

Full Length Research Paper

Obstetric trauma admissions in a level 1 trauma centre in South Africa: a 5-year retrospective review

Brian Madikizela¹, Douglas Motshekga² and John Mgoqi³

¹School of Clinical Medicine, Faculty of Health, University of the Witwatersrand, Johannesburg, South Africa.

²Department of Obstetrics and Gynaecology, Chris Hani Baragwanath Academic Hospital, Johannesburg, South Africa.

³Department of Anaesthesia and Peri-operative Medicine, Royal Brisbane and Women's Hospital, Queensland, Australia.

Accepted 05 December, 2022

Abstract

Purpose: The accurate incidence of trauma in pregnancy is not well known, but trauma complicates 6 to 8% of pregnancies and it is one of the leading causes of morbidity and mortality in pregnancy and remains the most common cause of fetal mortality worldwide. **Methods:** A retrospective review of data of all pregnant patients admitted to Chris Hani Baragwanath Academic Hospital from 01 January 2015 to 31 December 2019 with trauma. Data collected included demographic data, mechanisms of injury, clinical interventions, as well as maternal and fetal outcomes. **Results:** Data of 800 patients was included in the study during the five-year period. The mean age was 31.00 years and the mean gestational age was 26.00 weeks. The majority of patients were black Africans (89.1%). Five hundred and sixty-two patients were of single marital status (70.3%) and 484 identified as unemployed (60.5%). Assaults were the most frequent cause of trauma (41.3%), followed by falls (33.1%) and motor vehicle accidents (25.5%). **Conclusion:** Trauma in pregnancy is associated with significant morbidity and negative pregnancy outcomes. The implementation of strategies aimed at detecting and preventing intimate partner violence as well as road safety may contribute significantly to a reduction of maternal and fetal mortality.

Keywords: Trauma, pregnancy, gender-based violence, blunt abdominal trauma, penetrating abdominal trauma, pregnancy outcomes, Critical care.

2.2 INTRODUCTION

Trauma complicates about six to eight percent of pregnancies worldwide and is the leading cause of non-obstetric deaths (1). It remains the most common cause of fetal demise worldwide (2). The impact of obstetric trauma in developing countries is less known as available literature is mostly from high-income countries (3). A retrospective study conducted at the Pietermaritzburg Metropolitan Trauma Service, South Africa, which included 1075 female trauma patients, found four percent (n=42) of female trauma patients were pregnant at the time of presentation (4). The possibility of pregnancy should thus be considered in all injured females between the ages of 10 and 50 years

(5). Trauma in pregnant patients has been reported to increase the risk of spontaneous abortion, preterm premature rupture of membranes, preterm labour, uterine rupture, placental abruption and stillbirth (6). Pregnant woman are almost twice as likely to experience violent trauma and have 66% higher risk of death compared to nonpregnant woman (7).

Mendez-Figueroa and colleagues, in a systemic review of data found motor vehicle accidents and domestic violence to account for most cases of trauma in pregnancy in the US (6). Burns, suicide, fall and homicide accounted for the remainder (6). Falls as a mechanism of injury, account for 22 % of trauma in preg-

nancy worldwide and are associated with a three percent of fetal deaths (8,9). The risk of adverse outcomes from a motor vehicle accident increases in the second trimester of pregnancy if the pregnant woman was the driver and in fact, motor vehicle accidents are the most common cause of non-obstetric trauma associated fetal deaths (10).

Domestic violence during pregnancy is a significant public health problem that affects both the mother and the fetus and pregnancy is a particular vulnerable period for domestic violence because of the economic, social, emotional and physical changes that happen to the women and their families (11). Notably, domestic violence is reported to occur in four to eight percent of all pregnancies in the US (12). Associated risk factors include a lower socioeconomic status, single marital status, classification as African-American or Hispanic and age less than 26 years (13). The antenatal period is considered as a “window opportunity” to address intimate partner violence because women are in constant contacts with health professionals and enquiry to violence exposure can be done and routine enquiry about violence exposure is recommended in antenatal care if confidentiality and privacy exists (11). Globally head and neck injuries are the most common causes of trauma related maternal death in pregnancy with the most common aetiologies for head injuries attributed to motor vehicle accidents (14). South Africa has one of the highest rates of interpersonal trauma, however local institutional data on the prevalence, mechanisms of injury and outcomes of obstetric trauma remains limited. We aimed to describe clinical characteristics and the clinical management of obstetric trauma admissions to our institution.

