

Trauma in pregnancy: An analysis of the adverse perinatal outcomes and the injury severity score

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ABSTRACT

BACKGROUND: Trauma during pregnancy is one of the most important causes of non-obstetric maternal and fetal mortality and morbidity. The aim of our study is to evaluate the adverse perinatal outcomes that may occur according to the type and severity of the trauma.

METHODS: In this retrospective cohort study, pregnant traumatized women aged 18–50 years and referred for consultation to the Prof. Dr. Cemil Taşçıoğlu City Hospital's emergency services of the departments of gynecology and obstetrics, between January 1, 2017, and December 31, 2022, were evaluated. Demographic characteristics, trauma findings, Injury Severity Scoring (ISS), and obstetric outcomes were recorded.

RESULTS: A total of 1825 trauma patients, including 900 pregnant were referred to our emergency gynecology clinic for consultation. One hundred and fifty three pregnant patients, whose birth information we reached, were selected as the study group. The mean age of the patients was 25.56 ± 5.99 years and the mean gestational week at the time of trauma was 21.59 ± 9.89 weeks, the patients had fallen (67.97%), had been exposed to violence (30.07%), and had a traffic accident (1.96%). The patient's delivery and hospitalization status on the day of trauma, fracture and ISS ≥ 9 were statistically significantly at a higher rate in the 3rd trimester. Rates of hospitalization and 3rd trimester traumas were found to be significantly higher in the ISS ≥ 9 group. ($P=0.0001$, $P=0.028$, respectively).

CONCLUSION: Compared to the general population, the rates of preterm premature rupture of membranes-premature rupture of membranes, fetal death, fetal distress, cesarean delivery, placental abruption, and preterm delivery increased in traumatized pregnant women. Patients with low ISS scores should also be followed closely during pregnancy in terms of perinatal complications, as well as the severe trauma group.

Keywords: Injury severity scoring; pregnancy; trauma.

INTRODUCTION

Trauma during pregnancy is one of the most important causes of non-obstetric maternal and fetal mortality and morbidity and is seen in approximately 6%–7% of all pregnancies. In order to evaluate the mechanisms of some adverse maternal, fetal and neonatal outcomes as a result of trauma, the type and mechanism of trauma and the physiological changes that may occur during pregnancy should be well known. A multi-

disciplinary approach including obstetrics, perinatology, anesthesiology, surgery, and intensive care teams is recommended for the trauma patient.^[1,2]

During the first 12 gestational weeks, the uterus is a pelvic organ and therefore it is protected from external injury by the bony pelvis. However, fetal loss can be observed in maternal pelvic injuries such as severe gunshot wounds and pelvic fractures that decrease uteroplacental blood flow. As pregnancy progresses, the risk of bowel injury increases in

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penetrating injuries affecting the uterine fundus. Injured and dilated pelvic vascular structure during pregnancy may cause rapid blood loss.^[3,4]

Motor vehicle accidents, falls, slips, domestic or intimate partner violence, and physical assaults are the most common traumas seen during pregnancy. Lesser use of seat belts during pregnancy increases both maternal and fetal morbidity and mortality risks. Blunt trauma most commonly occurs as a result of motor vehicle accidents, while penetrating traumas result from gunshots or stabbings. Blunt trauma to the abdomen increases the risk of placental abruption. However, in penetrating trauma, the probability of direct fetal injury is higher. Imaging studies should not be delayed due to fetal radiation exposure concerns. In case of need, perimortem cesarean delivery should be considered before maternal death for the resuscitation of traumatized pregnant women.^[5,6]

Incidence rates of undesirable perinatal outcomes such as preterm birth, spontaneous abortion, placental abruption, preterm premature rupture, stillbirth increase due to trauma. The aim of our study is to evaluate the adverse perinatal outcomes that may occur according to the type and severity of the trauma.

MATERIALS AND METHODS

In this retrospective cohort study, pregnant traumatized women aged 18–50 years and referred from the general emergency department of Prof. Dr. Cemil Tascioglu City Hospital for consultation to the emergency services of the departments of gynecology and obstetrics between January 1, 2017 and December 31, 2022, were evaluated. Patient information was obtained from patient records. Gestational age was calculated according to the last menstrual period or findings of ultrasound performed before the 20th gestational week. Women with a history of multiple pregnancies, and pregnant women under 18 years old were not included in the study.

Complete blood count, complete blood biochemistry, and obstetric ultrasonography were performed on all patients at the time of their first admission. Amniotic fluid and presence of vaginal bleeding were evaluated by speculum and bimanual examinations. Fetal well-being was evaluated by applying a non-stress test to the patients in the last trimester. At the same time, the amount of amniotic fluid and areas of retroplacental bleeding were assessed with fetal measurements in ultrasonography. Consultations from departments of orthopedics and traumatology, neurosurgery, general surgery, and plastic surgery were requested for the patients who applied to our clinic. Patients under observation were evaluated several times for the presence of bleeding and pain during follow-up.

Injury severity scoring (ISS) is an anatomical scoring system applied to trauma patients. All traumatized pregnant women were evaluated with this scoring system at their first admission. In this scoring system, the body is divided into six regions

as head and neck, face, chest, abdomen, extremity, external, and these regions are scored. The ISS score is calculated by adding the squares of the scores of three most injured areas. ISS values range from 0 (no injuries) to 75 (unsurvivable).^[7] ISS cutoff value is accepted as 9 points. There are studies showing that rates of fractures, dislocations, sprains, open wounds, internal injuries, intracranial injuries, and adverse obstetric outcomes are seen more frequently in patients having scores higher than this cutoff value.^[8]

Jain et al. published a guideline for the management of traumatized pregnant women.^[3] If the frequency of uterine contractions within 10 min is <1 in a mother with stabilized vital signs who has not vaginal bleeding, and pain, then monitorization for 4 h is appropriate. However, in the presence of vaginal bleeding, abnormal fetal heart beat, abdominal or pelvic pain, rupture of membranes in patients with abdominal injury whose uterine contractions are recurring ≥ 1 within 10 min, and in cases of coagulopathy with serum fibrinogen levels <200 mg/dL at least 24 h of follow-up is required. Anti-D immunoglobulin should be given to all rhesus D-negative traumatized pregnant patients. In our clinic, we applied this follow-up protocol for our traumatized pregnant women in accordance with this guideline and hospitalized the patients in case of need.

