

OBSTETRIC TRAUMA ADMISSIONS IN A LEVEL 1 TRAUMA

CENTRE IN SOUTH AFRICA: A 5-YEAR RETROSPECTIVE REVIEW

Njaya Bruce Moyo



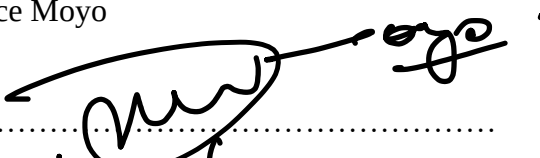
A dissertation submitted to the Faculty of Health Sciences, University of Witwatersrand,
Johannesburg, in partial fulfillment of the requirements for the degree
of
Master of Medicine in Obstetrics and Gynaecology.

Johannesburg, 2023

DECLARATION

I, Njaya Bruce Moyo, declare that this research report is my own original work and has not been submitted or published for any degree program or examination in any institution. I am submitting this research report in the submissible format with my protocol and extended literature review in the department of Obstetrics and Gynaecology at the University of the Witwatersrand, Johannesburg. Any literature work done by others and cited in this research report has been given due acknowledgement and listed in the references section.

Njaya Bruce Moyo

Signature.....

Date.....20/04/2023.....

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I am extremely fortunate and grateful to have married my wife Mmaphuti Meso, whose understanding and constant encouragement were sustaining factors in completing this research report. I love you

To my daughters Ndzalama and Nyiko thank you for giving me unlimited smiles, happiness and pleasure. Your sad faces when I had to lock myself and study pushed me to complete this research report. I love you

ABSTRACT

Background: Trauma is one of the leading causes of morbidity and mortality in pregnancy and remains the most common cause of fetal mortality worldwide. The severity of injury as well as early and aggressive management of injuries are significant factors that determine maternal and fetal outcomes.

Objectives: The aim of this study was to describe the characteristics, mechanisms of injury, clinical interventions performed as well as maternal and fetal outcomes of obstetric trauma admissions to our institution.

Methods: This was a retrospective review of data of all pregnant trauma patients admitted to Chris Hani Baragwanath Academic Hospital from 01 January 2015 to 31 December 2019. Patients were identified from admission registries from the departments of obstetrics and gynaecology, emergency medicine, general surgery, orthopaedics and intensive care. 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 median age and gestational ages were 31.00 years and 26.00 weeks respectively. The majority of pregnant trauma patients self-identified as black Africans (n= 713; 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 (n= 330; 41.3%), followed by falls (n= 265; 33.1%) and motor vehicle accidents (n= 204; 25.5%). Hundred and forty-one patients (18.0%) were documented to have consumed alcohol on the day of the injury. Four patients (0.5%) were admitted to the intensive care unit (ICU). Of these, one died in ICU. Ten fetal deaths were recorded, of these, three were delivered by patients admitted to ICU. Eleven neonates were delivered before 37 weeks.

Conclusion: Trauma in pregnancy is associated with significant morbidity and a negative pregnancy outcomes. We identified unemployment pregnant patients of single marital status as being at increased risk of obstetric trauma. Assaults, followed by falls and motor vehicle accidents, were the commonest causes of maternal trauma in our population. 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.

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RESEARCH OUTPUTS ARISING FROM THIS PROJECT

Poster Presentations:

Title: Obstetric Trauma admissions in a Level I Trauma Centre in South Africa: a 5-year retrospective Review.

1. Biennial research day, School of Clinical Medicine, University of the Witwatersrand, 30 September 2021.
2. SASOG 2022 Congress: 29 November 2022, Cape Town International Convention Centre.

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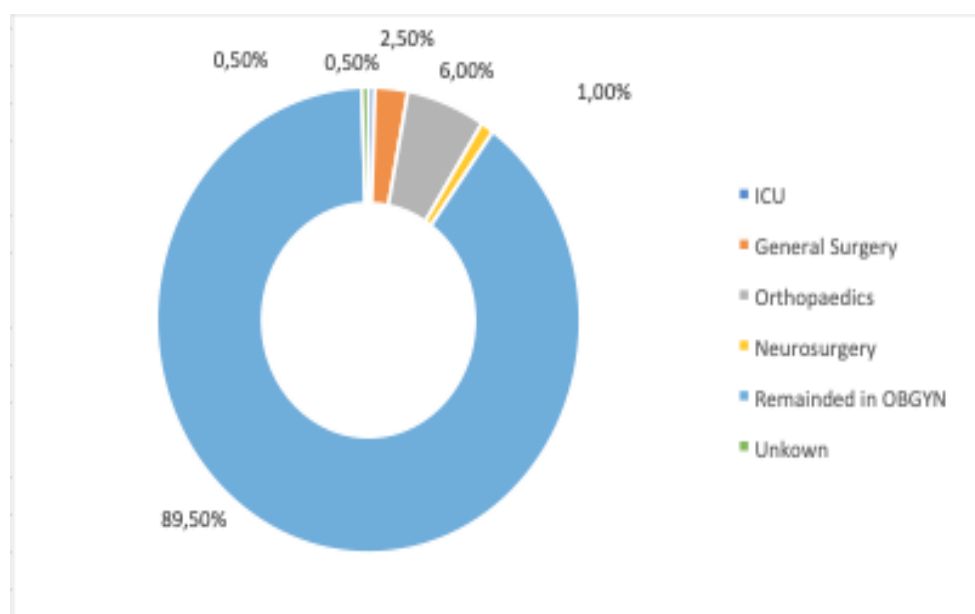


Figure 1. Number of patients transferred to other departments

ABBREVIATIONS

SA	South Africa
USA	United State of America
ANC	Antenatal Clinic
ACOG	American College of Obstetrics and Gynecology
MMR	Maternal mortality rate
HIV	Human immunodeficiency virus
CHBAH	Chris Hani Baragwanath Academic Hospital
ICU	Intensive care unit
ER	Emergency medicine department
REDCap	Research electronic data capture
CEO	Chief executive officer
BP	Blood pressure
SBP	Systolic blood pressure
DBP	Diastolic blood pressure
BPM	Beats per minute
MVA	Motor vehicle accident
POCUS	Point of care ultrasound
MRI	Magnetic resonance imaging
CT scan	Computerized tomography scan
ORIF	Open reduction and internal fixation
K-Wires	Kirschner wire
ET tube	Endotracheal tube

CHAPTER 1: PROTOCOL AND EXTENDED LITERATURE REVIEW

1.1. INTRODUCTION

Maternal death is defined as the death of a woman while pregnant or within 42 hours of termination of pregnancy, irrespective of the cause of death (1). Physical violence and unintentional injury are common causes obstetric mortality worldwide (1).