2.3 METHODS

This was a retrospective review of data of all pregnant patients admitted at Chris Hani Baragwanath Academic Hospital (CHBAH) with the diagnosis of trauma in the Department of Obstetrics and Gynaecology, Intensive Care Unit, Emergency Department, Department of General Surgery and Department of Orthopaedics between 01 January 2015 and 31 December 2019.

Ethical approval was obtained from the University of Witwatersrand's Ethics Committee (Study number: M210317). Institutional permission was obtained from Chris Hani Baragwanath Academic Hospital CEO (GP_202011_030) and from respective Heads of Departments.

Data of 800 patients from the hospital records was included during the 5-year period.

A total of 823 patients were identified retrospectively through the hospital registry. Of these 23 records were excluded due to incomplete data. Demographic data, mechanism of injury, clinical management interventions, as well as maternal and fetal outcomes were collected. We excluded pregnant patients admitted with any diagnosis other than trauma.

Data was captured and entered into REDCap (Research Electronic Data Capture) and Statistical analysis was conducted in consultation with a biostatistician. Categorical variables were described using frequencies and percentages. Continuous variables were described using means (SD) and medians (IQR with ranges). Association between categorical variables was assessed with Chi square test whilst that for continuous variables was assessed with rank sum test or Kruskal-Wallis tests. A P value of <0.05 was considered statistically significant. All analysis were conducted in Stata statistical software version 16 (Stata Corp, Texas USA).

2.4 RESULTS

2.4.1 Demographics

The median age was 31.00 years. The majority of patients were black (n= 713; 89.1%), five hundred and sixty-two were of single marital status (70.3%) and 484 patients were unemployed (60.5%). Hundred and forty-one patients (18.0%) reported recent alcohol consumption. Characteristics of patients are listed in table 1 below.

2.4.2 Presenting physiology

The presenting physiology is summarized below in table 2. Most of our patients were admitted with a normal blood pressure (systolic of < 120 mmHg & diastolic of < 80 mmHg) and normal pulse of between 60 to 100 beats per minute.

2.4.4 Indications for admission and mechanism of injury

Assaults were the most frequent cause of traumatic injury (n=330; 41.3%), followed by falls (n= 265; 33.1%) and motor vehicle accidents (n=204; 25.5%). Table 2 provides a breakdown of the mechanism of traumatic injuries. The site of injuries was as follows: head and neck region (n=228), limbs (n=551), thoracic region (n=264), abdominal region (n=350), pelvic region (n=22) and uterine injuries (n=6). The total number of injuries surpasses the total number of patients owing to some patients sustaining more than one injury.

Table 3 and 4 below summarizes the mechanisms and types of injuries.

2.4.5 Risk factors

The median (IQR) age of patients in the study was 31.00 (27.00, 37.00) years. Eighteen percent (n=141) of patients reported alcohol consumption. Most patients self-identified as black African (89.1%, n=713), followed by Coloured (10.5%, n=84) and then Caucasian (0.4%, n=3). Four hundred and eighty-six (60.5%) were reported as unemployed. This is illustrated in table below.

Table 1. Patient's characteristics of obstetric trauma patients admitted at CHBAH from 01 January 2015 to 31 December 2019.