Maternal age, gravida, parity, abortion, type, time, and location of the trauma, hospitalization time, gestational week at delivery, fetal weight, type of delivery, indications for cesarean section, ISS scores, maternal, and obstetric outcomes were recorded.

Preterm labor is defined as delivery with cervical effacement and dilatation accompanying uterine contractions before the 37th gestational weeks. Small for gestational age (SGA) is defined as birth weight below the 10th percentile for gestational age. Preterm premature rupture of membranes (PPROM) is defined as spontaneous rupture of the amniotic membrane and discharge of amniotic fluid before the 37th gestational week. Premature rupture of membranes (PROM) is defined as the rupture of fetal membranes before the onset of labor. Abruption placentae is defined as bleeding at the decidual-placental interface that causes partial or complete placental detachment. The diagnosis of preeclampsia was established according to the criteria determined by the ACOG Practice Bulletin.^[9] The diagnosis of gestational diabetes mellitus (GDM) was made in 2 steps as recommended by the American College of Obstetricians and Gynecologists (AGOC).^[10]

Statistical Evaluation

In this study, statistical analyzes were performed with Number Cruncher Statistical System 2007 Statistical Software (Utah, USA) package program. In addition to descriptive statistical methods (frequency and percentage distributions, mean, standard deviation, median, interquartile range) used in the evaluation of the data, the distribution of the variables was examined with the Shapiro–Wilk normality test. Krus-

Table 1. Demographic characteristics and trauma findings in all traumatized pregnant women

		All traumatized pregnant women	
Age (years)	Mean (SD)	26.92±5.82	
	Median (IQR)	26 (23–31)	
Gravida	Mean (SD)	2.29±1.54	
	Median (IQR)	2 (1–3)	
Parity	Mean (SD)	0.94±1.18	
	Median (IQR)	1 (0–1)	
Abortus	Mean (SD)	0.35±0.75	
	Median (IQR)	0 (0–0)	
Gestational weeks at the time of trauma	Mean (SD)	19.85±9.9	
	Median (IQR)	19.45 (11–28.075)	
Trauma type (%)	Falls	559	62.11
	Violence	279	31.00
	Motor vehicle accidents	60	6.67
	Penetrating trauma	2	0.22
Hospitalization (%)	No	734	81.56
	Yes	166	18.44
Hospitalization (days)	Mean (SD)	1.86±1.79	
	Median (IQR)	1 (1–2)	
Head trauma (%)	93	10.33	
Lower extremity trauma (%)	150	16.67	
Upper extremity trauma (%)	117	13.01	
Fracture (%)	73	8.11	
Abdominal trauma (%)	84	9.33	
Bleeding (%)	17	1.89	
Nulliparous (%)	420	46.67	
Trimester (%)	1 trimester	294	32.67
	2 trimester	384	42.67
	3 trimester	222	24.67
ISS (%)	0	556	61.78
	1–8	268	29.78
	≥9	76	8.44

ISS: Injury severity scoring; SD: Standard deviation; IQR: Interquartile range.

kal–Wallis test was used for comparisons between groups, Dunn's multiple comparison test was employed for subgroup comparisons, and Chi-square test was used for comparisons of qualitative data. The results were evaluated at the statistical significance level of $P < 0.05$.

Ethics Approval

This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Ethics Committee of University of Health Sciences, Prof. Dr. Cemil Tascioglu City Hospital (Date. January 23, 2023./No. 48670771-514.99-206807619).

RESULTS

A total of 1825 trauma patients, 900 of whom were pregnant, were referred to our emergency gynecology clinic for consultation within 6 years from the general emergency department of our hospital. Patients were divided into groups according to severity of trauma based on ISS system as follows: ISS 0: uninjured, ISS 1–8: non-severely injured, and ISS ≥9 severely injured.

The pregnant group was evaluated in terms of age, gravida, parity, abortion, gestational week, type of trauma, hospitalization time, affected body part, type of treatment applied, presence of bleeding, trimester, and ISS scores (Table 1). The

Table 2. Demographic characteristics and trauma findings in the abortion group

		Abortion	
Age	Mean (SD)	29.15±6.55	
	Median (IQR)	27.5 (24.25–32.25)	
Gestational weeks at the time of trauma	Mean (SD)	6.11±2.02	
	Median (IQR)	5 (5–6)	
Trauma type (%)	Falls	13	65.00
	Violence	7	35.00
Hospitalization (%)	No	16	80.00
	Yes	4	20.00
Hospitalization (days)	Mean (SD)	1±0	
	Median (IQR)	1 (1–1)	
Nulliparity (%)	4	20.00	
Head trauma (%)	4	20.00	
Lower extremity trauma (%)	4	20.00	
Upper extremity trauma (%)	2	10.00	
Fracture (%)	2	10.00	
Abdominal assault (%)	2	10.00	
Bleeding (%)	5	25.00	
ISS (%)	0	11	55.00
	1–8	7	35.00
	≥9	2	10.00

ISS: Injury severity scoring, SD: Standard deviation, IQR: Interquartile range

mean age of the patients was 26.92±5.82 years. The mean gestational week (19.85±9.9 weeks) at the incident of trauma was also recorded. At the time of trauma, the respective percentages of patients were in the 1st (32.67%), 2nd (42.67%), and 3rd (24.67%) trimesters of their pregnancies as indicated. Types of traumas they were exposed to were falling (62.11%), violence (31.00%), traffic accident (6.67%), and penetrating injury with a sharp object (0.22%). ISS scores obtained were 0 in 61.78%, 1–8 in 29.78%, and ≥9 points in 8.44% of the patients.