Maternal death can be classified as direct (obstetric) or indirect (non-obstetric) (2). Direct obstetric deaths result from the obstetric complications of pregnancy, associated interventions, omissions, incorrect treatment, or a chain of events resulting from any of the above (3).

Indirect obstetric deaths result from a pre-existing disease, or disease that developed during pregnancy that is not due to direct obstetric causes, but is aggravated by the physiological effects of pregnancy (3).

Obstetric trauma affects about six to eight percent of pregnancies worldwide and is the leading cause of non-obstetric deaths during pregnancy(4). It remains a significant cause of fetal demise worldwide (5). In a retrospective study at the Pietermaritzburg Metropolitan Trauma Service, South Africa, which included 1075 female trauma patients, four percent (n=42) of female trauma patients were found to be pregnant at the time of presentation (6). The possibility of a pregnancy should thus be considered in all injured females between the ages of 10 and 50 years (7). As pregnancy advances, the gravid abdomen becomes more vulnerable to trauma. Trauma in pregnancy is reported to increase the risk of spontaneous abortion, preterm premature rupture of membranes, preterm labour, uterine rupture, placental abruption and stillbirth (8).

1.1.1. EPIDEMIOLOGY OF TRAUMA IN PREGNANCY

The distribution of trauma in pregnancy comprises burns (1%), assaults (22%), falls (22%) and motor vehicle accidents (55%) (9). Motor vehicle accidents and domestic violence account for most cases of trauma in pregnancy in the US, with burns, suicide, falls, and homicide accounting for the remainder (8).

More than 12 000 road fatalities were reported in 2018 in South Africa (10), although this was a decrease from 14 050 road facilities recorded in 2017, the number remains high (10).

Schiff and Holt conducted a retrospective cohort study looking pregnancy outcomes following hospitalization for motor vehicle crashes in Washington State from 1998 to 2001(11). In this study, pregnant drivers involved in motor vehicle accidents were at an increased risk of adverse pregnancy outcomes, including placental abruption (7.8 % vs. 1.4% in general population) preterm birth (58.9% vs. 6.6% in general population), stillbirths (0.3% vs. 0% in general population), and premature rupture of membranes (2.0% vs. 2.2% in general population) (11).

Domestic violence is reported to occur in four to eight percent of all pregnancies in the US (12). In South Africa, the national mortality rate associated with intimate partner violence was found to be double that of the United States (13). Domestic violence is defined as any physical, sexual, psychological or economic abuse that takes place between people who are sharing, or have recently shared a residence (13). Associated risk factors include a lower socioeconomic status, single marital status, classification as African-American or Hispanic and age less than 26 years (14). Substance and alcohol use as well as HIV infection have been recognised as risk factors for domestic violence (15).

Pregnancy outcomes associated with domestic violence include anaemia (haemoglobin of <10.5 g/dl), urinary tract infections, sexually transmitted infections, threatened abortion, antepartum haemorrhage, gestational diabetes, spontaneous preterm labour, gestational hypertension, placental disorders and intrauterine growth retardation (16). Severe adverse maternal and fetal outcomes attributed to domestic violence are maternal and fetal death (14).

Maternal death by suicide is emerging as a cause of death. The importance of maternal death due to suicide has been under-estimated in SA and has been missed in maternal mortality enquiries as maternal deaths due to suicide have been classified as psychiatric deaths, co-incident pregnancy deaths, herbal intoxication, sudden unexplained deaths and unknown (17). In a pilot retrospective study conducted at a tertiary hospital in Durban, SA, one third of women (n=9) of the 27 charts reviewed were pregnant, confirming that pregnancy is not a protective factor to suicide as previously suggested (18). In developing countries relationship conflicts and depression were risk factors for suicide attempts. In developed countries intimate partner violence was a risk factor (18). Modini and colleagues conducted a retrospective analysis of maternal suicides in Queensland, Australia between January 2004 and December 2017. In this study, sixty five deaths were by suicide; six occurred during pregnancy, thirty after a live birth, twenty two after a termination of pregnancy and seven followed a miscarriage or stillbirth (19).

Maternal homicide has been described as the commonest cause of death in the US. The rates of maternal homicide in the US were 0.97 to 10.6 per 100 000 live births in 2018 with the common perpetrator being the intimate partner, with alcohol or drugs involved (20).

Abrahams and colleagues conducted a retrospective study in South Africa investigating the mortality of women from intimate partner violence. In this study, the overall rate of female homicide was 24.7 per 100 000. This is 6-fold higher than the global rate of 4.0 per 100 000 (21). Women affected were aged less than 25, with poor socioeconomic and educational status, of African and Hispanic ethnicity, with a history of alcohol and drug use and of single marital status (20).

Falls during pregnancy account for 22% of trauma in pregnancy worldwide and have been associated with significant maternal and fetal complications (22,23). They are more common after 32 weeks of pregnancy (24). Risk factors for falls during pregnancy are divided into extrinsic and intrinsic factors. Extrinsic risk factors include uneven ground, inappropriate shoes, hurrying, slippery floors, cluttered floors, sedentary lifestyle, carrying additional loads and physically demanding jobs (25). Intrinsic risk factors are advanced pregnancy, multiparity, increased abdominal circumference, gestational diabetes, age less than 30 and height more than 160cm (25). Complications related to falls in pregnancy include, placental abruption, preterm labour, fetal growth restriction and fetal death (24).

1.1.2. PATTERNS OF MATERNAL INJURY

Globally head and neck injuries are the most common causes of trauma-related maternal deaths, with the most common aetiologies for head injuries in pregnancy attributed to motor vehicle accidents and falls (26). Traumatic head injuries in pregnancy are associated with higher rates of morbidity and mortality compared to the non-pregnant population (27). Reasons for the increased morbidity and mortality are unclear but maybe related to physiological changes of pregnancy as well as unmeasured epidemiology factors (28).

Abdominal trauma in pregnancy is commonly subdivided into blunt abdominal trauma, penetrating trauma and pelvic fractures (29). The commonest type of abdominal injury sustained in motor vehicle accidents is blunt trauma. The degree of injury depends on the

force of impact, which is associated with risk of injury to intra-abdominal organs specifically spleen, liver, kidneys, major vessels and uterus (29).