Characteristic	2015 (n=142)	2016 (n=187)	2017 (n=157)	2018 (n=173)	2019 (n=141)	Total (n=800)	*P-value
Age (years) Median (IQR)	33.00 (29.00,37.00)	34.00 (29.00,39.00)	32.00 (28.00,37.00)	29.00 (25.00,34.00)	29.00 (25.00,34.00)	31.00 (27.00,37.00)	< 0.01
N (% Missing)	142 (0.0%)	187(0.0%)	157 (0.0%)	173 (0.0%)	141 (0.0%)	800 (0.0%)	
Parity Median (IQR)	1.00 (0.00,2.00)	1.00 (0.00,2.00)	1.00 (0.00,2.00)	0.00 (0.00,2.00)	1.00 (0.00,2.00)	1.00 (0.00,2.00)	< 0.01
N (% Missing)	142 (0.00%)	187(0.0%)	157 (0.0%)	173 (0.0%)	141 (0.0%)	800 (0.0%)	
Gestational age (weeks) Median (IQR)	28.50 (23.00,33.00)	26.00 (22.00,29.00)	26.00 (22.00,32.00)	26.00 (23.00,30.00)	26.00 (24.00,30.00)	26.00 (23.00,31.00)	0.0034
N (% Missing)	142 (0.0%)	187(0.0%)	157 (0.0%)	173 (0.0%)	141 (0.0%)	800 (0.0%)	
Gestational age at ANC booking Median (IQR)	19.00 (16.00,22.00)	17.50 (14.00,29.00)	18.00 (14.40,20.00)	18.00 (15.50,20.00)	18.00 (16.00,20.00)	18.00 (15.00,20.00)	0.235
N (% Missing)	95 (33.1%)	120 (35.8%)	104 (33.8%)	112 (35.3%)	93 (34.0%)	524 (34.5%)	
Race Black White Coloured	133 (93.7%) 1 (0.7%) 8 (5.6%)	163 (87.2%) 0 (0.0%) 24 (12.8%)	139 (88.5%) 2 (1.3%) 16 (10.2%)	152 (87.9%) 0 (0.0%) 21 (12.1%)	126 (89.4%) 0 (0.0%) 15 (10.6%)	713 (89.1%) 3 (0.4%) 84 (10.5%)	0.216
Marital status Married Single	51 (35.9%) 91 (64.1%)	74 (39.6%) 113 (60.4%)	43 (27.4%) 114 (72.6%)	40 (23.1%) 133 (76.9%)	30 (21.3%) 111 (78.7%)	238 (29.8%) 562 (70.3%)	<0.001
Employment status Not employed Employed	90 (63.4%) 52 (36.6%)	99 (52.9%) 88 (47.1%)	81 (51.6%) 76 (48.4%)	115 (66.5%) 58 (33.5%)	99 (70.2%) 42 (29.8%)	484 (60.5%) 316 (39.5%)	0.001
Social habits None Smoking Alcohol Recreational substance	101 (73.7%) 3 (2.2%) 32 (23.4%) 1 (0.7%)	148 (82.2%) 3 (1.7%) 29 (16.1%) 0 (0.0%)	129 (83.8%) 3 (1.9%) 21 (13.6%) 1 (0.6%)	142 (82.1%) 2 (1.2%) 29 (16.8%) 0 (0.0%)	106 (76.3%) 3 (2.2%) 30 (21.6%) 0 (0.0%)	626 (79.9%) 14 (1.8%) 141 (18.0%) 2 (0.3%)	0.550
ANC attendance No Yes	47 (33.1%) 95 (66.9%)	67 (35.8%) 120 (64.2%)	53 (33.8%) 104 (66.2%)	61 (35.3%) 112 (64.7%)	48 (34.0%) 93 (66.0%)	276 (34.5%) 524 (65.5%)	0.985
Pregnant at admission No Yes	1 (0.7%) 141 (99.3%)	0 (0.0%) 187 (100.0%)	0 (0.0%) 157 (100.0%)	1 (0.6%) 172 (99.4%)	0 (0.0%) 141 (100.0%)	2 (0.3%) 798 (99.8%)	0.535

*Kruskall-Wallis test used for numerical variables and Chi-squared test/Fisher exact test used for categorical variables.

