



Physical trauma etiologies in pregnancy in Turkey

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Background: Pregnancy and trauma combination is a rare condition which requires additional attention. Adequate experience and a multidisciplinary approach are important to maintain maternal and fetal health. This study aimed to analyze trauma cases during pregnancy. **Methods:** We investigated the data of pregnant women who were admitted to our emergency department after trauma between 2014 and 2019. We recorded trauma etiologies and the distribution of etiologies based on variables such as age, gravidity number and pregnancy week. In addition, we analyzed obstetric/non-obstetric injuries and pregnancy outcomes. **Results:** This study included 1031 cases. The mean age was 25.9 ± 5.8 (15–48) years. The second trimester had the highest number of trauma cases (411 [39.9%]), whereas the first trimester had the lowest (221 [21.4%] patients). Trauma cases were highest during the first pregnancy (420 [40.7%]). Blunt trauma was the main trauma mechanism (1007 of 1031 cases [97.7%]). The most common trauma etiology was simple fall (SF) (503 [48.8%]). The second common trauma mechanism was assault and affected 180 (17.5%) of patients. In 46 (25.6%) cases assailant was patients partner. The most common obstetric symptom was vaginal bleeding (2.7%), and the most common bone fracture was tibial fracture (0.5%). **Conclusions:** The etiologies of trauma in pregnant women significantly differ from the normal population. SFs and assaults play a major role in the etiology. Knowledge of the distribution of these etiologies according to pregnancy week may allow preventive measures to be taken.

Keywords

Pregnancy; Trauma; Assault; Fall; Accident; Electric shock

1. Introduction

Trauma during pregnancy is an important clinical challenge that can threaten maternal and fetal health [1–4]. Approximately 6%–7% of women experience physical trauma during pregnancy. Traumatic injuries can complicate one of 12 pregnancies and 0.2% of pregnant women can be needed hospitalization because of trauma [2–4].

In pregnant women, trauma etiologies may be different from general trauma population. Most pregnant women are admitted to hospital after blunt traumas, such as simple falls (SF) and motor vehicle accident (MVA); and the rate of domestic violence is also reported very high [3–7]. Despite these important features, there are only a few studies about trauma etiologies during pregnancy in the literature. For example, falls are common traumas during pregnancy, but studies which investigate the fall details (falls from stairs, falls on

the same level, falls from height, etc.) are extremely rare [1–9].

In addition to etiology differences, presence of fetus requires different approaches, instead of the conventional trauma protocols. The limited use of diagnostic tests, such as X-ray graphics and computed tomography, the teratogenic effects of drugs, and the physiological changes during pregnancy require further attention, experience, and multidisciplinary approach [1, 4, 8].

In our study, we tried to determine the most common trauma etiologies during pregnancy in Turkey and then identified the distribution of these etiologies according to variables, such as gestational age and patient age, in order to illustrate a guide for protective measures against trauma. We examined the obstetric and non-obstetric injuries of the patients. Finally, post-traumatic pregnancy outcomes and follow-up strategies were opened to discussion.

2. Materials and methods

This study was approved by the Institutional Ethics Committee Board of the İzmir Katip Çelebi University, Atatürk Training and Research Hospital (No. 152 dated 27 March 2019). We analyzed the data of the pregnant women's who were admitted to our emergency room after trauma, between 28 February 2014, and 28 February 2019 retrospectively. Pregnancy diagnosis were verified by ultrasonography (USG) which performed by an obstetrics and gynecologists physicians in all patients. Patients with intrauterine fetus presence in USG were considered pregnant. Patients who did not meet this criterion were excluded from study. The demographic data of the patients and their detailed medical history (number of previous pregnancies and outcomes of pregnancies etc.) were recorded. Examination findings, radiological examination results and all suggestions from consultations with other clinics were recorded similarly. Moreover, control examinations after discharge, pregnancy results, delivery patterns and difficulties/pathologies detected at birth were recorded. Patients who were exposed to trauma more than once during the same pregnancy were included in the study considering their last trauma. Patients who had been exposed to trauma in different pregnancies during the 5-year of the study period were included in the study focusing on their latest trauma for each pregnancy.