Penetrating trauma results from gunshots or stab wounds, with gunshot injuries being more common in the US (73%) compared to stab injuries (23%) (29). Similarly in South Africa the commonest cause of penetrating trauma results from stab wounds (64%) and gunshot injuries (35%) (30). Injuries are often directed towards the pregnant women's abdomen (31). Such penetrating injuries can result in fatal maternal and fetal outcomes due to excessive haemorrhage resulting from injury to major vessels and exsanguination from rupture of the gravid uterus.

Pelvic fractures are commonly sustained in motor vehicle accidents but can also occur during accidental falls (8). The resulting injuries commonly involve anatomy adjacent to the bony pelvis such as bladder, urethra, gravid uterus and major pelvic vessels (32). Such injuries pose particular difficulties in pregnancy and will require multidisciplinary team approach.

1.1.3. PATHOPHYSIOLOGICAL CHANGES RELEVANT DURING MATERNAL INJURY

Physiological changes that occur during pregnancy provide an additional unique challenge to the management of critically ill obstetric women with trauma (33).

1.3.1.1. Airway and ventilator changes

During a healthy pregnancy, alterations in ventilation, pulmonary function and gaseous exchange occur secondary to hormonal effects and the mechanical pressure exerted by an enlarging uterus (34).

Airway changes

Pregnancy results in increased vascularity throughout the respiratory tract which results in increased oedema of the pharynx, larynx and trachea (35). These changes of the airway mucosa are secondary to elevated estrogen levels and increased blood volume associated with pregnancy (36).

Anatomical changes

The subcostal angle increases progressively from about 68° in early pregnancy to 103° in late pregnancy (36). The diaphragm rises by 4 cm, with both the transverse diameter and the anterior-posterior diameter increasing by 2 cm, resulting in an increase of 5 – 7 cm in the circumference of the lower rib cage (36). These anatomical changes should be taken into account when performing thoracic procedures like chest drain insertion and cardiopulmonary resuscitation (37). Pregnant patients must be placed in a left lateral tilt and chest compressions should be performed with the hand placed higher on the sternum than in non-pregnant women due to the elevated diaphragm (38).

1.3.1.2. Cardiovascular and Haemodynamic changes

Significant cardiovascular changes occur early in order to meet the increased metabolic demands of both the mother and fetus (39). There is a gradual increase in heart rate by 10 to 20 beats per minute throughout pregnancy (40). Cardiac output increases by about 50%, predominately from a rise in stroke volume in early pregnancy (40). Blood volume increases by up to 45%, with an increase in plasma volume that is greater than that of red blood cell mass, resulting in haemodilution and physiological anaemia (4,40). The physiological anaemia is a protective factor for both the mother and fetus in case of obstetric complications or trauma associated with blood loss. An injured pregnant woman may as a result lose up to 35% of circulating blood volume before showing signs and symptoms of hypovolaemic shock (4).

The primary factor determining fetal outcome is the extent of trauma sustained by the mother (41). Restoring maternal physiology remains the primary objective in the management of pregnant trauma patients (12). The management of maternal cardiac arrest should follow Advanced Cardiac Life Support resuscitation guidelines with some modifications (42). As the supine position results in aorto-caval compression, the relief of aorto-caval compression through a left lateral tilt must be maintained continuously during cardiopulmonary resuscitation (42). Manual left uterine displacement may also be used to relieve aorto-caval compression during resuscitation (43). If return to spontaneous circulation is achieved through cardiopulmonary resuscitation within four minutes, a peri-mortem caesarean delivery is recommended in order to optimise maternal resuscitation efforts and possible infant survival (12).

1.3.1.4. Gastrointestinal changes

Pregnancy is associated with delayed gastric emptying, decreased intestinal motility and decreased lower esophageal sphincter tone mediated by the hormonal effects of progesterone (42), these gastrointestinal changes increase the risk of aspiration during general anaesthesia (42). **Error! Bookmark not defined.**

1.3.1.5. Radiological imaging during pregnancy

Radiological investigations play an important role in the management of trauma patients. Indications for radiological investigations are no different in the pregnant trauma population (44). Indicated radiographic studies should thus be performed regardless of the status of pregnancy (37). The sequelae of radiation on pregnancy depend on the gestational age, with the greatest risk to the fetus from radiation occurring in early pregnancy during organogenesis (weeks 2-8) and neural tube development (up to week 15) (45).

The American college of Obstetricians and Gynecologists (ACOG) Guidelines for Diagnostic Imaging During Pregnancy and Lactation states that exposure to less than 5 rads has not been associated with an increase in fetal anomalies or pregnancy loss (44). Therefore, although there are concerns about radiation exposure during pregnancy, in general, the benefits of the radiological investigations outweigh the associated risk (37).

1.2 . RATIONALE FOR THE STUDY

Trauma in pregnancy complicates up to eight percent of pregnancies. It is the leading non-obstetric cause of maternal death and remains the most common cause of fetal death.

In South Africa, there is scarcity of published data on the incidence and outcomes of obstetric trauma patients. We aim to describe clinical characteristics as well as clinical management of trauma-related maternal mortality and morbidity in our institution.

1.3. STUDY AIMS AND OBJECTIVES

1.3.1. AIM

A retrospective review of trauma-related hospitalisations of pregnant patients at a tertiary hospital in South Africa, Chris Hani Baragwanath Hospital (CHBAH) aimed at describing the obstetric trauma population managed at CHBAH and to identify associated injury mechanisms and mortality outcome.

1.3.2. OBJECTIVES

- To describe the demographic, clinical characteristics and indications of admissions of obstetric trauma patients admitted to CHBAH from 1 January 2015 – 31 December 2019.
- To identify the mechanism of injury and risk factors associated with obstetric trauma patients admitted to CHBAH from 1 January 2015 – 31 December 2019.
- To describe the clinical management and interventions of obstetric trauma patients admitted to CHBAH from 1 January 2015 – 31 December 2019.
- To describe the maternal and fetal outcome of obstetric trauma patients admitted to CHBAH from 1 January 2015 – 31 December 2019.

1.4. Demarcation of study field and study methods

This was a retrospective review of data conducted at CHBAH in the Department of Obstetrics and Gynaecology, ICU, emergency medicine, general surgery and orthopaedics from 01 January 2015 to 31 December 2019. CHBAH is situated in Diepkloof, Soweto, Johannesburg. It is a 3000-bed hospital with 300 obstetrics beds, 96 gynaecology beds and a 26 bed intensive care unit (ICU). It is affiliated to the University of the Witwatersrand.