2.4.6 Investigations and clinical management

2.4.6.1 Investigations

Point of care ultrasound was performed on 255 of 258 (99%) patients who were seen in the emergency department. Obstetrics ultrasound was performed on all patients seen in the obstetrics department (n=542, 100%) patients. Hundred and twenty-seven radiographs were performed; these included twenty-two of the pelvis, three cervical spine, one skull, seven lumbar spine, sixty nine lower extremities, fourteen upper extremities and eleven of the chest. Computed tomography was performed on thirteen patients, twelve of these were of the head and one was of the head as well as the abdomen. Magnetic resonance imaging (MRI) was performed on one patient.

2.4.6.2. Management

Eighty patients were transferred to other departments for further management. This is illustrated in figure 1. Twenty patients (2.50%) were referred to the department of general surgery. Of these, none underwent a major operative procedure. Two (0,25 %) were treated for human bite wounds, fifteen (1.9%) had lacerations sutured and three (0.4%) were treated for haemopneumothorax. Forty-eight (6%) patients were referred to the orthopaedics department, thirty-four (4.25%) were discharged without any operative management. Four (0.5%) had stable fractures of lower limbs and one (0.12%) had a stable fracture of the upper limb for which a plaster of Paris was applied. One (0.12%) patient had fractured phalanges of the hand and was treated with K-wires, two (0.25%) patients were

Table 2. Presenting physiology.

Characteristics	Patient NO. (n)	*P-value
	N=800	
Admission pulse (bpm)		<0.01
Median (IQR)	88.00 (80.00, 96.00)	
N (% Missing)	799 (0.1%)	
Systolic blood pressure on admission		<0.01
Median (IQR)	118.00 (112.00, 126.00)	
N (% Missing)	796 (0.1%)	
Diastolic blood pressure on admission		0.105
Median (IQR)	68.00 (61.00, 74.00)	
N (% Missing)	792 (1.0)	

Chi-squared test/Fisher exact test used for categorical variables.

Table 3. Mechanism of traumatic injury.

	2015 (n = 142)	2016 (n = 187)	2017 (n = 157)	2018 (n = 173)	2019 (n = 141)	Total (n = 800)	*p-value
Mode of trauma							0.169
Fall	52 (36.6%)	59 (31.6%)	60 (38.2%)	52 (30.1%)	42 (29.8%)	265 (33.1%)	
MVA	36 (25.4%)	56 (29.9%)	36 (22.9%)	49 (28.3%)	27 (19.1%)	204 (25.5%)	
Assault	53 (37.3%)	72 (38.5%)	61 (38.9%)	72 (41.6%)	72 (51.1%)	330 (41.3%)	

*Kruskall-Wallis test used for numerical variables and Chi-squared test/Fisher exact test used for categorical variables

managed with open reduction and internal fixation for humeral and femur fractures respectively. The patient with a pelvic fracture surgery was performed while admitted to ICU. One (0.12%) patient had a fracture of the patella bone which was treated with K-wires. Five (0.6%) patients were treated for soft tissue injuries of the ankle and knee with back slab casts applied. Eight patients were referred to the neurosurgery department (1.00%) for observation over a period of 24 to 48 hours. None of these patients underwent an operative procedure. Table 6 provides a breakdown of procedures done.

Four patients were admitted to ICU (0.50%), of these, three (0.40%) were intubated and ventilated. One

patient was admitted for observations after sustaining a head injury in a motor vehicle accident (MVA). Three patients were operated on; 1st patient had a caesarean section, caesarean hysterectomy and exploratory laparotomy after a gunshot wound to the abdomen; 2nd patient had internal fixation of the pelvis, a caesarean section and exploratory laparotomy after being involved in an MVA and the last patient had a laparotomy after sustaining a gun short to the abdomen. Seven hundred and sixteen patients (89.5%) were cared for in the obstetrics and gynecology department. Table 7 outlines interventions performed and table 8 outlines the investigations and interventions performed in ICU.

Table 4. Type of injuries with each mode of injuries.

	Blunt trauma	Penetrating trauma
MVA	151	1
Assault	240	41
Fall	27	0
Total	418 (52.25%)	42 (5.25%)

Table 5. Risk factors associated with trauma in pregnancy.