Table 1. Demographic features of patients.

	Average	Median
Age (Year)	25.9 ± 5.8 (15–48)	25
Gravidity number	2.2 ± 1.3 (1–10)	2
Parity number	0.8 ± 1.1 (0–8)	1
Miscarriage and abortion number	0.3 ± 0.3 (0–5)	0
Ectopic pregnancy	0.005 ± 0.1 (0–1)	0
Live births	0.8 ± 1.0 (0–8)	0
Vaginal delivery	0.5 ± 0.9 (0–8)	0
Cesarean section	0.3 ± 0.6 (0–3)	0
Pregnancy date which traumatized (day)	151.7 ± 64.6 (42–281)	149

The demographic characteristics, previous gestational history and trauma timing of the patients are summarized.

The etiology of trauma was thoroughly examined in all patients and were categorized as simple falls (SF) (fall from same level, fall while walking, etc.), falling from stairs, falling from high, bumps (bumping the head, chest, and abdomen; bumping into an object while straightening or stretching), assault and violence, MVAs as occupant/driver (MVAO), MVAs as pedestrian (MVAP), motorcycle accidents, penetrating injuries (by a stabbing weapon, gunshot injuries), electric shocks, burns and other injuries. For patients who had a history of falling from high or from stairs, the estimated falling height was also recorded. Suicidal attempts were also noted but suicidal attempts with overdose drugs were not included in the study due to the concerns about the lack of clear information about the doses of the drugs used and the unclear relationship between the drug and pregnancy outcome. Despite this, suicidal attempts related to physical trauma (gunshot injury, falling from high places, etc.) were included in the study.

Non-obstetric injuries of the patients were evaluated by consultant physicians from relevant disciplines. After a detailed examination, additional radiological examination decision was made by the consultant physicians if needed. This approach allowed to reduce unnecessary radiological examinations. The obstetrical and fetal pathologies were evaluated by obstetrics and gynecologists, and when needed, fetal cardiogram, tocometry or additional tests were applied. Furthermore, patients data who underwent emergency birth/cesarean section were recorded in detail.

All statistical data were analyzed using the IBM SPSS 25 package program. Then, distribution of trauma cases and trauma etiologies were determined according to variables.

3. Results

We included 1031 pregnant women in the study. The mean age of the patients was 25.9 ± 5.8 (15–48 years) (Table 1). Approximately (51.0%) of the patients were between the ages of 19–26. After traumas were distributed according to age, it was observed that 21 years old was prominent age for trauma and 71 (6.9%) of the patients were exposed to trauma at the age of 21 (Fig. 1).

Regarding pregnancy history; the mean number of gravid-

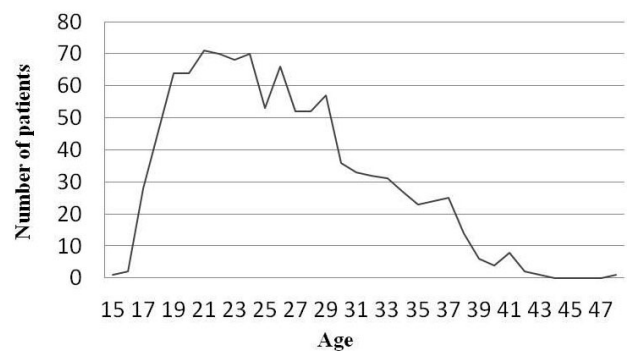


Fig. 1. Distribution of trauma by age. 21 years old was prominent age for trauma and 71 (6.9%) of the patients were exposed to trauma at the age of 21.

ity was 2.2 ± 1.4 (1–10). 420 (40.7%) patients were found to be traumatized during their first pregnancy and 278 (27.0%) during their second pregnancy. Nevertheless, as the number of previous pregnancies increased, the trauma exposure decreased significantly (Fig. 2).