1.4.1 Study sample and sample size

Data of all obstetric trauma patients admitted at CHBAH Obstetrics Unit, CHBAH-ICU, orthopaedics department, general surgery and emergency medicine from 01 January 2015 to 31 December 2019 was extracted from admissions registries and analysed. Demographic data, information relating to gestational age of pregnancy, data regarding the mechanism of injury and maternal and fetal outcome was collected.

1.5. Selection criteria

1.5.1 Inclusion criteria

All pregnant women up to six weeks postpartum with the diagnosis of trauma injury admitted to CHBAH Obstetrics Unit, CHBAH ICU, orthopaedics, general surgery and emergency medicine were included.

1.5.2 Exclusion criteria

- Pregnant patients admitted with other conditions other than trauma related conditions.
- Insufficient or irretrievable demographic and laboratory data from the file.

1.6. DATA

1.6.1 Data collection process and tools

Data was collected retrospectively. Pregnant trauma patients were identified from the obstetrics unit, ICU, emergency medicine, orthopaedics and general surgery registers from 01 January 2015 to 31 December 2019. Names and file numbers were collected and then used to identify appropriate records from the records room. The information and data were recorded on a data sheet created on Microsoft excel.

The following data was collected and recorded as illustrated on the data sheet (Appendix 1)

- I. Demographic data: age, race and employment
- II. Mechanism and site of trauma
- III. Primary indication for obstetric unit and ICU admission and diagnosis
- IV. Organ dysfunction
- V. Therapeutic interventions in the obstetrics unit and/or in ICU
- VI. Complications in the obstetric unit and ICU
- VII. Length of hospital stay
- VIII. Maternal outcome on hospital discharge
- IX. Fetal outcome on hospital discharge

1.6.2 Data analysis

Data was captured using Microsoft Excel 2011 and entered into the REDCap (Research Electronic Data Capture) tool. Statistical analysis was conducted in consultation with a biostatistician. Categorical variables were described using frequencies and percentages. Parametric data if normally distributed was described using the mean and standard deviation. Non-parametric data or data that is not normally distributed was described using the median, interquartile range. Chi-squared or Fisher's Exact tests were used to compare categorical variables. Numerical data was compared using either an unpaired t-test or a Mann-Whitney test as appropriate. A p-value of <0.05 was considered statistically significant.

1.7. ETHICS

1.7.1 Authorisation

Permission to access patients' files was obtained from the CHBAH Chief Executive Officer. Approval was obtained from the Human Research Ethics Committee (Medical) of the University of the Witwatersrand prior to commencement of the study.

1.7.2 Confidentiality of Subject Records

Confidentiality of subject data was maintained at all times. All documentation relating to the subjects were kept in a secure location. The names and hospital numbers of the patients were assigned a number on a restricted access document. Confidentiality will be guaranteed in any resulting publication.

1.7.3. Declaration of Helsinki

The World Medical Association declaration of Helsinki and its subsequent amendments forms the basis for the ethical conduct of this study.

1.8. SIGNIFICANCE OF STUDY

This study will highlight the prevalence and impact of traumatic injuries in pregnant patients admitted to CHBAH. The results will be published in a peer-reviewed journal.

1.9. WORK PLAN

1.9.1 Schedule of target dates

This Master of Medicine research project was planned to be completed over a twelve to eighteen month period. The target date for submission of the proposal to the Post Graduate Committee Meeting was November 2020. The target date for submission to the Ethics committee was November 2020. Data Collection was expected to start in the final quarter of 2020

	2020									2021				
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	May	Jun
Literature Review														
Preparing Protocol														
Protocol Assessment														
Ethics application														
Data analysis														
Write-up report														
Publication														

1.9.2 FUNDING

The researcher funded the expenses incurred during the study for data capture, stationery and statistician fees. No costs were incurred by the hospital services.

1.9.3 BUDGET

Activity	Estimated in kind costs
Photocopies, printing and stationery	R1500
Research time (R/hour)	R281, 25 per hour x 8 hours a day x 5 days a week x 4 weeks a month = R45 000

Potential limitations

The following potential limitations, which are acknowledged as part of the discussion of the study's results, were identified:

1. The study was retrospective in nature, analysing data from a single institution.
2. Sample size may be limited in number.
3. The study design under-appreciated adverse trauma effects that occurred outside of the hospital setting.
4. Chris Hani Baragwanath Academic Hospital does not have electronic record keeping systems and the location of patient files from the records room was impaired by factors such as missing files.
5. Due to multiple disciplines involved in the management of obstetric trauma patients (general surgery, orthopaedics and gynaecology), some patients with less severe injuries could have been managed in these departments and may have been missed and not included in the study.
6. Bed limitations at CHBAH ICU may result in some patients being transferred to other hospitals and ICUs and would thus not be included in the study.

REFERENCES

1. World Health Organization (2017). Trends in maternal mortality 2000 to 2017: estimates by WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division: executive summary. World Health Organization: 1-47
2. van den Akker T, Nair M, Goedhart M, Schutte J, Schaap T, Knight M (2017). Maternal mortality: direct or indirect has become irrelevant. *The Lancet Global Health*. 5: e1181-e1182.
3. World Health Organization (2012). The WHO Application of ICD-10 to deaths during pregnancy, childbirth and the puerperium: ICD-MM. WHO Libr. 2012. 7-34.
4. Battaloglu E, Battaloglu E, Chu J, Porter K (2015). Obstetrics in trauma. *Trauma*. 17: 17–23.
5. Petrone P, Talving P, Browder T, Teixeira PG, Fisher O, Lozornio A, Chan L (2011). Abdominal injuries in pregnancy: A 155-month study at two level 1 trauma centers. *Injury*. 42: 42-47.
6. Wall SL, Figueiredo F, Laing GL, Clarke DL (2014). The spectrum and outcome of pregnant trauma patients in a metropolitan trauma service in South Africa. *Injury*. 45: 1221-1223.
7. Petrone P, Asensio JA (2006). Trauma in pregnancy: Assessment and treatment. *Scand J Surg*. 45: 383-392
8. Mendez-Figueroa H, Dahlke JD, Vrees RA, Rouse DJ (2013). Trauma in pregnancy: an updated systematic review. *Am J Obstet Gynecol*. 209:1-10
9. Hill CC, Pickinpaugh J (2008). Trauma and Surgical Emergencies in the Obstetric Patient. *Surg Clin North Am*. 88: 421-420.
10. ITF (2019). Road Safety Annual Report 2019. OECD. 8-35.
11. Schiff MA, Holt VL (2005). Pregnancy Outcomes following Hospitalization for Motor Vehicle Crashes in Washington State from 1989 to 2001. *Am J Epidemiol*. 2005. 161: 503–510.
12. Huls CK, Detlefs C (2018). Trauma in pregnancy. *Semin in Perinatol*. 42: 13–20.
13. Field S, Onah M, van Heyningen T, Honikman S (2018). Domestic and intimate partner violence among pregnant women in a low resource setting in South Africa: a facility-based, mixed methods study. *BMC Womens Health*. 18: 119.
14. Alhusen JL, Ray E, Sharps P, Bullock L (2015). Intimate Partner Violence During Pregnancy: Maternal and Neonatal Outcomes. *J Women's Health (Larchmt)*. 24: 100-