All of the patients came to the pregnancy controls within 10 days after the trauma. Pregnancies of 20 patients resulted in abortion within the first 10 days after trauma (Table 2). The mean age of the women who had miscarried due to trauma was 29.15±6.55. years. The mean gestational week (6.11±2.02 weeks) at the time of trauma was also recorded. The patients had experienced falls (65.00%) or had been exposed to violence (35.00%). The patients had been exposed to abdominal trauma (10.00%) and 25.00% of the patients had suffered from bleeding episodes. When ISS was evaluated, ISS scores were 0 in 35.00%, 1–8 in 10.00%, and ≥9 in 55.00% of the patients.

Obstetric data of 727 patients who gave birth in other hospitals and did not come to the controls could not be reached.

The remaining 153 pregnant women were selected as the study group and the demographic characteristics and obstetric results of the patients were examined (Table 3). The mean age of the patients was 25.56±5.99 years. The mean gestational week at the time of trauma was 21.59±9.89 weeks, while 30.72% of the patients were nulliparous. The patients had fallen (67.97%), had been exposed to physical assault (30.07%), and had a traffic accident (1.96%). The patient had been exposed to a trauma in the 1st (27.45%), 2nd (43.14%), and 3rd (29.41%) trimesters. The mean duration of hospitalization of trauma patients was 2.57±2.96 days. The mean gestational week of delivery was 37.7±2.19 weeks. The mean fetal weight was 3042.25±511.45 g. Normal delivery was detected in 45.75%, and cesarean delivery in 54.25% of the patients. The most common cause of primary cesarean section was fetal distress in 15.03% of the patients. Five-minute Apgar score was ≥7 points in 94.77% of newborns, while 5.23% of the patients gave birth on the day of trauma.

When perinatal obstetric outcomes of the patients were reviewed GDM (4.58%), preeclampsia (6.54%), abruptio placentae (3.27%), SGA (12.42%), PPROM-PROM (6.54%), preterm labor (4.58%), preterm birth (23.53%), hospitalizations in neonatal intensive care unit (NICU) (24.18%), and maternal intensive care unit (MICU) (1.31%) and fetal demise (1.31%) were detected.

Table 3. Demographic characteristics and perinatal outcomes in trauma patients who gave birth in our hospital

		Trauma patients	
Age (years)	Mean (SD)	25.56±5.99	
	Median (IQR)	24 (21–29)	
Gravida	Mean (SD)	2.59±1.49	
	Median (IQR)	2 (1–3.5)	
Parity	Mean (SD)	1.22±1.12	
	Median (IQR)	1 (0–2)	
Abortion	Mean (SD)	0.37±0.7	
	Median (IQR)	0 (0–1)	
Trauma (gestational weeks)	Mean (SD)	21.59±9.89	
	Median (IQR)	22 (12.6–29.7)	
Trauma type (%)	Fall	104	67.97
	Violence	46	30.07
	Motor vehicle accidents	3	1.96
Nulliparity (%)		47	30.72
Hospitalization (days)	Mean (SD)	2.57±2.96	
	Median (IQR)	2 (1–3)	
Gestational age at delivery	Mean (SD)	37.7±2.19	
	Median (IQR)	38 (36.8–39)	
Fetal weight (g)	Mean (SD)	3042.25±511.45	
	Median (IQR)	3065 (2797.5–3357.5)	
Type of delivery (%)	Vaginal	70	45.75
	Cesarean	83	54.25
Indications for cesarean sections (%)	Previous cesarean	49	32.03
	Fetal distress	23	15.03
	Progress failure	5	3.27
	Cephalopelvic disproportion	3	1.96
	Malpresentation	3	1.96
Apgar scores (%)	Apgar <7	8	5.23
	Apgar ≥7	145	94.77
GDM (%)	7	4.58	
Preeclampsia (%)	10	6.54	
Abruptio placentae (%)	5	3.27	
SGA (%)	19	12.42	
PPROM-PROM (%)	10	6.54	
Preterm labor (%)	7	4.58	
Preterm birth (%)	36	23.53	
Delivery at the day of trauma (%)	8	5.23	
NICU (%)	37	24.18	
Maternal intensive care unit (%)	2	1.31	
Fetal demise (%)	2	1.31	
Bleeding (%)	2	1.31	
Abdominal trauma (%)	15	9.80	
Head trauma (%)	15	9.80	
Lower extremity trauma (%)	17	11.11	
Upper extremity trauma (%)	25	16.34	
Fracture (%)	13	8.50	
Trimester (%)	1 trimester	42	27.45
	2 trimester	66	43.14
	3 trimester	45	29.41
ISS (%)	0	93	60.78
	1–8	49	32.03
	≥9	11	7.19

PROM: Premature rupture of membranes; SGA: Small for gestational age; GDM: Gestational diabetes; ISS: Injury severity score; PPRM: Preterm PROM; NICU: Neonatal intensive care unit; SD: Standard deviation; IQR: Interquartile range.