Risk factor	2015 (n = 142)	2016 (n= 187)	2017 (n = 157)	2018 (n= 173)	2019 (n = 141)	Total (n = 800)	P-value
Age (years)							<0.001
Median (IQR)	33.0 (29.00, 37.00)	34.00 (29.00, 39.00)	32.00 (28.00, 37.00)	29.00 (25.00, 34.00)	29.00 (25.00, 33.00)	31.00 (27.00, 37.00)	
N (%Missing)	142 (0.0%)	187 (0.0%)	157 (0.0%)	173.00 (0.0%)	141 (0.0%)	800 (0.0%)	
Race							0.216
Black	133 (93.7%)	163 (87.2%)	139 (88.5%)	152 (87.9%)	126 (89.4%)	713 (89.1%)	
White	1 (0.7%)	0 (0.0%)	2 (1.3%)	0 (0.0%)	0 (0.0%)	3 (0.4%)	
Coloured	8 (5.6%)	24 (12.8%)	16 (10.2%)	21 (12.1%)	15 (10.6%)	84 (10.5%)	
Marital status							<0.001
Married	51 (35.9%)	74 (39.6%)	43 (27.4%)	40 (23.1%)	30 (21.3%)	238 (29.8%)	
Single	91 (64.1%)	113 (60.4%)	114 (72.6%)	133 (76.9%)	111 (78.7%)	562 (70.3%)	
Employment status							0.001
Unemployed	90 (63.4%)	99 (52.9%)	81 (51.6%)	115 (66.5%)	99 (70.2%)	484 (60.5%)	
Employed	52 (36.6%)	88 (47.1%)	76 (48.4%)	58 (33.5%)	42 (29.8%)	316 (39.5%)	
Social Habits							0.550
None	101 (73.7%)	148 (82.2%)	129 (83.8%)	142 (82.1%)	106 (76.3%)	626 (79.9%)	
Smoking	3 (2.2%)	3 (1.7%)	3 (1.9%)	2 (1.2%)	3 (2.2%)	14 (1.8%)	
Alcohol use	32 (23.4%)	29 (16.1%)	21 (12.6%)	29 (16.8%)	30 (21.6%)	141 (18.0%)	
Recreational substance	1 (0.7%)	0 (0.0%)	1 (0.6%)	0 (0.0%)	0 (0.0%)	2 (0.3%)	

*Kruskall-Wallis test used for numerical variables and Chi-squared test/Fisher exact test used for categorical variables.

2.4.7 Fetal and maternal outcomes

There was one maternal death and ten fetal deaths. Of the ten fetal deaths, three were of patients admitted in ICU. Seven fetal deaths were recorded in the obstetrics and gynecology department. Of these, one was a macerated stillbirth and six were confirmed abruptio placentae at caesarean section. There were seven threatened miscarriages and eleven preterm deliveries. Of these, four were delivered by caesarean section and

seven were vaginal deliveries and eight term deliveries by caesarean section. All preterm deliveries survived. Table 9 and table 10 outlines the outcome of pregnancies and delivery rates respectively.

2.5. DISCUSSION

The aims of this study were to describe the demographic, clinical characteristics, indications of admissions of obstetric trauma patients, clinical interven-

Table 6. Number of patients transferred to other departments.

Department	ICU	General surgery	Orthopaedics	Neurosurgery	Remained in obstetrics and gynaecology	Unknown
Number	4	20	48	8	716	4

Figure 1. Number of patients transferred to other departments.