15. Matseke G, Peltzer K, Mlambo G (2012). Partner violence and associated factors among pregnant women in Nkangala district, Mpumalanga. *S Afr J Obstet Gynaecol.* 18: 77-81.
16. Martin-de-las-Heras S, Velasco C, Luna-del-Castillo J de D, Khan KS (2019). Maternal outcomes associated to psychological and physical intimate partner violence during pregnancy: A cohort study and multivariate analysis. *PLoS One.* 14: e0218255.
17. Soma-Pillay P, Fawcus S, Ibrahim T, Moodley J (2020). Maternal deaths from suicide reported to the National Committee On Confidential Enquiries Into Maternal Deaths (NCCEMD) 2017-2019. *Obstet Gynaecol Forum.* 30: 26–29.
18. Vawda NBM (2018). Suicide attempts during pregnancy in South Africa. *South African J Psychiatry.* 24: 3–5.
19. Modini C, Leske S, Roberts S, Whelan N, Chitakis A, Crompton D, Ellwood D (2021). Maternal deaths by suicide in Queensland, Australia, 2004–2017: an analysis of maternal demographic, psychosocial and clinical characteristics. *Arch Womens Ment Health.* 24: 1019–1025.
20. Cliffe C, Miele M, Reid S (2019). Homicide in pregnant and postpartum women worldwide: a review of the literature. *Journal of Public Health Policy.* 40: 180-216.
21. Abrahams N, Jewkes R, Martin LJ, Mathews S, Vetten L, Lombard C (2009). Mortality of Women From Intimate Partner Violence in South Africa: A National Epidemiological Study. *Violence Vict.* 24: 546–556.
22. Garg N, Sharma A, Khanna P, Goel V (2017). Trauma in pregnancy – A brief review. *Trauma Emerg Care.* 2: 1-4.
23. Weiss HB, Songer TJ, Fabio A (2001). Fetal deaths related to maternal injury. *J Am Med Assoc.* 286: 1863-1868
24. Jain V, Chari R, Maslovitz S, Farine D, Bujold E, Gagnon R, et al (2015). Guidelines for the Management of a Pregnant Trauma Patient. *J Obstet Gynaecol Canada.* 37: 533-571.
25. Hrvatin I, Rugelj D (2021). Risk factors for accidental falls during pregnancy – a systematic literature review. *J Matern Neonatal Med.* 35: 7015–7024
26. Kuczkowski KM (2005). Trauma during pregnancy: A situation pregnant with danger. *Acta Anaesthesiol Belg.* 56: 13-18.
27. Kho GS, Abdullah JM (2018). Management of severe traumatic brain injury in pregnancy: A body with two lives. *Malays J Med Sci.* 25: 151-157.
28. Van Mieghem T, Whittle WL, Farine D, Seaward G, D’Souza R (2013). Motor Vehicle

- Accidents in Pregnancy: Implications and Management. *J Obstet Gynaecol Canada*. 35: 303–304.
29. Romero VC, Pearlman M (2012). Maternal Mortality Due to Trauma. *Seminars in Perinatology*. 36: 60-67.
 30. Zalgaonker M, Naidoo N, Christopher LD (2021). Penetrating injury from interpersonal violence and related haemorrhagic shock resuscitation practices in an urban South African emergency medical service. *Australas J Paramed*. 18: 1-9.
 31. Osnaya-Moreno H, Zaragoza Salas TA, Escoto Gomez JA, Mondragon Chimal MA, Torres Castaneda MDL, Jimenez Flores M (2013). Gunshot wound to the pregnant uterus: case report. *Rev Bras Ginecol e Obs*. 35: 427–431.
 32. Atkinson (2013). Pelvic Fracture in the Pregnant Patient. *J Med Cases*. 4: 201-203.
 33. Aldawood A (2011). Clinical characteristics and outcomes of critically ill obstetric patients: A ten-year review. *Ann Saudi Med*. 31: 518-522.
 34. LoMauro A, Aliverti A (2015). Respiratory physiology of pregnancy. *Breathe*. 11: 297-301.
 35. Preston R, Jee R (2014). Obstetric airway management. *Int Anesthesiol Clin*. 52: 1–3.
 36. Hegewald MJ, Crapo RO (2011). Respiratory Physiology in Pregnancy. *Clinics in Chest Medicine*. 32: 1–13.
 37. Petrone P, Marini CP (2015). Trauma in pregnant patients. *Curr Probl Surg*. 52: 330–351.
 38. Durga P, Padhy S, Bardaa A (2019). Challenges of Cardiopulmonary Resuscitation during Pregnancy. *Indian J Cardiovasc Dis Women WINCARS*. 04: 032–039.
 39. Soma-Pillay P, Nelson-Piercy C, Tolppanen H, Mebazaa A (2016). Physiological changes in pregnancy. *Cardiovasc J Afr*. 27: 89-94.
 40. Sanghavi M, Rutherford JD (2014). Cardiovascular physiology of pregnancy. *Circulation*. 130: 1003–1008.
 41. Weinberg L, Steele RG, Pugh R, Higgins S, Herbert M, Story D (2005). The pregnant trauma patient. *Anaesthesia and Intensive Care*. 32: 167-180.
 42. Jeejeebhoy F, Windrim R (2014). Management of cardiac arrest in pregnancy. *Best Pract Res Clin Obstet Gynaecol*. 28: 607-618.
 43. Morris S (2003). Resuscitation in pregnancy. *BMJ*. 327: 1277-1278.
 44. Sakamoto J, Michels C, Eisfelder B, Joshi N (2019). Trauma in Pregnancy. *Emergency Medicine Clinics of North America*. 37: 317-338.
 45. Refa N, Ali RAR, Gomaa H (2019). Update in obstetric trauma management. *Updat Anaesth*. 63-68.