Table 4. Comparison of demographic characteristics and perinatal outcomes between the trimester groups

		1 trimester		2 trimester		3 trimester		P
Age (years)	Mean (SD)	26±6.22		25.26±5.65		25.47±6.54		0.824*
Gravida	Mean (SD)	2.57±1.4		2.62±1.38		2.58±1.74		0.786‡
	Median (IQR)	2 (1–4)		2 (2–3)		2 (1–3.5)		
Parity	Mean (SD)	1.12±0.99		1.29±1.06		1.22±1.31		0.697‡
	Median (IQR)	1 (0–2)		1 (1–2)		1 (0–2)		
Abortus	Mean (SD)	0.45±0.71		0.33±0.69		0.36±0.71		0.494‡
	Median (IQR)	0 (0–1)		0 (0–0)		0 (0–0.5)		
Type of trauma (%)	Fall	23	54.76	49	74.24	32	71.11	0.082+
	Violence	19	45.24	16	24.24	11	24.44	
	Motor vehicle crash	0	0.00	1	1.52	2	4.44	
Nulliparity (%)	I4	33.33	15	22.73	18	40.00	0.140+	
Type of delivery (%)	Vaginal	14	33.33	37	56.06	19	42.22	0.059+
	Cesarean	28	66.67	29	43.94	26	57.78	
Indications for cesarean sections (%)	Previous cesarean	17	60.71	21	70.00	11	44.00	0.609+
	Fetal distress	7	25.00	6	20.00	10	40.00	
	Progress failure	2	7.14	2	6.67	1	4.00	
	Cephalopelvic disproportion	1	3.57	1	3.33	1	4.00	
Apgar scores (%)	Malpresentation	1	3.57	0	0.00	2	8.00	
	Apgar <7	1	2.38	3	4.55	4	8.89	0.374+
	Apgar ≥7	41	97.62	63	95.45	41	91.11	
Gestational age at delivery	Mean (SD)	38.22±1.55		37.55±2.61		37.44±1.96		0.187*
Fetal weight (gr)	Mean (SD)	2984.29±402.26		3070.83±581.63		3054.44±498.52		0.683*
GDM (%)		1	2.38	5	7.58	1	2.22	0.302+
Preeclampsia (%)		5	11.90	3	4.55	2	4.44	0.255+
Abruptio placentae (%)		2	4.76	2	3.03	1	2.22	0.793+
SGA (%)		5	11.90	9	13.64	5	11.11	0.918+
PPROM-PROM (%)		4	9.52	3	4.55	3	6.67	0.594+
Preterm labor (%)		1	2.38	4	6.06	2	4.44	0.671+
Preterm birth (%)		7	16.67	15	22.73	14	31.11	0.278+
Delivery at the day of trauma (%)		0	0.00	1	1.52	7	15.56	0.001+
Hospitalization (%)		5	11.90	9	13.64	23	51.11	0.0001+
Hospitalization (days)	Mean (±SD)	1.4±0.55		2±1.23		3.26±3.78		0.355‡
	Median (IQR)	1 (1–2)		2 (1–2)		2 (1–3)		
NICU (%)		11	26.19	14	21.21	12	26.67	0.755+
Maternal intensive care unit (%)		1	2.38	1	1.52	0	0.00	0.609+
Fetal demise (%)		1	2.38	1	1.52	0	0.00	0.615+
Bleeding (%)		2	4.76	0	0.00	0	0.00	0.069+
Abdominal trauma (%)		5	11.90	5	7.58	5	11.11	0.716+
Head trauma (%)		3	7.14	9	13.64	5	11.11	0.578+
Lower extremity trauma (%)		5	11.90	13	19.70	7	15.56	0.557+
Upper extremity trauma (%)		4	9.52	6	9.09	3	6.67	0.868+
Fracture (%)		3	7.14	1	1.52	7	15.56	0.019+
Fetal distress (%)		7	16.67	6	9.09	10	22.22	0.155+
ISS (%)	0	29	69.05	38	57.58	26	57.78	0.028*
	1–8	10	23.81	27	40.91	12	26.67	
	≥9	3	7.14	1	1.52	7	15.56	

*One-way analysis of variance; †Kruskal–Wallis test; ‡Chi-square test; SGA: Small for gestational age; GDM: Gestational diabetes; PROM: Premature rupture of membranes; ISS: Injury severity score; PPROM: Preterm PROM; NICU: Neonatal intensive care unit; SD: Standard deviation; IQR: Interquartile range.

Table 5. Comparison of demographic characteristics and perinatal outcomes between the injury severity score groups

