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(RESEARCH ARTICLE)

Influence of health system factors on Fetomaternal outcomes among pregnant women presenting with antepartum hemorrhage at Jaramogi Oginga Odinga Teaching and Referral Hospital, Kisumu-Kenya

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Abstract

Background: Globally, maternal mortality is decreasing, but in developing countries, especially Sub-Saharan Africa, maternal death has remained high. Antepartum haemorrhage (APH), which is the per-vaginal bleeding after 28 weeks of gestation and before delivery complicates 2-5% of pregnancies. Although timely access to quality obstetric services, availability of trained health service providers, availability of transfusion products, theatre waiting time are major determinants of both maternal and new-born outcomes after antepartum haemorrhage, the impact of the health system and health provider related factors associated with APH on the neonatal and maternal outcomes remains to be investigated. As such, this study evaluated the influence of health system factors on maternal and neonatal outcomes among women presenting with Antepartum haemorrhage at the Jaramogi Oginga Odinga Teaching and Referral Hospital (JOOTRH), Kisumu County, Kenya.

Methods: The study was a prospective case-control study that recruited mothers (n=63) presenting at the maternity department with antepartum haemorrhage. The control group comprised of mothers (n=63) presenting without antepartum haemorrhage at the same maternity. The study took a period of one year. Data was coded and analysed by SPSS program version 23.0 and STATA version 14.0.

Results: Abruptio placentae and placenta Previa were the major causes of APH recorded in 17 (27%) and 39 (61.9%) of APH patients, respectively. A large proportion of patients presenting with antepartum haemorrhage (APH) were younger, aged between 20-29 years (n=37, 58.7%), with an overall mean age of 26.22. Cases with APH had a lower mean parity (1.17), while controls had a higher mean parity (2.97 Caesarean section rate was high among pregnant women who had APH (n=42, 66.7%). (p=0.001). Out of these, 32 (52.4%) were done as emergency. Majority of the emergency caesarean sections were done within 30 minutes from the time the decision to deliver had been made (n=17, 54.8%). Most patients who presented with APH were referred from another facility (n=42 (66.7%) in our study. Risks of perinatal and maternal mortality were higher for patients who came from outside of JOOTRH compared to patients from JOOTRH (OR=3.16, 95%CI=1.34-5.57, P< 0.0001). High risks of perinatal mortality (19.9%) and maternal mortality (3.2%) were observed among APH patients in our study hospital compared to mothers who did not experience APH (8% and 0% respectively). Majority of new-borns of patients who had APH were admitted to NBU (n=42, 66.7%) (p=0.017) and the major reason for admission to NBU was prematurity and low Apgar score.

Conclusion of the study is that APH is a major cause of maternal and perinatal morbidity and mortality. This could be prevented by regular and focused antenatal care, early detection of risk factors and prompt referrals. Many facilities for caesarean sections, availability of blood banks and blood transfusion products, facilities with ICU and proper new-born units with adequate staffing can improve maternal and perinatal outcome of patients with APH

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Keywords: Antepartum Hemorrhage; Placenta previa; Abruptio placentae; Maternal mortality; Perinatal mortality;

1. Introduction

Antepartum hemorrhage (APH) is defined as bleeding from or into the genital tract during pregnancy, after the period of viability until delivery of fetus (Donald's, 2014). The World Health Organization defines antepartum hemorrhage as bleeding after 28th week of pregnancy and before birth (WHO |Aph.2015) (Naiknaware, 2015). Antepartum hemorrhage is a serious complication of pregnancy and is associated with significant maternal and fetal morbidity and mortality (Morgan & Arulkumaran, 2003). It occurs in 2-5% of pregnancies (Morgan & Arulkumaran, 2003).

The causes of antepartum hemorrhage can be divided into three main groups, placenta previa, placental abruption and others (HIRST, 1914). The others include cervicitis, uterine rupture, cervical polyps, cervical and vaginal neoplasms (Decherney et al, 2006).Placenta previa exists when the placenta is implanted partially or completely over the lower uterine segment that is over and adjacent to the internal os. (HIRST, 1914). Placenta abruptio is one form of antepartum hemorrhage where the bleeding occurs due to premature separation of normally situated placenta.