CHAPTER 2: SUBMISSIBLE ARTICLE

TITLE: OBSTETRIC TRAUMA ADMISSIONS IN A LEVEL 1 TRAUMA CENTRE IN SOUTH AFRICA: A 5-YEAR RETROSPECTIVE REVIEW

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Keywords

Trauma in pregnancy, gender-based violence, blunt abdominal trauma, penetrating abdominal trauma, pregnancy outcomes

ABSTRACT

Background:

Trauma is one of the leading causes of morbidity and mortality in pregnancy and remains the most common cause of fetal mortality worldwide. The severity of injury as well as early and aggressive management of injuries are significant factors that determine maternal and fetal outcomes.

Objectives:

The aim of this study was to describe the characteristics, mechanisms of injury, clinical interventions performed as well as maternal and fetal outcomes of obstetric trauma admissions to our institution.

Methods:

This was 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. Patients were identified from admission registries from the departments of obstetrics and gynaecology, emergency medicine, general surgery, orthopaedics and intensive care. 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 median age and gestational ages were 31.00 years and 26.00 weeks respectively. The majority of pregnant trauma patients self-identified as black Africans (n= 713; 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 (n= 330; 41.3%), followed by falls (n= 265; 33.1%) and motor vehicle accidents (n= 204; 25.5%). Hundred and forty-one patients (18.0%) were documented to have consumed alcohol on the day of the injury. Four patients (0.5%) were admitted to ICU, of these one died in ICU. Ten fetal deaths were recorded, of these three were delivered by patients admitted to ICU. Eleven neonates were delivered before 37 weeks.

Conclusion:

Trauma in pregnancy is associated with significant morbidity and negative pregnancy outcomes. We identified unemployed pregnant patients of single marital status as being at increased risk of obstetric trauma. Assaults followed by falls and motor vehicle accidents were the commonest causes of maternal trauma in our population. 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.

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).

With regards to mechanism of injury, Mendez-Figueroa and colleagues, in a systemic review of data found motor vehicle accidents and domestic violence accounted 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 pregnancy worldwide and are associated with a three percent of fetal deaths (7,8).

Notably, domestic violence is reported to occur in four to eight percent of all pregnancies in the US (9). Associated risk factors include a lower socioeconomic status, single marital status, classification as African-American or Hispanic and age less than 26 years (10). Globally head and neck injuries are the most common causes of trauma related maternal death in pregnancy with the most common aetiology for head injuries attributed to motor vehicle accidents (11). 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, injury severity and clinical management interventions, as well as maternal and fetal outcomes was 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).

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. Most of the patients were aware of pregnancy status on admission (n=798; 99.8%). Characteristics of patients are listed in table 1 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
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
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
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
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

2.4.2 Presenting physiology

The presenting physiology is summarized below in table 2. The majority 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. The p-value indicates that the presenting blood pressure and pulse were statistically significantly different, however, they were not clinically significant. Majority were stable on admission.

Table 2. Presenting blood pressure and pulse

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

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.

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%)	

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

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%)

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. The majority of 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 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)	
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

2.4.6 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 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 knees with back slab casters applied. Eight patients were referred to the neurosurgery department (1.00%) for observation over a period of 24 to 48 hours. None of the 8 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; one had a caesarean section, caesarean hysterectomy and exploratory laparotomy after a gunshot wound to the abdomen; one patient had internal fixation of the pelvis, a caesarean section and exploratory laparotomy after being involved in an MVA and one 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 the investigations interventions in ICU.

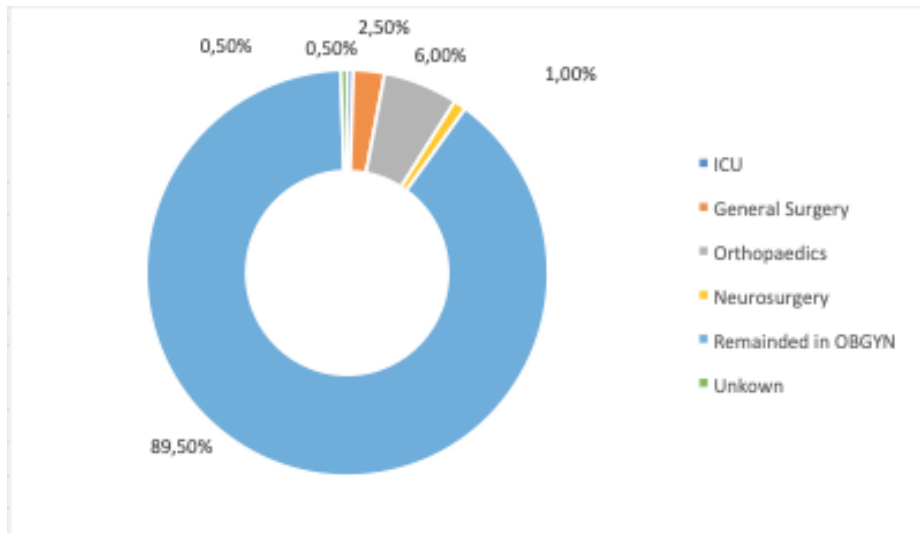


Figure 1. Number of patients transferred to other departments.

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%)

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	
ET tube + Ventilation	3 (75%)
Orthopaedic surgery	1 (25%)
Exploratory laparotomy	3 (75%)
Caesarean sections	2 (50%)
Outcomes	
Fetal death	3 (75%)
Maternal death	1 (25%)

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 10 outlines the outcome of pregnancies and table 11 outlines the caesarean section and vaginal delivery rate.

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%

2.5. Discussion

Gender-based violence remains a social burden which predominantly affects women from poor socio-economic status in South Africa (12). 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%) assaults were a result of intimate partner violence and thirty-nine were assaulted by either siblings, neighbours or strangers. This highlighted the enormous burden of trauma and violence in SA. In keeping with 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 ANC 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 (13). 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 (14).

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 (8). 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. There was no maternal mortality documented related to MVA's, however two patients were admitted to ICU (with head trauma and blunt abdominal trauma with pelvic fracture respectively). In a retrospective study conducted in South Africa, Wall and colleagues found that in 1990 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.