		Uninjured		1-8 ISS nonsevere injury				>9 ISS severe injury		P
Age (years)	Mean±SD	25.4±6.07		25.96±6.23		24.64±5.33		0.769*		
Gravida	Mean±SD	2.44±1.51		2.86±1.41		2.73±1.56		0.136‡		
	Median (IQR)	2 (1-3.5)		3 (2-3.5)		3 (1-4)				
Parity	Ort±SS	1.09±1.06		1.43±1.12		1.45±1.51		0.180‡		
	Median (IQR)	1 (0-2)		1 (1-2)		1 (0-2)				
Abortion	Mean±SD	0.35±0.717		0.43±0.71		0.27±0.47		0.691‡		
	Median (IQR)	0 (0-0)		0 (0-1)		0 (0-1)				
Gestational week at the time of trauma	Mean±SD	20.88±9.66		21.58±9.16		27.57±13.43		0.116‡		
	Median (IQR)	21 (12.25-29.15)		22 (15.5-28.3)		35 (13-37)				
Trauma type	Fall	64	68.82	30	61.22	10	90.91	0.191+		
	Violence	26	27.96	19	38.78	1	9.09			
	Motor vehicle crash	3	3.23	0	0.00	0	0.00			
	Nulliparity (%)	34	36.56	10	20.41	3	27.27		0.135*	
Type of delivery (%)	Vaginal	47	50.54	19	38.78	4	36.36	0.331+		
	Cesarean	46	49.46	30	61.22	7	63.64			
Indications for cesarean sections (%)	Previous Cesarean	28	59.57	18	62.07	3	42.86	0.871+		
	Fetal distress	12	25.53	7	24.14	4	57.14			
	Progress failure	3	6.38	2	6.90	0	0.00			
	Cephalopelvic disproportion	2	4.26	1	3.45	0	0.00			
	Malpresentation	2	4.26	1	3.45	0	0.00			
Apgar scores (%)	Apgar <7	6	6.45	1	2.04	1	9.09	0.446+		
	Apgar ≥7	87	93.55	48	97.96	10	90.91			
Gestational week at birth	Mean±SD	37.65±2.29		37.66±2.11		38.3±1.64		0.645*		
Fetal weight (g)	Mean±SD	3011.72±575.41		3047.76±391.16		3275.91±355.82		0.270*		
GDM (%)		5	5.38	2	4.08	0	0.00	0.708*		
Preeclampsia (%)		6	6.45	2	4.08	2	18.18	0.231+		
Abruptio placentae (%)		3	3.23	1	2.04	1	9.09	0.493+		
SGA (%)		13	13.98	6	12.24	0	0.00	0.413+		
PPROM-PROM (%)		8	8.60	2	4.08	0	0.00	0.386+		
Preterm labor (%)		5	5.38	2	4.08	0	0.00	0.708*		
Preterm birth (%)		23	24.73	11	22.45	2	18.18	0.869*		
Delivery at the day of trauma (%)		4	4.30	2	4.08	2	18.18	0.134+		
Hospitalization (%)		18	19.35	12	24.49	7	63.64	0.005*		
Hospitalization (days)	Mean±SD	3.06±3.98		1.75±0.75		3.43±3.05		0.758‡		
	Median (IQR)	2 (1-3)		2 (1-2)		1 (1-7)				
NICU (%)	25	26.88	11	22.45	1	9.09	0.430*			
Maternal intensive care unit (%)		2	2.15	0	0.00	0	0.00	0.520*		
Fetal demise (%)	2	2.17	0	0.00	0	0.00	0.516*			
Bleeding (%)	2	2.15	0	0.00	0	0.00	0.520*			
Abdominal trauma (%)		5	5.38	10	20.41	0	0.00	0.009*		
Head trauma (%)	0	0.00	14	28.57	3	27.27	0.0001+			
Lower extremity trauma (%)		1	1.08	19	38.78	5	45.45	0.0001+		
Upper extremity trauma (%)		0	0.00	10	20.41	3	27.27	0.0001+		
Fractures (%)	0	0.00	0	0.00	11	100.00	0.0001+			
Fetal distress (%)	12	12.90	7	14.29	4	36.36	0.118*			
Trimester (%)	1 trimester	29	31.18	10	20.41	3	27.27	0.028*		
	2 trimester	38	40.86	27	55.10	1	9.09			
	3 trimester	26	27.96	12	24.49	7	63.64			

*One-way analysis of variance; ‡Kruskal-Wallis test; †Chi-square test; SGA: Small for gestational age; GDM: Gestational diabetes; ISS: Injury severity score; PROM: Premature rupture of membranes; NICU: Neonatal intensive care unit; PPROM: Preterm PROM; SD: Standard deviation; IQR: Interquartile range.

11.11%, upper extremity trauma in 16.34%, and fractures in 8.50% of the cases. Injury Severity Scores were 0 in 60.78%, 1–8 in 32.03%, and ≥ 9 points in 7.19% of the patients. ISS 0 was significantly higher in the entire patient group.

The patients were divided into three groups as for the time of traumatic incidents (Group 1 [1st trimester: n: 42; 27.45%]; Group 2 [2nd trimester n: 66; 43.4%] and Group 3 [3rd trimester n: 45; 29.42 %]) and their demographic characteristics, and perinatal outcomes were compared (Table 4). When rates of adverse obstetric outcomes such as GDM, preeclampsia, abruptio placentae, SGA, PPROM-PROM, preterm labor, preterm birth, need for hospitalization in NICU, and MICU, and fetal demise were examined, and compared. No significant difference was found among all 3 trimesters. The patient's delivery and hospitalization status on the day of trauma were statistically significantly at a higher rate in the 3rd trimester ($P=0.001$, $P=0.0001$, respectively). Any difference was not observed between trimesters in terms of trauma localizations in the body. However, the presence of fracture in the 3rd trimester group was detected at a higher rate when compared

with the other groups ($P=0.019$). A statistically significant difference was observed between the distributions of Injury Severity Scores of the groups ($P=0.028$). In the 3rd trimester group, ISS ≥ 9 was higher than the 1st trimester and 2nd trimester groups.

The patients were also divided into Groups 1 (ISS 0 uninjured 60.78% n: 93), 2 (ISS 1–8 Non-severe injury 32.03% n: 49), 3 (ISS ≥ 9 Severe injury 7.19% n: 11) They were divided into three groups and compared in terms of demographic characteristics and perinatal outcomes (Table 5). When adverse obstetric outcomes such as GDM, preeclampsia, abruptio placentae, SGA, PPROM-PROM, preterm labor, preterm birth, NICU, MICU, and fetal demise were examined, no significant difference was found between all three groups of ISS. Rates of hospitalization and 3rd trimester traumas were found to be significantly higher in the ISS ≥ 9 group ($P=0.0001$, $P=0.028$, respectively). When types of trauma such as falls, and physical assault were compared in terms of demographic characteristics and perinatal outcomes, any significant intergroup difference was not found (Table 6).