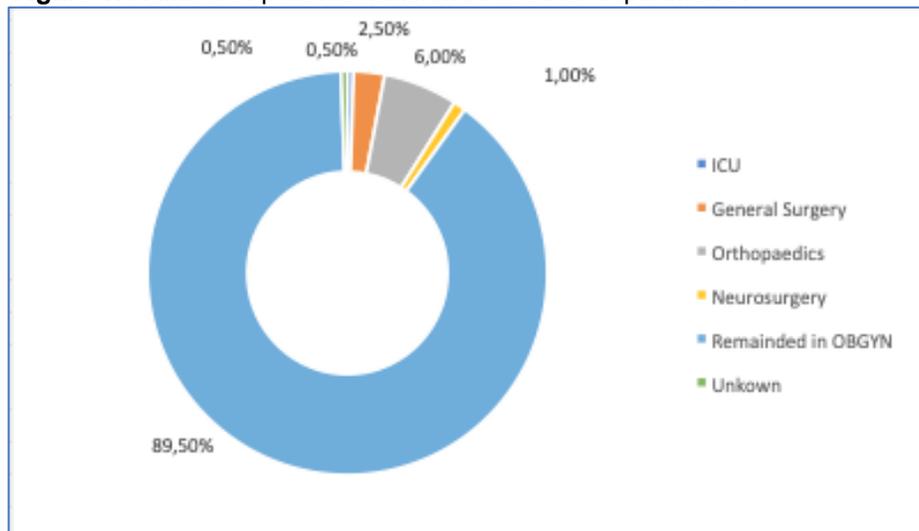


Table 7. Breakdown of procedures done.

Procedure	n (%)
Emergency caesarean section	14 (1.75%)
Laparotomy	3 (0.4%)
Intercostal drainage	3 (0.4%)
Open reduction and internal fixation	2 (0.25%)
Plaster of Paris applied	4 (0.5%)
K-wires	2 (0.25%)
Suturing of lacerations	15 (1.9%)

tions and to identify the mechanism of injury as well as risk factors associated with obstetric trauma patients. Approximately 36% of pregnant patients in our study experienced gender based violence. Gender-based violence remains a social burden which predominantly affects women from poor socio-economic status in South Africa (15) and intimate partner violence during pregnancy is a global health problem with adverse effects for mothers, fetus, infants and families (11). Our

study is representative of this. Four hundred and eighty-four (60.5%) pregnant trauma patients were unemployed. Of these, three hundred and thirty (41.3%) presented with assault as a mechanism of traumatic injury. Two hundred and ninety-one (36%) of assaults were as a result of intimate partner violence and thirty-nine were as a result of assault by either siblings, neighbours or strangers. This highlighted the enormous burden of trauma and violence in SA. In keeping with

Table 8. Outline of the investigations in ICU.

ICU diagnostic investigations	n (%)
X-ray	3 (75%)
CT-scan	3 (75%)
Ultrasound	1 (25%)
MRI	1 (25%)
Interventions in ICU	
ETtube + Ventilation	3 (75%)
Orthopaedic surgery	1 (25%)
Exploratory laparotomy	3 (75%)
Caesarean sections	2 (50%)
Outcomes	
Fetal death	3 (75%)
Maternal death	1 (25%)

Table 9. Pregnancy outcomes.

	Penetrating trauma	Blunt trauma	Minor surgical and orthopaedic injuries
Fetus died	3 (0.4%)	7 (0.9%)	0
Preterm delivery	0	11 (1.4%)	0
Unaffected pregnancy	39 (4.9%)	418 (52.25%)	323 (40.4%)

Table 10. Outline of delivery rates.

Mode of delivery	Fetus alive	Born term	Born preterm	Fetal death	Delivery rates
Caesarean section (n= 21)	12	8	4	9	1.5%
Normal vaginal delivery (n= 08)	7	0	7	1	0.9%

our findings, a case control study conducted in Ethiopia by Berhanie and colleagues, found 389 of 954 women (40.8%) had experienced intimate partner violence.

Thirty four percent (n=276) did not attend antenatal clinic prior to admission with trauma. In keeping with our study, a cross-section study by Aboagye and colleagues concluded that pregnant patients experiencing intimate partner violence are likely to have difficulties accessing antenatal services and therefore attend their first antenatal booking late in pregnancy

(16). Alcohol related injuries comprised eighteen percent (n=141). This is consistent with findings from the randomised trial conducted by Davis and colleagues who found an association of assault and motor vehicle accidents with alcohol consumption (17).

Injuries related to falls were the second commonest cause of injury, accounting for a third of all cases (33.1%, n=265). However, injuries from falls were non-fatal. Height of more than 160 cm, advanced gestational age and age of more than 30 years is associated with

falls in pregnancy (9). The median age in our study was 31 years, which is not advanced maternal age. Height and weight data were not collected in this review.