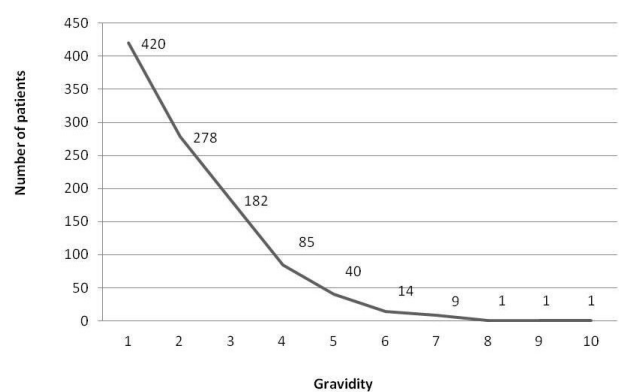


Fig. 2. Distribution of trauma by gravidity. Regarding pregnancy history; the mean number of gravidity was obtained as 2.2. 40.7% patients were found to be traumatized during their first pregnancy. Nevertheless, as the number of previous pregnancies increased, the trauma exposure decreased significantly.

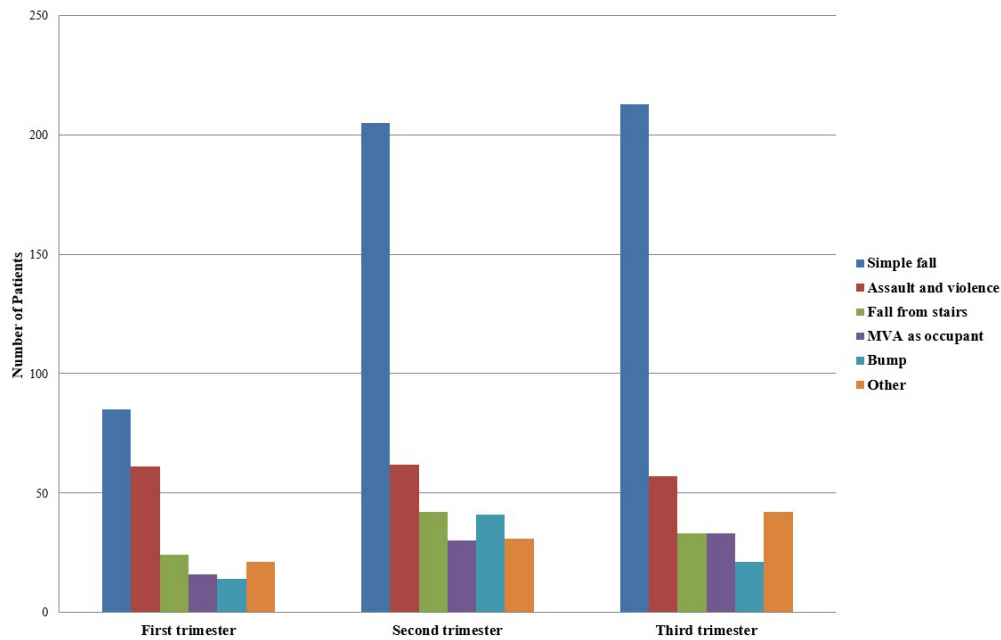


Fig. 3. Distribution of trauma by trimester. The highest number of trauma cases was obtained during the second trimester. The most common etiology for blunt trauma was falls, and simple fall (SF) was the most dominant one in all trimesters.

Patients exposed trauma on 151.7 ± 64.6 (42–281) days of their pregnancy. The highest number of trauma cases was obtained during the second trimester (411 [39.9%] patients), followed by the third trimester (399 [38.7%] patients), and the lowest was during the first trimester (221 [21.4%] patients) (Fig. 3).

In terms of trauma etiology, blunt trauma was noted in 1007 (97.7%) patient, 24 (2.3%) patients were admitted with different trauma mechanism as follows: 8 (0.8%) electric shocks, 6 (0.6%) burns, 4 (0.4%) penetrating trauma, 3 (0.3%) animal bites, and 3 (0.3%) suicidal attempts (fall from height, wrist-cutting, and hanging) (Fig. 3, Table 2). The most common etiology for blunt trauma was falls, and simple fall (SF) was the most dominant one (48.8%). The second most frequent blunt injury mechanism was assault and violence, which affected 180 (17.5%) of patients, and the least frequent was motorcycle accident, which affected only 16 (1.6%) patients (Table 2). A total of 127 patients (12.3%) were injured because of MVAO, MVAP, and motorcycle accidents collectively (MVAs); hence, MVAs were the third most frequent cause of trauma after SF and assault/violence.