Table 6. Comparison of obstetric outcomes between the type of trauma groups

		Fall (n=104)		Violence (n=46)		P
Age (years)	Mean (SD)	25.06 \pm 5.93		26.41 \pm 6.42		0.210*
	Median (IQR)	23 (20–29)		25 (21.75–30.25)		
Nulliparity (%)		35	33.65	11	23.91	0.233*
Delivery (%)	Vaginal	51	49.04	18	39.13	0.262*
	Cesarean	53	50.96	28	60.87	
GDM (%)		3	2.88	3	6.52	0.295*
Preeclampsia (%)		7	6.73	3	6.52	0.962*
Abruptio placentae (%)		4	3.85	1	2.17	0.599*
SGA (%)		13	12.50	6	13.04	0.926*
PPROM-PROM (%)		6	5.77	4	8.70	0.508*
Preterm labor (%)		5	4.81	2	4.35	0.902*
Preterm birth (%)		27	25.96	9	19.57	0.398*
Delivery at the day of trauma (%)		6	5.77	1	2.17	0.336*
NICU (%)		21	20.19	16	34.78	0.056*
Maternal intensive care unit (%)		1	0.96	1	2.17	0.551*
Fetal demise (%)		1	0.96	1	2.22	0.539*
Fetal distress (%)		18	17.31	4	8.70	0.169*
Trimester (%)	1 trimester	23	22.12	19	41.30	0.061*
	2 trimester	49	47.12	16	34.78	
	3 trimester	32	30.77	11	23.91	
ISS (%)	0	64	61.54	26	56.52	0.132*
	1–8	30	28.85	19	41.30	
	≥ 9	10	9.62	1	2.17	

*Independent t-test; †Chi-square test; SGA: Small for gestational age; GDM: Gestational diabetes; ISS: Injury severity score; PROM: Premature rupture of membranes; NICU: Neonatal intensive care unit; PPROM: Preterm PROM; SD: Standard deviation; IQR: Interquartile range.

DISCUSSION

Trauma during pregnancy is one of the most important causes of non-obstetric mortality and morbidity. Knowing the mechanism of injury is also important in terms of planning the diagnosis and treatment of patients. In our study, in the traumatized pregnant group whose birth records were examined, most commonly falls were observed followed by violence and traffic accidents. Severe trauma and fractures were found to be significantly higher in the 3rd trimester patients than in other trimester groups. In addition, hospitalization was found to be significantly higher in severely injured patients.

In general, non-life-threatening injuries such as simple contusion, abrasion, and cases with ISS score of 0 are evaluated as minor trauma; while multiple trauma and fractures are considered as major trauma. The risk of death from trauma, need for hospitalization, recovery time, and impact on quality of life should be also considered^[1,11] Petrone et al. conducted a systematic review of the literature and motor vehicle crash was the most common cause of blunt trauma.^[12] In the study of Mendez-Figueroa et al., domestic violence was the most common type of trauma, followed by motor vehicle accidents and falls. On the other hand, penetrating trauma was rarely seen as 3 out of 100,000 live births.^[13] In our study, the most common cause of trauma among pregnant women were falls with a rate of 62.11%. This rate was different from other studies. Most of these patients suffered from minor traumas. Penetrating injuries with stab wounds were observed very rarely with a rate of 0.22%.

Estimation of the gestational week is important for interventions. If the uterus is above the umbilicus, the fetus is 20 weeks or more. But it will press on the vena cava, making resuscitation difficult, and then an emergency cesarean section may be required. In addition, since fetal viability is 22 weeks, there is no need to perform an additional operation for a fetus earlier than this gestational week when deciding for cesarean section for fetal indications.^[14] Since all pregnant patients were evaluated ultrasonographically in our emergency clinic, the gestational week could be determined and the fetal viability limit could be evaluated. First of all, by ensuring the stability health status of the mother, emergency cesarean section was decided in case of need.

In a 6-year retrospective study of Moffatt et al., the average age of the patients was 25.64 years, and an average gestational week of 19.16 weeks.^[15] In the study of Siddiqi et al., in which The National Trauma Databank was scanned between 2017 and 2018, the mean age of traumatized pregnant women over the 20th gestational week was found to be 26.7±6 years.^[16] In our study, the mean age of the traumatized pregnant women was 26.92±5.82 years and the gestational age at the time of trauma was 19.85±9.9 weeks, which was consistent with the literature. Trauma was most common in the second trimester (42.67%). However, compared to other trimesters, significantly higher number of pregnant in the 3rd trimester

had both given birth, and hospitalized on the same day of the traumatic incident (P=0.001, P=0.0001, respectively).

In the retrospective cohort study of El-Kady et al., fractures, dislocations, sprains, and strains were the most common types of injuries. Women who were hospitalized at the time of trauma and delivered immediately had the worst outcomes, regardless of the severity of the injury. In the same study, an increase was observed in the rates of placental abruption, preterm labor and maternal death in pregnant women who did not give birth during the trauma but gave birth in the following weeks. Considering that this late morbidity may be associated with subclinical chronic abruption, it is thought that post-traumatic pregnancy follow-ups should be done regularly.^[17] In our patient group, this type of injury was most common due to falls, which was consistent with the above-mentioned study. In our clinic, 5.23% of the traumatized pregnant women gave birth on the day of trauma. Most of these patients were in the 3rd trimester and the most common injury was fall. Preterm birth was observed in half of these patients, while 25% of the newborns required hospitalization in the NICU. Placental abruption was observed in 12.5% of patients, although ISS was above 9 in only 25% of those who gave birth on the day of trauma.

Placental abruption is the leading complication of maternal trauma and can occur even with minor injury. Its frequency varies between 5% and 50%, depending on the severity of the trauma. Most of them occur within the first 24 h after trauma. Increase in trauma severity also increases the frequency of abruption, delivery and fetal death.^[3,18] Cahill et al., investigated the risk of abruption in pregnant women who had minor trauma during pregnancy. In their 3-year prospective cohort study, only one case of abruption occurred 6 weeks after the traffic accident. No other negative results were found.^[19] While the rate of placental abruption was 3.27% in the entire trauma group in our study, this rate was 12.5% in those who gave birth on the same day as the trauma. Considering that placental abruption is seen at a rate of 0.3%–1% in the normal population,^[20] in our clinic its risk increased in patients, who gave birth on the same day, and also weeks after the traumatic incident. In only 1/5 of the cases with placental abruption in our clinic, placental abruption occurred within the first 24 h on the same day as the trauma. Severe trauma is present in these traumas as a result of falls and the the pregnancy terminated prematurely. It is known that preeclampsia is seen at a rate of 2%–8% in the general population.^[9] In our study, this rate was found to be 6.54%. As a result, it is seen that the risk of preeclampsia does not increase in traumatized pregnant women.