Antepartum hemorrhage is a major cause of mortality and morbidity globally and particularly to developing countries such as Kenya (Dolea et al., 2003). Globally, maternal mortality is decreasing, but in developing countries, especially Sub-Saharan Africa maternal death has not been reducing. The global maternal mortality ratio was estimated at 210 per 100,000 live births in 2010 and 480 per 100,000 in Africa. In Kenya the current Maternal Mortality Ratio (MMR) of 362 maternal deaths per 100,000 live births, and the still birth rate of 23 deaths per 1000 live births is far below the target of 147 maternal mortality per 100,000 live births and 12 stillbirths per 1000 live births respectively. Despite efforts by the Kenyan government to invest in maternal health, maternal mortality has not declined significantly over the past 15 years. According to the United Nations Population Fund report, Kisumu County is amongst the 15 of 47 counties in Kenya accounting for 98.7% of total maternal deaths in the Country. (UNFPA., 2020)

Timely access to quality obstetric services, availability of trained health service providers, availability of transfusion products, theatre waiting time are major determinants of both maternal and newborn outcomes after antepartum hemorrhage. Blood transfusion facilities are still inadequate in rural Nyanza. Late referral, lack of transport facilities and inadequate knowledge of medical and paramedical staff contributes to poor outcomes in developing countries like Kenya(Maoulidi, 2015). The risk of adverse outcomes in patients with APH is high especially in the developing countries such as Kenya. This study demonstrated the influence of health system factors on the maternal and neonatal outcomes of pregnancies associated with APH and this will be used to prevent mortality and morbidity resulting from antepartum hemorrhage.

2. Material and methods

2.1. Study setting

The study was conducted in Jaramogi Oginga Odinga Teaching and Referral Hospital located in Kisumu County in western Kenya. The Jaramogi Oginga Odinga Teaching and Referral Hospital (JOOTRH) is a 600-bed hospital situated in the lake side City of Kisumu in Western Kenya. Kisumu County is one of 47 counties in the Republic of Kenya. It has a population of 1,155,574 (2019 National Census). The hospital serves County, Sub-County and Private Hospitals in more than 10 counties in the Western Kenya Region with a population of more than 5 million. The JOOTRH has an out-patient department (OPD), Obstetric units (Ante natal care, labour ward post-natal care) and a gynecological unit. All receiving female patients. The main mandate of JOOTRH is to provide curative, preventive, promotive and rehabilitative health services. It offers specialized clinical services in various disciplines. It serves as a center for research activities, training of medical students and health workers. The hospital has a total of 880 staff: consisting of 492 regular staff, 107 from partners, 140 casuals/contract, 141 outsourced services (JOOTRH, 2016). The hospitals labor ward has a capacity of 20 beds while the post-natal unit has a bed capacity of 50. Every year, approximately 5000 deliveries are conducted within the hospital. Out of these about 1100 are caesarean deliveries and about 900 elective surgeries in a year. Averagely 3000 pregnant women are seen at the antenatal clinic in a year. About 75% of these mothers coming for antenatal care services come from Kisumu County. The obstetrics and gynecology department has 11 consultants and 3 medical officers. A total of 15 nursing staff and 8 registrars in the department.

2.2. Study design

The study was a prospective case-control study that recruited mothers (n=63) presenting at the maternity department with antepartum hemorrhage. The control group comprised of mothers (n=63) presenting without antepartum hemorrhage at the same maternity. The study took a period of one year.

2.3. Inclusion criteria

Pregnant women who are bleeding from the genital tract. Pregnant mothers in their current pregnancy 28 weeks of gestation. Mothers who give consent to participate in the study

2.4. Exclusion criteria

Patient suffering from bleeding disorder. Bleeding from a source other than the genital tract. Mothers below the age of 16 who are unaccompanied by their parents

2.5. Data Collection

Once the proposal had been approved by Jaramogi Oginga Odinga Teaching and Referral Hospital (JOOTRH) ethical review committee, we began the process of data collection by seeking permission from the hospital's chief executive officer. This study used one research assistant who was required to have qualified with a diploma in clinical medicine from a recognized training institution. Together with the principal investigator the recruited research assistant collected data for this study. There was continuous scrutiny of the data collected to ensure accuracy, consistency and uniformity of the data. Data regarding demographic characteristics, medical and obstetrical history and the current pregnancy, as well as delivery and neonatal outcomes, was obtained from patient files in the hospital's health records department and also using Pre- tested structured questionnaires. The researcher and assistant checked the records on a daily basis during the data collection period to identify patients diagnosed with antepartum hemorrhage (APH). Those diagnosed with APH were recruited as cases while those admitted immediately after the case without a diagnosis of APH were the controls. The study participants were told about the study and given opportunity to ask questions or seek any clarifications, after which they were asked to give signed informed consent. All eligible consenting cases were recruited until the desired sample size was obtained.