With regard to the distribution of trauma mechanisms according to pregnancy trimester, SF was the most common trauma etiology and also the most common trauma mechanism in all trimesters (Table 2). In addition, a big portion of SFs cases (42.4%) occurred during the third trimester (only 16.9% transpired during the first trimester). SFs accounted for 53.4% of all the traumas during the third trimester (Fig. 3).

The second most frequent trauma mechanism was assault and violence in all trimesters (Fig. 3). Around 61 (33.9%) of the 180 assault and violence cases occurred during the first

trimester, 62 (34.5%) during the second trimester, and 57 (31.7%) during the third trimester (Fig. 3). In 46 (25.6%) case, patient's partner was reported as assailant.

Of the 99 patients who fell from stairs, 24 (24.2%) fell during the first trimester, 42 (42.4%) during the second trimester, and 33 (33.3%) during the third trimester. The average number of stair steps that the patients fell on was 4.0 ± 2.7 (1–15 steps).

Overall, 127 patients experienced MVAs. MVAO (79 [62.2%] patients) was the most common MVA type. It was observed that 41.1% of admissions to the hospital after a traffic accident were obtained in the third trimester.

Regarding non-obstetric injuries, tibial fracture was the most common bone fracture (5 [0.5%]). Other bone fractures were; radial fracture (4), patellar fracture (2), malleolar fracture (2), facial bone fracture (2), vertebral fracture (2), fibula fracture (1), femoral fracture (1), and metacarpal fracture (1). The most common cause of bone fracture was falling from stairs (6), and second was SFs (4). Bone fracture-related surgery was performed in three (0.3%) patients. Other non-obstetric injuries were tympanic membrane perforation (2), subdural hematoma (3), and eye injuries (3).

Moreover, obstetric pathologies during admission were as follows: vaginal bleeding (28 [2.7%]), retroplacental hematoma (9 [0.9%]), missed abortion (2 [0.2%]), intrauterine mortis fetus (1 [0.1%]), uterine rupture (1 [0.1%]), and rupture of membranes (ROM) (1 [0.1%]). In the case of uterine rupture, the fetus died after being delivered *via* emergency cesarean section. Only 4 (0.4%) patients experienced pregnancy loss during the early post-traumatic period; nonetheless, maternal death was not observed. Of these four preg-

Table 2. Distribution of trauma by etiology.

Trauma	Total		1 st trimester		2 nd trimester		3 rd trimester	
	n	%	n	%	n	%	n	%
Simple fall	503	48.8	85	38.5	205	49.9	213	53.4
Assault and violence	180	17.5	61	27.6	62	15.1	57	14.3
Fall from stairs	99	9.6	24	10.9	42	10.2	33	8.3
MVAO	79	7.7	16	7.2	30	7.3	33	8.3
Bump	76	7.4	14	6.3	41	9.9	21	5.3
MVAP	32	3.1	6	2.7	11	2.7	15	3.8
Fall from height	22	2.1	5	2.3	8	1.9	9	2.3
Motorcycle accident	16	1.6	3	1.4	5	1.2	8	2.0
Electrical shock	8	0.8	2	0.9	3	0.7	3	0.8
Burn	6	0.6	1	0.5	2	0.5	3	0.8
Suicidal attempt	3	0.3	1	0.5	1	0.2	1	0.3
Animal attack	3	0.3	2	0.9	0	0	1	0.3
Gunshot injuries	2	0.2	0	0	1	0.2	1	0.3
Penetrating injuries by a stabbing weapon	2	0.2	1	0.5	0	0	1	0.3
All falls	624	60.5	114	51.6	255	62.1	255	63.9
All motor vehicle accidents	127	12.4	25	11.3	46	11.2	56	14.1
Total number of traumas	1031		221		411		399	

MVAO, motor vehicle accidents as occupant/driver; MVAP, motor vehicle accidents as pedestrian.

nancy losses, three occurred following assault/violence, and one occurred after falling from stairs. Most of obstetric injuries 12 of 42 (28.6%) (vaginal hemorrhages [8], ROM [1], and retroplacental hematomas [3]) occurred after SFs, whereas 10 (23.8%) (vaginal hemorrhages [8] and retroplacental hematomas [2]) occurred after MVAs.