Whatever the mechanism, trauma is associated with a two-fold higher risk of preterm birth, even with minor injuries.^[21] Traumatic injury during pregnancy can cause preterm labor through various mechanisms. Abruption placenta may result in preterm birth in 20% of cases. Extravasation of blood at the placental border may lead to decidual necrosis, which may initiate prostaglandin production and cause preterm delivery.

[3] In our study, while the rate of preterm birth was 23.53% in the whole trauma group, this rate was 50% in those who gave birth on the same day. Considering the 10% rate of preterm birth in the normal population,^[22] in our clinic, the rate of preterm birth increases in patients who gave birth on the same day or weeks after the traumatic incident. PPROM is also associated with preterm delivery. PPROM-PROM is seen in 2-3% of the general population.^[23] In our study, PPROM-PROM was seen in 6.54% of trauma patients, and these rates were considerably higher than those reported for the general population.

In a retrospective study where patient records were scanned for 13 years, blunt injury and penetrating trauma were detected in 91% and 9% of 321 pregnant patients, respectively. Overall maternal and fetal mortality was 3% and 16%, respectively. On the other hand, in cases with penetrating trauma, mortality rates increased due to abdominal injury and maternal hypotension.^[24] Penetrating trauma patients more often required operative intervention than blunt trauma patients. Despite the low ISS, a significant proportion of these patients require operative procedures.^[16] In our clinic, penetrating injury was stabbing injury and observed in only 2 (0.22%) patients who presented with trauma. Severe trauma was detected in one of these patients. All patients underwent surgery and were discharged with recovery. However, perinatal outcomes could not be evaluated because the patients did not give birth in our clinic.

Trauma during pregnancy is responsible for 5 out of 1000 fetal deaths. Early diagnosis and treatment of directly injured fetus will affect the survival of the fetus.^[25] As a result of a 3-year research, Weiss et al. detected fetal demise due to maternal trauma in 2.3/100,000 live births. In this study, placental injury (42%) and maternal death (11%) were detected in respective percentages of cases.^[26] The fetal death rate in the general population is 0.625%.^[27] But we found to be 1.31%, and this rate is higher than that of non-traumatized pregnant women. In another study examining 1262 traumatized pregnant women, traumatized and non-traumatized mothers were compared, and any intergroup difference was not found in fetal death rates in term fetuses. However, fetal death rate in the preterm period increases in trauma patients.^[28] In our clinic, in cases of fetal demise, half of our patients had a history of physical assault and the other half had a history of falling. Any significant difference was not found between groups of physical assault, and fall in terms of fetal death rates. Fetal death did not occur during traumatic incidents in our patients. However, all patients needed maternal intensive care during delivery. Placental abruption was the major factor leading cause of fetal death. However, placental abruption was not observed in any of our patients with fetal death and trauma history.

In the study of Deshpande et al., maternal mortality rates were 1.6 times higher in traumatized pregnant women compared to non-traumatized pregnant women. They reported highest mortality rates at the time of first hospitalization. Mortality rates in cases with violent trauma were 3.14 times

higher than those with non-violent trauma.^[29] In our clinic, post-traumatic maternal death has never been observed.

The average rate of development of gestational diabetes mellitus, and SGA has been reported as 7%, and 19.3%, respectively.^[10,30] In our study group, these rates were lower in traumatized pregnant women. It was determined that the risk for GDM and SGA did not increase in trauma.

In a retrospective population-based study, pregnant women who were subjected to physical assault and hospitalized were young, multiparous patients with inadequate prenatal controls. Adverse outcomes such as prematurity, maternal death, fetal demise, and uterine rupture were more common in pregnant women who gave birth immediately after the assault. Rates of placental abruption increased by 2% and prematurity by 15% in pregnant women who were discharged after the assault and gave birth later on. Preterm birth, low birth weight, and placental abruption are also significantly higher in pregnant women who gave birth long after the trauma.^[31] When the traumatized pregnant group, whose birth information we reached, was examined, 30.06% of the patients were exposed to physical assault. The ISS was observed to be <9 in the vast majority of patients. Consistent with the literature, the majority of our patients were multiparous. Only 1 (2.17%) patient gave birth on the day of trauma. Preterm delivery and neonatal intensive care requirement were observed in this patient. Similar to the literature, placental abruption was observed in 2.17% of pregnant women who were discharged after the incident of physical assault and gave birth later. Prematurity was seen in 19.57% of these patients that was higher than the rates reported in the literature, while 35% of the pregnant women who applied to us with abortion after trauma had a history of physical assault. In some of the studies, physical assault was most common in the third trimester and most commonly (64%) abdominal trauma had been observed.^[3] Most of our patients who were exposed to violence were in the 1st trimester and abdominal trauma were detected at a rate of 21.73%. Abdominal trauma was observed at a lower rate than that cited in the literature.

In the study of Jain et al., falls were the cause of 3%–31% of maternal traumas, and <10% of them had serious maternal and fetal complications which was mostly observed after the 32nd week of pregnancy. The increase in lumbar lordosis during pregnancy causes a displacement in the center of gravity. This condition leads to an increase in falls during pregnancy. Preterm labor, placental abruption, uterine rupture, fetal growth restriction, and fetal death rates also increase with falls.^[3] In the trauma group in our study, falls were seen at a rate of 67.97% that is, at a higher rate than those reported in the literature. Contrary to the literature, falls were mostly seen in the second trimester. Most of the pregnant women who applied with abortion after trauma had a history of falls.