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, it resulted in one maternal death and one ICU admission.

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 (15). 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.

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. A limitation of the study was missing data. Results of this retrospective review will help inform the design of future retrospective studies.

2.7. Conclusion

We identified unemployed pregnant patients of single marital status as being of increased risk of obstetric trauma. 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 (2017). *J Paediatr Child Health*. 53: 3-117
2. Say L, Chou D, Gemmill A, Tunçalp Ö, Moller AB, Daniels J, et al (2014). Global causes of maternal death: A WHO systematic analysis. *Lancet Glob Heal*. 2: e323-e333.
3. Battaloglu E, Battaloglu E, Chu J, Porter K (2015). Obstetrics in trauma. *Trauma*. 17: 17–23.
4. Wall SL, Figueiredo F, Laing GL, Clarke DL (2014). The spectrum and outcome of pregnant trauma patients in a metropolitan trauma service in South Africa. *Injury*. 45: 1221-1223.
5. Petrone P, Asensio JA (2006). Trauma in pregnancy: Assessment and treatment. *Scand J Surg*. 45: 383- 392.
6. Mendez-Figueroa H, Dahlke JD, Vrees RA, Rouse DJ (2013). Trauma in pregnancy: An updated systematic review. *Am J Obstet Gynecol*. 209: 1–10.
7. Garg N, Sharma A, Khanna P, Goel V (2017). Trauma in pregnancy – A brief review. *Trauma Emerg Care*. 2: 1-4.
8. Weiss HB, Songer TJ, Fabio A (2001). Fetal deaths related to maternal injury. *J Am Med Assoc*. 286: 1863-1868.
9. Huls CK, Detlefs C (2018). Trauma in pregnancy. *Seminars in Perinatology*. 42: 13–20.
10. Alhusen JL, Ray E, Sharps P, Bullock L (2015). Intimate Partner Violence During Pregnancy: Maternal and Neonatal Outcomes. *J Women’s Health (Larchmt)*. 24: 100-106.
11. Kuczkowski KM (2005). Trauma during pregnancy: A situation pregnant with danger. *Acta Anaesthesiolo Belg*. 56: 13-18.
12. Abrahams N, Jewkes R, Mathews S (2010). Guns and gender-based violence in South Africa. *South African Med J*. 9: 586-588.
13. Aboagye RG, Seidu A-A, Asare BY-A, Adu C, Ahinkorah BO (2022). Intimate partner violence and timely antenatal care visits in sub-Saharan Africa. *Arch Public Heal*. 80: 2-11.
14. Davis EC, Rotheram-Borus MJ, Weichle TW, Rezai R, Tomlinson M (2017). Patterns of Alcohol Abuse, Depression, and Intimate Partner Violence Among Township Mothers in South Africa Over 5 Years. *AIDS Behav*. 21: 174–182.

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

CHAPTER 3: APPENDICES

3.1. Data collection Sheet

Admission details	• Admssion date (yyyy/mm/dd)
Location pre-admission	• Interhospital transfer (YES/NO) • Emergency department referral (YES/NO) • Self referral to obstetrics unit (YES/NO)
Patient's information	• Age • Parity • Race • Citizenship • Marital status (YES/NO) • Employment (YES/NO) • Co-morbidities • Social habits
Obstetrics data	Gestational age Booking details • Is the patient booked (YES/NO) • Gestational age of booking • Number of ANC visits • Problems at ANC
Indications for admission	
Mode of trauma	• Blunt or penetrating • Fall • Motor Vehicle Accident/PVA • Assault • Other

Site of injury	• Head and neck (YES/NO) • Limbs (YES/NO) • Thoracic (YES/NO) • Abdomen (YES/NO) • Pelvis (YES/NO) • Uterine injuries (Rupture, abruption or penetrating injuries) (YES/NO) • Other
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Admission status	• Admission GCS • Admission blood pressure and mean arterial pressure • Admission pulse • Admission temperature • Admission glucose • SOFA • APACHE • Pregnancy status (viable pregnancy/ non-viable)
Interventions during stay in obstetrics department	• Fetal monitoring • Fetal maturation • Delivery and mode of delivery • Transfer to ICU/ General Surgery/ Orthopaedics/ Neurosurgery
Interventions during ICU stay	• Airway management (own/ET tube/facemask/tracheostomy) • Fetal monitoring • Fetal maturation support offered (Y/N) • Surgery and type
Complications during ICU Stay	• Infection/sepsis (YES/NO) • Surgery related (YES/NO) • Other
Outcome	• Maternal (Alive or dead) • Maternal length of stay (days)

	Fetal	- Alive or dead - Birth weight - Mode of delivery
	Prognosis	
Investigations	- X-rays (YES/NO) - CT scans (YES/NO) - Sonar (YES/NO) - MRI (YES/NO) - Lactate on admission - Admission haemoglobin and platelets - Admission creatinine	

Discharge Data

Discharge information	- Date (yyyy/mm/dd) - Time (hh:mm)
Patients condition	- GCS - Sedated - Alive or dead
Fetal condition	Alive or dead
- Duration of stay (ICU) - Duration of ventilation - Duration of stay in Obstetrics department	
Laboratory findings	- Blood gas - FBC - LFT - U&E - LFT - Clotting profile
Discharge status	Alive or dead

3.2. Ethics clearance certificate



R49 Dr NB Moyo

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL) CLEARANCE CERTIFICATE NO. M210317

NAME:
(Principal Investigator)

Dr NB Moyo

DEPARTMENT:

School of Clinical Medicine
Department of Obstetrics and Gynaecology
Medical School
University

PROJECT TITLE:

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

DATE CONSIDERED:

2021/03/26

DECISION:

Approved unconditionally

CONDITIONS:

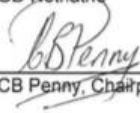
NOTE:

If contact information regarding student study participants is required,
please contact the Registrar's office - <Nicoleen.Potgieter@wits.ac.za>

SUPERVISOR:

Dr GD Nethathe

APPROVED BY:


Dr CB Penny, Chairperson, HREC (Medical)

DATE OF APPROVAL:

2021/09/07

This Clearance Certificate is valid for 5 years from the date of approval. An extension may be applied for.

3.3 Institutional Approvals

3.3.1. Approval from CHBAH CEO



GAUTENG PROVINCE

HEALTH
REPUBLIC OF SOUTH AFRICA

MEDICAL ADVISORY COMMITTEE

CHRIS HANI BARAGWANATH ACADEMIC HOSPITAL

PERMISSION TO CONDUCT RESEARCH

Date: 3rd December 2020

TITLE OF PROJECT:

Obstetric Trauma Admission in a level 1 trauma Centre in South Africa: a 5 year Retrospective Review.