Pregnancy follow-ups and terminations were performed in 187 patients. Overall, 79 (42.2%) patients had spontaneous pelvic birth, and 94 (50.3%) underwent cesarean section. Spontaneous abortion, dilatation and curettage, and provoked abortion occurred in 10 (5.3%), 3 (1.6%), and 1 (0.5%) patients, respectively.

4. Discussion

Pregnancy and trauma combination is common for gynecologists and obstetricians but it is particularly rare for trauma specialists. While (1.5%) of women admitted for trauma are pregnant, and (6%–7%) of pregnant women are exposed to trauma [1, 4, 5, 11].

This special patients group differs from the general trauma population in many respects. Many factors such as complex pregnancy physiology, association of mother and fetus, limited use of radiological tests, teratogenic effects of drugs require a different approach than the normal trauma population [1, 12]. Combination of traumatic maternal injuries, fetal injuries and obstetric problems requires a carefully multidisciplinary cooperation [1, 5]. Concerns about treatment effects on the fetus, and decisions to not pursue treatment to protect the fetus are also frequently encountered condition in pregnant women.

Considering the association of pregnancy and trauma, the first issue to be explained is the differences in etiology. Although different rates are given in the literature, the most

common traumas in pregnancy are blunt traumas and penetrating traumas affect only 2–7% of all patients [5, 8–10]. The most common causes of blunt traumas are falls, MVAs, and assault/violence [5, 12]. In the study by El-Kady *et al.* [5] the most common blunt trauma mechanism in pregnancy was falls, and second was MVAs. Similarly, Tinker *et al.* [13] reported that in their study, most of patients (51.6%) were admitted to hospitals because of falls. However, in a study by Petrone *et al.* [12] they explained the most common trauma mechanism during pregnancy as MVAs. In addition to this variance in blunt trauma distribution, very few studies have investigated falls and MVAs by dividing them into subcategories [5, 8–11]. For this reason, we subcategorized and detailed examined these two important trauma etiologies in our study and got surprising results. The most common trauma mechanism was “falls” in our study and this finding was also compatible with general literature. Falls affected 624 (60.5%) patients and contained “simple falls”, “falling from stairs” and “falling from height” subcategories.

In pregnant women, gravity center of body moves forward. With the growth of the uterus, the field of view on the ground decreases, and the step localization becomes less visible. These physiological changes make pregnant women more prone to fall [8, 14, 15]. It also seems acceptable finding that these factors become more evident in the late pregnancy weeks and cause an increase in the number of “falls”. As expected; rate of falls increased during late weeks of pregnancy in our study. While the all falls rate was 51.6% in the first trimester, this rate reached 62.1% in the second, and 63.9% in the third trimester. SFs have also increased similarly; while it was determined as 38.3% in the first trimester, it reached 54.3% in the third trimester.

Another remarkable finding in our study is the high rate of assaults/violence. Despite all the measures taken to prevent violence against women, assault and violence were the second most common trauma mechanism. The incidence of intimate partner violence (IPV) during pregnancy is substantially influenced by sociodemographic characteristics [16, 17]. The results can be different, particularly due to the relativity of the concepts of violence/abuse and failure to report incidents of assault due to forensic concerns. Depending on all these variables, the rate of physical violence/abuse during pregnancy is as wide as 1%–20% [16–18]. Although only patients who exposed physical violence were included in our study, the violence rate was very high and obtained as 17.5%. In 46 cases (25.6%), the assailant was the partner of the patient. Therefore, in 4.5% of the 1031 cases, the patient's partner was responsible for the trauma. This high rate reveals the importance of this issue for Turkey. Knowing which pregnancy period the violence occurred is also important. Nannini *et al.* [19] concluded that most of violence case occurs during the first trimester of pregnancy and during the first 3 months following childbirth. The cases in our study were acquired approximately equal rates (33.9%, 34.5%, and 31.7%) in all trimesters. Despite all this detailed analysis, our results are open to discussion due to important unlit points. Many of the patients may have hidden their violent events by suggesting different trauma mechanisms due to fear and anxiety. At this stage, both healthcare professionals, physicians and security guards have a great responsibility to prevent patients from being subjected to violence again. Examination findings that are not compatible with the history of trauma, injuries findings compatible with different times, the patient's unstable psychological state, previous trauma records, diminished self-image, depression, previous suicide attempts, frequent emergency department visits may be guiding. Although our study was carried out with great care, the importance of the partner violence may not be sufficiently demonstrated due to retrospective nature of study and the limited psychiatric evaluation in emergency room. As a suggestion, this special patient group could routinely undergo a psychiatric and social examination to be evaluated for violence and abuse after trauma related examinations were completed. When suspicious situations are detected, forensic centers should be informed and patient safety promptly should be ensured.

