major contributors.

Sepsis-related conditions were observed in 8% of cases, primarily septic abortion (6%) and puerperal sepsis (2%). Additionally, pulmonary thromboembolism was diagnosed in 2% of cases.

Among non-obstetric causes, 42% of patients had pulmonary disorders, 32% had cardiac conditions, 12% had gastrointestinal/hepatobiliary diseases, 8% had renal dysfunction, and 6% had miscellaneous systemic illnesses.

All ICU admissions were clinically justified, and no unnecessary ICU stays were reported.

**Table 6: Indications for ICU Admission**

Condition	N	Percentage (%)
<b>Obstetric Causes</b>		
Postpartum Hemorrhage (PPH)	28	56
- Uterine Atony	17	34
- Retained Placenta, Membranes, Genital Tears	11	22
Hypertensive Disorders of Pregnancy (HDP)	12	24
- Preeclampsia	6	12
- HELLP Syndrome	4	8
- Eclampsia	2	4
Septic Conditions	4	8
- Septic Abortion	3	6
- Puerperal Sepsis	1	2
Pulmonary Thromboembolism	1	2
<b>Non-Obstetric Causes</b>		
Pulmonary Disorders	21	42
Cardiac Disorders	16	32
Gastrointestinal/Hepatobiliary Disorders	6	12
Renal Disorders	4	8
Other Miscellaneous Disorders	3	6

#### Severity Scoring and Maternal Outcomes

The APACHE II score was calculated for all ICU-admitted patients. The mean score was  $11.25 \pm 4.02$ . A threshold of 18 points was set, above which patients were considered at high risk for mortality. Eighteen percent (18%) of patients had an APACHE II score  $\geq 18$ , while 82% had scores below this threshold.

The MEOWS (Modified Early Obstetric Warning Score) assessment showed:

- 74% of patients scored between 0–1 (low risk)
- 16% had a score of 3 (moderate risk)
- 6% scored 4–5 (high risk, requiring urgent attention)
- 4% had a score of  $\geq 6$  (critical risk, requiring immediate intervention)

**Table 7: APACHE II and MEOWS Scores**

Scoring System	N	Percentage (%)
<b>APACHE II Score</b>		
<18	41	82
$\geq 18$	9	18
<b>MEOWS Score</b>		
0-1	37	74
3	8	16
4-5	3	6
$\geq 6$	2	4

#### Maternal Mortality and Morbidity

Maternal mortality was recorded in 2% of cases (1 patient).

**Table 8: Maternal Mortality Rate**

Outcome	N	Percentage (%)
Survived	49	98
Deceased	1	2

#### Summary of Clinical Diagnoses

The most frequent diagnoses among ICU-admitted patients included:

- Postpartum hemorrhage due to uterine atony (34%)
- Hypertensive disorders of pregnancy (24%)

- Septic complications (8%)
- Pulmonary disorders (42%)
- Cardiac conditions (32%)

**Table 9: Identification of Various Disorders in Pregnant and Postpartum Women in the Intensive Care Units of Imam Reza Hospital, Categorized by Individual Study Population**

Patient No.	Condition
1	Dilated Cardiomyopathy (DCM), Mitral Regurgitation (MR)
2	Sepsis, Medically Induced Abortion
3	Preeclampsia + Cardiopulmonary Arrest
4	Intra-abdominal Hemorrhage Following Ruptured Ectopic Pregnancy
5	Exacerbation of Renal Failure
6	Postpartum Hemorrhage + Hysterectomy
7	COVID-19
8	Breast Abscess and Abscess Drainage During Pregnancy
9	Fulminant Hepatitis A
10	Esophageal Varices in the Context of Liver Cirrhosis
11	Placenta Increta and Percreta + Hysterectomy + Preeclampsia
12	HELLP Syndrome
13	Uterine Rupture Following Induced Abortion
14	Preeclampsia and Postpartum Hemorrhage
15	Asthma Attack
16	Severe Influenza
17	Twin Pregnancy and Postpartum Hemorrhage
18	Postpartum Hemorrhage in a Patient with Thalassemia Minor
19	Preeclampsia + Uterine Atony
20	Liver Cirrhosis + COVID-19 + Postpartum Hemorrhage
21	Heart Disease + Pulmonary Embolism
22	HELLP Syndrome
23	Medically Induced Abortion and Sepsis
24	HELLP Syndrome + Uterine Atony
25	COVID-19 + Uterine Atony
26	Patient with Kidney Transplant + Preeclampsia + Uterine Atony
27	COVID-19
28	Peripartum Cardiomyopathy + Postpartum Hemorrhage
29	Preeclampsia + Postpartum Hemorrhage
30	Exacerbation of Asthma + COVID-19
31	Uterine Atony + Preeclampsia
32	Postpartum Hemorrhage Due to Placenta Accreta
33	Exacerbation of Asthma + COVID-19
34	Uterine Atony + Preeclampsia
35	Postpartum Hemorrhage Due to Placenta Accreta
36	Postpartum Hemorrhage Due to Placenta Accreta + Hysterectomy
37	Sepsis + Postpartum Hemorrhage
38	HELLP Syndrome + Postpartum Hemorrhage
39	COVID-19 + Eclampsia
40	Eclampsia + Placenta Accreta + Hysterectomy
41	Intra-abdominal Hemorrhage Following Ruptured Fallopian Tube in Ectopic Pregnancy After Medical Treatment
42	Postpartum Hemorrhage Due to Placental Abruption
43	Postpartum Hemorrhage Due to Placenta Accreta
44	Postpartum Hemorrhage Due to Placenta Accreta
45	Postpartum Hemorrhage Due to Placenta Previa
46	Postpartum Hemorrhage Due to Placenta Accreta + Hysterectomy
47	Postpartum Hemorrhage Due to Uterine Atony
48	Postpartum Hemorrhage Due to Uterine Atony
49	Postpartum Hemorrhage Due to Uterine Atony
50	Postpartum Hemorrhage Due to Uterine Atony