UNIVERSITY: Witswatersrand

Principal Investigator: Dr NJaya Bruce Moyo

Department: Obstetric and Gynaecology

Supervisor : Dr G Nethathe

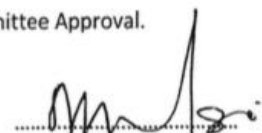
Permission Head Department (where research conducted): Yes

NHRD No. GP_202011_030

The Medical Advisory Committee recommends that the said research be conducted at Chris Hani Baragwanath Academic Hospital. The CEO / management of Chris Hani Baragwanath Academic Hospital is accordingly informed and the study is subject to:-

- **Permission having been granted by the Committee for Research on Human Subjects of the University of the Witwatersrand.**
- The Hospital will not incur extra costs as a result of the research being conducted on its patients within the hospital
- The MAC will be informed of any serious adverse events as soon as they occur
- Permission is granted for the duration of the Ethics Committee Approval.


.....
Recommended
(On behalf of the MAC)
Date: 3/12/2020


.....
Approved/Not Approved
Hospital Management
Date: 04/12/2020

3.3.2. Approval from Obstetrics and Gynaecology HOD



GAUTENG PROVINCE

HEALTH
REPUBLIC OF SOUTH AFRICA

PERMISSION TO CONDUCT RESEARCH AT CHRIS HANI BARAGWANATH ACADEMIC HOSPITAL

PRINCIPAL RESEARCHER:

FULL NAME

NJAYA BRUCE MOYO

DESIGNATION

REGISTRAR

CONTACT NUMBER

078 263 4046

EMAIL

brcm437@sanat.com

NAME OF SUPERVISOR

Gladness Nkomo and Robert Nyakoe

TITLE OF RESEARCH

Obstetric Trauma Admissions in a
Level I Trauma Centre in South Africa:
a 5 year Retrospective Review.

STUDY SITE/S

Chris Hani Baragwanath Academic Hospital

BRIEF OUTLINE OF METHODOLOGY

Retrospective review of all obstetric trauma
patients admitted at CHBAH Obstetric unit
and CHBAH - ICU.

PROTOCOL

Yes

DATA SHEET

Yes

EXPECTED START DATE

January 2021

EXPECTED DURATION

June 2021

ETHICS CLEARANCE?

Y

/

N

/

DEPENDENT

CONFLICT OF INTEREST?

Y

/

N

DETAILS

COST TO HOSPITAL AND OR PATIENTS?

Y

/

N

SOURCE OF FUNDING

Myself

APPROVAL OF HOD Y/N

[Signature]

Prof Jasmin Adam

SIGNATURE

NAME IN PRINT+ DESIGNATION

OFFICIAL STAMP+ DATE

3.3.3. Approval Department of Surgery HOD



GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

CHRIS HANI BARAGWANATH ACADEMIC HOSPITAL

Directorate: Department of Surgery

☎011 933 8804 / 9267 / 8386

📠011 938 2002

27th May 2021

**Prof Jeenah
HOD Psychiatry Dept
CHBAH**

Re: Permission for Research Activity

I have read the Research Protocol submitted by Dr Moyo – Obstetrics and Gynecology Registrar – CHBAH. The titled of his topic: “ **Obstetric Trauma Admission in a level 1 trauma centre in South Africa: a 5 year Retrospective Review.**”

I agree and support this project and hence I give him permission to conduct this study/research project.

His supervisors are Drs G Nethathe, R Nyakoe and I Mashayamombe.

The study will be at no additional cost to the hospital.

Yours faithfully.

Kindest regards.

**Prof MD Smith
Head and Chief Specialist,
Department of Surgery,
3.6. Approval from Orthopaedocs HOD**

3.3.4. Approval from Orthopaedic Department HOD



**health and
social development**
Department: Health and Social Development
GAUTENG PROVINCE

Division of Orthopaedic Surgery
P.O. Bertsham
Soweto
2013
12/05/2021

Enquiries: Prof M.T. Ramokgopa
Tel: 011 933-8914
Email: Mmampapatla.ramokgopa@wits.ac.za

TO: Research Protocol Review Committee (CHBAH)

Re: Permission to conduct a study at Chris Hani Baragwanath Academic Hospital

This letter serves to confirm that I give Dr. Njaya Bruce Moyo permission to conduct his study in the department of Orthopaedics for Research on Human Subjects of the University of the Witwatersrand.

Thanking you in advance

Prof M.T. Ramokgopa
Head of Orthopaedic Department
Chris Hani Baragwanath Academic Hospital
3.7. Approval from ICU HOD

3.3.4. Approval from Department of Intensive Care HOD



health and
social development
Department: Health and Social Development
GAUTENG PROVINCE



**CHRIS HANI BARAGWANATH ACADEMIC HOSPITAL
Intensive Care unit**

Dr JM Brown
Jacqui.Brown@wits.ac.za
Tel: 0119381596
Fax: 0119381595

26th May 2021

To whom it may concern

Re: Permission to conduct research in Chris Hani Baragwanath Hospital Intensive Care unit

Title of research project:

Obstetric Trauma Admissions in a level 1 Trauma Center In South Africa: a 5year Retrospective review

Investigator: Njaja B Moyo

Permission is hereby granted for Dr Njaja B Moyo to access ICU files for the purpose of their data collection. The data collected will be used for his MMed and subsequent publication in peer review journals.

The study is retrospective and the study data will be anonymous.

The hospital is not liable for any costs related to the study

The study will not disadvantage any Chris Hani (CH) Baragwanath patient/staff member

Regards

Dr JM Brown
Deputy Head: Intensive Care Unit
Chris Hani Baragwanath Hospital
Soweto
Affiliated to University of the Witwatersrand

3.3 Turnitin report

Final NB Moyo.docx

ORIGINALITY REPORT

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PRIMARY SOURCES

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4	Kuczkowski, KM. "A situation pregnant with danger: Trauma in pregnancy", Southern African Journal of Anaesthesia and Analgesia, 2008. Publication	1 %
5	Wall, S.L., F. Figueiredo, G.L. Laing, and D.L. Clarke. "The spectrum and outcome of pregnant trauma patients in a metropolitan trauma service in South Africa", Injury, 2014. Publication	<1 %
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