Motor vehicle accident rate has been reported as approximately 48% in the literature and our results were partially different [2, 5]. Vivian-Taylor *et al.* [20] reported MVA occurred in 2147 cases and its prevalence was 3.5 for every 1000 live births. This study reported the distribution of MVAs as MVAO (88.6%), MVAP (3.4%), motorcycle accident (0.9%), bicycle accident (0.8%), and other accidents (6.3%). In our study, the distributions of MVAO and MVAP were (62.2%) and (25.2%), respectively. The high difference in MVAP can be attributed to pedestrian rights and compliance with traffic rules. The rate of motorcycle accident in our study was (12.6%); this rate can be explained by the prevalent use of mo-

torcycle in the city and especially towns where the study was conducted.

Suicide thoughts might occur in 3%–33% of pregnant women, and this rate varies depending on several factors, such as socioeconomic status, educational background, demographic characteristics, additional psychiatric diseases, and the willingness of getting pregnant [21, 22]. In their study (that included 1439 pregnant women with psychiatric diseases), Gressier *et al.* [23] reported 154 (11.68%) suicidal attempts, of which 49 occurred during pregnancy and 105 after pregnancy. In their 263-case series, Wallace *et al.* [21] reported that only 70 patients had suicidal attempts during pregnancy, whereas 32 had suicidal attempts during the early postpartum period and 102 during the late postpartum period. In our study, we included only the suicide attempts that occurred during pregnancy and we detected in one patient in each trimester.

Penetrating traumas during pregnancy are uncommon, accounting for up to 2%–7% of all traumas and estimated at 3.3 cases per 100,000 live births [1, 10]. Despite its low incidence, it deserves attention because of 2 important features. First of all, pregnant women experience a higher rate of penetrating trauma than non-pregnant women [10, 11]. This surprising finding may be associated with violence and can be used as a secondary data showing increase of violence during pregnancy. The second important point is about high mortality and morbidity rates. Although rarely encountered, penetrating traumas may progress with higher maternal and fetal morbidity. Especially in advanced weeks of gestation, fetus is at serious risk for penetrating abdominal trauma [10, 11]. Fortunately, penetrating injuries accounted for only 0.4% of the trauma cases in our study. Two of them were gunshot injury and two of them by a stabbing weapon. A fetal problem was not detected in examination. Although penetrating injuries are considered as a separate category of trauma in our study, it should not be ignored that all 3 of these injuries were violence events and only one of them was accident.

Electric shock during pregnancy is extremely rare, and its exact incidence is unknown because asymptomatic cases are not reported [24, 25]. The severity of this injury can vary depending on the amount of voltage, duration of the current, and its tract in the body [19, 20]. Its maternal effects can range from asymptomatic injury to severe burns, arrhythmia, cardiac injury, and even death [24, 25]. Similarly, the fetus may experience different damages from a normal course of pregnancy to abortion [24, 25]. In our study, all 8 pregnant women were injured by “household circuit current”. Only one had a skin burn that required treatment. Related injuries such as arrhythmia, shock etc. were not detected in the patients. Fetal injury or early fetal loss did not detected in any patients.