Motor vehicle related injuries were the third most common cause of injury overall, accounting for 25.5% (n=204). Motor vehicle accidents (MVA's) were the most common cause of poor fetal outcome, all of which were confirmed abruption of the placenta. This is in keeping with a finding by Carmen Amezcua-Prieto and colleagues in their systematic review and meta-analysis that there is strongest association between placental abruption and MVAs (10). There was no maternal mortality documented related to MVA's, however two patients were admitted to ICU. In a retrospective study conducted in South Africa, Wall and colleagues found that in 2990 trauma patients who were admitted over a period of 6 years, polytrauma accounted for 40% of all cases. Notably, no maternal mortality related to MVA's was recorded which is similar to our findings.

The vast majority of trauma in both pregnant and non-pregnant patients is blunt, however, there is an increased likelihood of penetrating trauma in pregnant patients compared to non-pregnant patients and both maternal and fetal mortality rates are increased following penetrating trauma (18).

Blunt trauma was a frequent cause of traumatic injury in pregnancy (n= 418; 52.25%) in our review. We did not identify associated maternal mortality with blunt trauma in our review; however, it was associated with increased fetal mortality, (0.9%, n=7) and eleven (1.4%) preterm births. The need for surgery and direct trauma to the abdomen is associated with pregnancy loss. Advanced gestational age is associated with poor fetal outcome (19). This is in keeping with findings from our review. Three patients were admitted to ICU. Of these, there were three fetal losses from patients admitted to ICU at 23 weeks, 30 weeks and 32 weeks respectively with mean gestational age of 28 weeks.

Penetrating injuries affected 5.25% (n=42) of patients, and resulted in two third trimester pregnancy losses and a single second trimester pregnancy loss. The remaining thirty-nine cases of penetrating injuries, did not involve the abdomen. Injuries due to gunshot wounds were uncommon and contributed 0.25% (n=2). However, they resulted in one maternal death and one ICU admission.

The repercussions of either penetrating or blunt trauma depend on the gestational age and site of injury. Pelvic trauma and fracture may not only result in severe haemorrhage, but may also results in uterine or fetal injury associated with adverse fetal outcomes (18).

The principle of obstetric resuscitation is to prioritise the management of the pregnant patient. Following successful resuscitation and management of the mother, attention can be given to the fetus.

2.6. Strengths and limitations

This was a large retrospective review of data conducted

with a low cost. Limitations were missing data. Results of this retrospective review will help inform the design of future retrospective studies.

2.7. CONCLUSION

South African Women are to a great degree burdened by intimate partner violence and the findings of our study identified unemployed black African pregnant patients of single marital status as being of increased risk of obstetric trauma. South African women are currently not screened for intimate partner violence during pregnancy, despite the fact that it was more common. Screening done in conjunction with an intervention may reduce women's risk of future intimate partner violence. Assaults and falls were the most frequent mechanisms of injury. Of interest, 0.5% of obstetric trauma admissions were admitted to ICU during the study period.