#### IV. Discussion

In relation to obstetric complications, 0.56% of the studied population experienced postpartum hemorrhage. Among these cases, 0.34% were due to uterine atony, and 0.22% were related to retained placenta and membranes, as well as genital tract lacerations. Hypertension-related disorders were observed in 24% of the studied population, with 12% diagnosed with preeclampsia, 8% with HELLP syndrome, and 4% with eclampsia. Septic disorders affected 8% of the patients, with 6% resulting from septic abortion and 2% from puerperal sepsis. Pulmonary thromboembolism was diagnosed in 2% of the cases. Additionally, 10% of the population had non-

obstetric related causes, which included: 42% pulmonary disorders, 32% cardiac disorders, 12% gastrointestinal, liver, and biliary tract disorders, 8% renal disorders, and 6% other -obstetric related diseases.

In a similar study, Zemorshidi (2020) in Mashhad examined pregnant women and those who experienced severe complications within the first 42 days postpartum (puerperium). The results showed that the most common risk factors were hypertension (22%) and bleeding during the current pregnancy (19%). The most common life-threatening complications were severe bleeding during pregnancy and postpartum (32%) and severe preeclampsia (22%). The most frequently used critical interventions were ICU admission (62%) and the use of blood and blood products (37%). The authors concluded that hypertension and bleeding were the most significant risk factors during pregnancy and the most critical life-threatening complications in near-miss maternal cases [29], which aligns with the findings of this study. Therefore, appropriate health measures should be taken to prevent complications related to these factors.

In another study, Mostafavi et al. (2019) in Bushehr examined three categories of complications: serious and life-threatening/non-life-threatening maternal cardiac complications, maternal obstetric complications, and fetal/neonatal complications in pregnant women. The findings indicated that cardiovascular diseases, including hypertension in mothers, could lead to deterioration of their condition and complications in mothers [30], which is consistent with the results of this study. However, in our study, a 2% mortality rate was reported, whereas no deaths were reported in Mostafavi's study. This difference is due to the fact that our study examined all cases admitted to the ICU, while Mostafavi's study only examined individuals with cardiac diseases, making our study more comprehensive and reliable.

In another study, Tabasi et al. (2011) in Kashan examined the frequency of maternal and neonatal outcomes of expectant management in severe preeclampsia before 34 weeks. This retrospective descriptive study reviewed the records of 55 mothers with severe preeclampsia before 34 weeks and their neonates during 2010-2015 in Kashan. The extracted information included demographic variables of the mother and neonate and maternal outcomes. The findings showed that the rates of seizures, postpartum hemorrhage, ICU admission, and platelet decline were 5.5%, 1.8%, 6.3%, and 3.7%, respectively. Additionally, 10.9% of mothers experienced renal failure, elevated liver enzymes, and hemolysis [31], which is consistent with the results of this study, as it was also found that preeclampsia and its related complications are significant factors in examining mothers admitted to the ICU.

In another study, Taghavi et al. (2014) in Tabriz examined the frequency, underlying factors, and outcomes of acute pulmonary edema in pregnant women referred to hospitals in Tabriz. This study included 22,250 patients using a census method, and 2,750 patients were included in the study based on a researcher-made checklist. The results showed that the prevalence of acute pulmonary edema in high-risk pregnancies was 1.2% (34 patients) and 0.15% in the general population of pregnant women. The most common causes of acute pulmonary edema in pregnancy were preeclampsia (52.9% - 18 patients), cardiac diseases (26.5% - 9 patients), and infection (23.5% - 8 patients) [32], which is consistent with the results of this study. Specifically, in our study, the prevalence of acute pulmonary edema was 2%, which is close to Taghavi's study. Similar to Taghavi's study, preeclampsia was identified as a common cause of complications, highlighting the importance of this issue.

In another study, Son et al. (2024) in the United States examined postpartum hemorrhage and its associated risks in the ICU. The results of this study, which reviewed 10,394 patients with postpartum hemorrhage, showed that hypertension-related disorders in mothers had a significant association with postpartum hemorrhage and its related risks in the ICU [33], which is consistent with the results of this study. Conversely, Lanza et al. (2023) in Brazil examined factors associated with severe maternal outcomes in ICU-admitted patients in northeastern Brazil with postpartum hemorrhage. The results showed that gestational age equal to or less than 34 weeks and multiparity were among the risk factors. However, preeclampsia was not significantly associated with postpartum hemorrhage [34], which is inconsistent with the results of this study. This discrepancy may be due to the small sample size in Lanza et al.'s study.

Overall, it can be concluded that hypertension-related disorders and postpartum and intrapartum hemorrhages are among the common causes of ICU admission and deterioration of the condition of pregnant women. Therefore, appropriate health measures should be taken to address these issues.

## **V. Conclusion**

Postpartum hemorrhage and hypertensive disorders remain major contributors to ICU admissions among pregnant and postpartum women. Efforts to enhance early diagnosis and management at primary healthcare levels are vital. Further research should explore preventive strategies and their efficacy in reducing ICU admissions and improving maternal outcomes.

### **Recommendations:**

1. Enhancing early detection systems for obstetric complications at primary healthcare centers, with a recommendation to incorporate APACHE II and MEOWS indices for improved patient assessment and care.



2. Implementing targeted training programs for healthcare providers on managing hypertensive disorders and hemorrhage.
3. Increasing resource allocation to improve maternal healthcare infrastructure in rural areas.
4. Conducting longitudinal studies to assess the long-term outcomes of ICU-admitted mothers and their infants.

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