In their study Parikh P. *et al.* [26] explained that, “total body surface area” of burns (TBSA) was positively associated with maternal death and maternal survival declines incrementally when TBSAB exceeds (55%). They also showed,

inhalation injuries were increased maternal and fetal risks. In a study with 38 cases, burns were most frequent in the second trimester [27]. In our study, burns were encountered in only 6 patients and all cases developed as a result of contact with hot water. Burn surface area was not more than 9% in any of our patients. Electrolyte imbalance, shock or secondary infection etc. did not develop in our patients. Maternal or fetal death was not observed.

Relating trauma severity and pregnancy outcomes is another issue in pregnant women. In pregnant women admitted for traumatic injuries, the focus should be on the mother first, ensuring respiratory and hemodynamic stability [2, 3]. At this stage, a quick and detailed obstetric examination can be effective for critical decisions like premortem cesarean section in patients with maternal instability [1–3]. Fortunately, most cases are minor traumas and are often suitable to undergo routine tests but, it should be noted that fetal injuries can occur independently of the severity of trauma [1–3]. Nine of every 10 traumatic injuries during pregnancy are considered as minor; however, 60%–70% of post-traumatic fetal losses are reported in cases with minor traumas [1, 3]. Therefore, follow-up by tocometry and USG examinations is recommended according to the pregnancy week after achieving patient stabilization [1, 3]. A 24-hour follow-up is also recommended for fetuses over the 20th gestational week, considering that placental ablation may occur up to 24-hour following the occurrence of trauma [1, 3]. In our study, all patients underwent a detailed obstetric examination, and they were also examined using USG/NST based on their gestational week. No maternal loss was reported, and only one patient underwent emergency surgery because of uterine rupture.

The retrospective and single center design of our study is major limitations. Although our hospital is a training hospital that is used by a large population living in both urban and rural areas, some of our results are specific to our study population. For example, we found the rate of motorcycle accidents as 1.6%. Obviously, this rate was not an expected result in the rest of our country and in many parts of the world. However, local people, agricultural workers and tourists frequently use motorcycles in our study area and this ratio seems to be compatible for this geographical area. Emotional trauma and abuse is another issue open to criticism, the authors' expertise may also have caused them to focus only on the physical findings of the trauma than social findings and interventions. In this respect, especially the cases of emotional violence and abuse may have been overlooked.

We hope that, this study revealed the most common etiologies of trauma during pregnancy and its distribution according to trimesters. The determination of trauma distribution by age and gestational week could enable to take preventive measures. For example, SFs are experienced most often during the 2nd and 3rd trimesters. In our study, falling from stairs and falling from height were shown to have a similar temporal distribution. Especially during advanced ges-

tation weeks, pregnant women should not be employed in jobs requiring balance. Furthermore, the issue of assault and violence is one of the most remarkable topics in our study. Despite all the measures taken to prevent violence against women, the incidents of violence still occur. Assault/violence is the second most common trauma etiology after simple falls. Our study has demonstrated the importance of the subject in a concrete way and made a significant contribution to the limited database related to this subject in our country.

5. Conclusions

The pregnancy and trauma combination requires considerable attention during the diagnosis, treatment, and follow-up stages and etiologies of trauma also significantly differ from routine trauma population. Simple falls and assaults/violence are the most common causes in trauma etiology. Knowledge of the distribution of these etiologies according to gestational week may allow preventive measures to be taken.

Abbreviations

IPV, Intimate partner violence; MVA, Motor vehicle accident; MVAO, Motor vehicle accident as occupant/driver; MVAP, Motor vehicle accident pedestrian; ROM, rupture of membranes; SF, Simple falls; TBSA, Total body surface area of burns; Td, Diphtheria and tetanus vaccination; USG, Ultrasonography.

Author contributions

SAK and AG conceived and designed the study; SAK performed the experiments and collected data; AG analyzed the data; SAK wrote the paper.

Ethics approval and consent to participate

All informations and materials were obtained with the informed consent of all participants. The institutional review board of the Izmir Katip Celebi University, Ataturk Training and Research Hospital approved, code 152 dated 27 March 2019.

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Conflict of interest

The authors declare no conflict of interest.

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