The rate of traffic accidents during pregnancy was found to be 6.47/1000 in Canada.^[32] In the study of Mattox and Goetzl traffic accidents accounted more than 50% of traumatic inci-

dents exposed by pregnant women, and 82% of fetal deaths were attributed to these accidents.^[33] In the study of Aboutanos et al., fetal demise as a result of traffic accident was found to be 1300–13000/year. Motor vehicle accidents are the leading cause of maternal injuries during pregnancy.^[34] Only 6.67% of all traumatized pregnant women admitted to our clinic had a traffic accident, and 5% of these patients gave birth in our clinic without any resultant adverse obstetric outcomes.

In a retrospective cohort study of Schiff and Holt, cesarean delivery was increased 1.6 times and placental abruption 9 times increased in severely injured pregnant women compared to pregnant women who had not had an accident.^[8] An increase in fetal distress and cesarean section rates was observed in severely, non-severely injured and uninjured patients. There was also an increase in placental abruption and premature births in uninjured pregnant women compared to pregnant women who had not had an accident. Consistent with the literature, there was an increase in fetal distress and cesarean section rates in all ISS groups in our study. In addition, there was an increase in placental abruption and preterm births in uninjured pregnant women compared to the general population.

Perimortem cesarean section should be performed for live pregnancies after the 23rd gestational week at the latest within 4 min following maternal cardiac arrest. The American Heart Association also recommends this approach. Delivery increases venous return and cardiac output by 25%–30% and may ensure a clear survival benefit for the mother.^[35,36] In our clinic, perimortem cesarean section was not required for any traumatized pregnant woman.

We acknowledge that this study has some limitations. Data related to socioeconomic status, race and ethnicity were not analyzed in this study. Although many trauma patients applied to our clinic, we had difficulty in obtaining obstetric results because some of these patients did not give birth in our hospital. Therefore, we had to exclude these patients from the study. However, the difference of our study that distinguishes it from many other studies is that we evaluated traumatized pregnant women using injury severity scores and adverse obstetric outcomes according to trauma types.

CONCLUSION

We evaluated the risk of adverse maternal and perinatal outcomes for pregnant women following trauma stratified by the severity of maternal injury. In the traumatized pregnant group, most frequently falling was observed followed by violence and traffic accidents. The rates of delivery and hospitalization at the same day, fracture, and severe trauma were statistically significantly higher in the third trimester group. Compared to the general population, the rates of PPROM-PROM, fetal death, fetal distress, cesarean delivery, placental abruption, and preterm delivery increased in traumatized pregnant women. An increase in adverse obstetrical outcomes was observed in pregnant women who both gave birth on the

same day as the trauma or the following weeks. Regardless of injury severity scores, all traumatized pregnant women are at in the risk group. Patients with low ISS scores should also be followed closely during pregnancy in terms of perinatal complications, as well as the severe trauma group. It should be kept in mind that all traumatized women who come to the emergency service may be pregnant and priority should be given to maternal resuscitation. Our study was conducted with a greater number of traumatized pregnant women, but multicenter prospective studies are needed to better evaluate perinatal outcomes.

Ethics Committee Approval: This study was approved by the University of Health Sciences Prof. Dr. Cemil Tascioglu City Hospital Research Ethics Committee (Date: 23.01.2023, Decision No: 48670771-514.99-206807619).

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ORIJİNAL ÇALIŞMA - ÖZ

Gebelikte travma: Olumsuz perinatal sonuçlar ve yaralanma şiddet puanının analizi

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AMAÇ: Gebelikte travma, obstetrik olmayan maternal ve fetal mortalite ve morbiditenin en önemli nedenlerinden biridir. Çalışmamızın amacı travmanın tipine ve şiddetine göre oluşabilecek olumsuz perinatal sonuçları değerlendirmektir.

GEREÇ VE YÖNTEM: Bu retrospektif kohort çalışmada, 1 Ocak 2017 ile 31 Aralık 2022 tarihleri arasında Prof. Dr. Cemil Taşçıoğlu Şehir Hastanesi Kadın Hastalıkları ve Doğum acil servislerine konsültasyon için başvuran 18-50 yaş arası travma geçirmiş gebeler değerlendirildi. Demografik özellikler, travma bulguları, Yaralanma Şiddet Skorlaması ve obstetrik sonuçlar kaydedildi.

BULGULAR: 900'ü gebe olmak üzere toplam 1825 travma hastası konsültasyon için acil jinekoloji kliniğimize sevk edildi. Doğum bilgilerine ulaştığımız 153 gebe hasta çalışma grubu olarak seçildi. Hastaların yaş ortalaması 25.56±5.99 yaş, travma geçirdiği gebelik haftası ortalaması 21.59±9.89 hafta idi. Hastalarda %67.97 düşme, %30.07 şiddet ve darp ve %1.96 trafik kazası izlendi. Travma günü doğum oranları, hospitalizasyon durumları, ISS ≥9 ve kırık varlığı 3. Trimesterde anlamlı olarak yüksek bulundu. Hospitalizasyon ve 3. Trimester travmaları ISS ≥9 grubunda anlamlı olarak daha fazla görülmekteydi. (p=0.0001, p=0.028).

SONUÇ: Genel popülasyonla karşılaştırıldığında, travma geçirmiş gebelerde PPROM-PROM, fetal ölüm, fetal distres, sezaryen doğum, plasenta dekolmanı ve erken doğum oranları artmıştır. ISS skoru düşük olan hastalar da, ciddi travma hastaları gibi gebelik döneminde perinatal komplikasyonlar açısından yakından izlenmelidir.

Anahtar sözcükler: Gebelik; travma; yaralanma şiddet puanı.

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