REFERENCES

1. Maternal Mortality in High Income Countries. *J Paediatr Child Health.* 2017;53(52):61–61.http://doi.wiley.com/10.1111/jpc.13494_177
2. Say L, Chou D, Gemmill A, Tunçalp Ö, Moller AB, Daniels J, et al. Global causes of maternal death: A WHO systematic analysis. *Lancet Glob Heal.* 2014;2(6):e323–e333. [https://doi.org/10.1016/S2214-109X\(14\)70277-X](https://doi.org/10.1016/S2214-109X(14)70277-X)
3. Battaloglu E, Battaloglu E, Chu J, Porter K. Obstetrics in trauma. *Trauma.* 2015;17(1):17–23. <https://doi.org/10.1177/1460408614530944>
4. Wall SL, Figueiredo F, Laing GL, Clarke DL. The spectrum and outcome of pregnant trauma patients in a metropolitan trauma service in South Africa. *Injury.* 2014;45(8):1221–1223. <https://doi.org/10.1016/j.injury.2014.04.045>
5. Petrone P, Asensio JA. Trauma in pregnancy: Assessment and treatment. *Scandinavian Journal of Surgery.* 2006;95(1):4–10. <https://doi.org/10.1177/145749690609500102>
6. Mendez-Figueroa H, Dahlke JD, Vrees RA, Rouse DJ. Trauma in pregnancy: An updated systematic review. *American Journal of Obstetrics and Gynecology.* 2013;209(1):1–10. <https://doi.org/10.1177/14574969060950010>
7. LA ROSA M, LOAIZA S, ZAMBRANO MA, ESCOBAR MF. Trauma in Pregnancy. *Clin Obstet Gynecol.* 2020;63(2):447–54.<https://doi.org/10.1097/GRF.0000000000000531>
8. Garg N, Sharma A, Khanna P, Goel V. Trauma in pregnancy – A brief review. *Trauma Emerg Care.* 2017;2(3):1–4. <https://doi.org/10.15761/tec.1000131>
9. Weiss HB, Songer TJ, Fabio A. Fetal deaths related to maternal injury. *J Am Med Assoc.* 2001;286(15):1863–1865. <https://doi.org/10.1001/jama.286.15.1863>
10. Amezcua-Prieto C, Ross J, Rogozińska E,

Mighiu P, Martínez-Ruiz V, Brohi K, et al. Maternal trauma due to motor vehicle crashes and pregnancy outcomes: a systematic review and meta-analysis. *BMJ Open*. 2020;10(10):11. <https://doi.org/10.1136/bmjopen-2019-035562>

11. Flaathen EME, Henriksen L, Småstuen MC, Schei B, Taft A, Noll J, et al. Safe Pregnancy intervention for intimate partner violence: a randomised controlled trial in Norway among culturally diverse pregnant women. *BMC Pregnancy Childbirth*.

2022;22(1):144.<https://doi.org/10.1186/s12884-022-04400-z>

12. Huls CK, Detlefs C. Trauma in pregnancy. *Seminars in Perinatology*. 2018; 42(1):13-20. <https://doi.org/10.1053/j.semperi.2017.11.004>

13. Alhusen JL, Ray E, Sharps P, Bullock L. Intimate Partner Violence During Pregnancy: Maternal and Neonatal Outcomes. *J Women's Heal*. 2015;24(1):100-106. <https://doi.org/10.1089/jwh.2014.4872>

14. Kuczkowski KM. Trauma during pregnancy: A situation pregnant with danger. *Acta Anaesthesiologica Belgica*.2005;56(1):13-18.

<https://doi.org/10.1080/22201173.2008.10872523>

15. Abrahams N, Jewkes R, Mathews S. Guns and gender-based violence in South Africa. *South African Med.J*.2010;100(9):586-588.

<https://doi.org/10.7196/SAMJ.3904>

16. Aboagye RG, Seidu A-A, Asare BY-A, Adu C, Ahinkorah BO. Intimate partner violence and timely antenatal care visits in sub-Saharan Africa. *Arch Public Heal*.2022;80(124):1-11.

<https://doi.org/10.1186/s13690-022-00853-y>

17. Davis EC, Rotheram-Borus MJ, Weichle TW, Rezai R, Tomlinson M. Patterns of Alcohol Abuse, Depression, and Intimate Partner Violence Among Township Mothers in South Africa Over 5 Years. *AIDS Behav*.2017;21(S2):174–82.

<https://doi.org/10.1007/s10461-017-1927-y>

18. Irving T, Menon R, Ciantar E. Trauma during pregnancy. *BJA Educ*. 2021(1):10–9.<https://doi.org/10.1016/j.bjae.2020.08.005>

19. Chibber R, Al-Harmi J, Fouda M, El-Saleh E. Motor–vehicle injury in pregnancy and subsequent fetomaternal outcomes: of grave concern. *J Matern Neonatal Med*. 2015;28(4):399–402.

<https://doi.org/10.3109/14767058.2014.918094>