2.6. Sampling Procedure

A convenient non-probability sampling was used to select pregnant women presenting at Jaramogi Oginga Odinga Teaching and Referral Hospital as cases and controls. Patients' information was obtained from the hospital's health records. Pregnant women who met the inclusion criteria were consented and recruited into the study. Controls were recruited from maternity ward.

2.7. Data management and analysis

Data was coded and analyzed by SPSS program version 23.0 and STATA version 14.0. Proportions between independent and dependent variables were analyzed using chi square test. Associations between case and control groups were computed using binary logistic regression models, controlling for potential confounding variables of age and gestation

2.8. Ethics

The study was approved by Jaramogi Oginga Odinga Teaching and Referral Hospital (JOOTRH) ethical review committee. Informed consent was obtained from all the patients included in the study

3. Results

3.1. Social Demographic Characteristics

A total of 126 patients (i.e. pregnant women; age 15-49 years) who attended Jaramogi Oginga Odinga Teaching and Referral Hospital (JOOTRH) were enrolled into the study. The patients recruited were mothers presenting with cases of antepartum haemorrhage in their current pregnancy (Cases, n=63). The study also included a control group, which comprised of pregnant women without antepartum haemorrhage in pregnancy (Controls, n=63). The social and demographic characteristics of the study participants are presented in table 4.1 below.

The largest proportions of participants enrolled into the study were aged between 20-29 years (n=44, 34.9%), followed by 30-39 years (n=42, 33.4%), with an overall mean age of 30.88 (Table 4.1). A large proportion of patients presenting

with antepartum haemorrhage (APH, Cases) were younger, aged between 20-29 years (n=37, 58.7%), with an overall mean age of 26.22. Conversely, a higher percentage of pregnant women without APH (Controls) were older (30-39 years, n=33, 52.4%), with an overall mean age of 35.54. There was a significant difference in the age distribution of the patients between the cases and controls (p=0.001) (Table 4.1).

Results from the marital status showed that majority of the patients with APH were married (n=72, 57.1%), with a significant proportion reporting being single (n=34, 27.0%) and divorced (n=15, 11.9%). The cases of patients with APH were mostly single mothers (n=29, 46.0%), followed by those married (n=19, 30.2%), while patients reporting without APH (controls) were largely married (n=53, 84.1%). A Fishers exact test analysis of the proportional distribution of the marital status between the cases and controls was statistically significant (p<0.001) (Table 4.1).

Analysis of the study participant's religion showed that Christians were the majority (n=71, 56.3%), followed by Muslims (n=42, 33.3%). In addition, there were more Christians (n=31, 49.2) reporting with APH cases, as were those without APH (n=40, 63.5%). The proportion distribution of patients' regions did not differ between the cases and control groups (p=0.564) (Table 4.1).

The level of education of patients was analysed. The results showed that majority of the patients attained a tertiary (college, university, or higher) level of education (n=51, 40.5%), followed by primary level (n=35, 27.8%) and secondary (n=32, 25.4%). Cases with APH were mostly patients who attained a primary level of education (n=31, 49.2%), as well as secondary education (n=20, 31.7%), while most patients in the control group reported having attained a tertiary level of education (n=40, 63.5%). A chi-square analysis of the distribution of the education level of patients in the case versus control groups was significant (p=0.009) (Table 4.1).

Analysis of parity of the pregnant women showed that those with APH had a lower mean parity (1.17). On the other hand, pregnant women without APH had a higher mean parity (2.97). A Fishers exact test analysis of the distribution of the mean parity between the cases and controls was statistically significant (p=0.004) (Table 1).

Table 1 Social Demographic Characteristics

Characteristic	**Total**	**Case**	**Control**	***p*-value**
	n=126	**n=63**	**n=63**	
Age				
15-19n (%)	13 (10.3)	11 (17.5)	2 (3.2)	0.001
20-29, n (%)	44 (34.9)	37 (58.7)	7(11.1)	
30-39, n (%)	42 (33.4)	9 (14.3)	33 (52.4)	
40-49, n (%)	27 (21.4)	6(9.6)	21 (33.3)	
Mean Age	30.88	26.22	35.54	
Marital Status				
Single n (%)	34 (27.0)	29 (46.0)	5 (7.9)	<0.001
Married n (%)	72 (57.1)	19 (30.2)	53 (84.1)	
Widowed n (%)	5 (4.0)	1 (1.6)	4 (6.3)	
Divorced n (%)	15 (11.9)	14 (22.2)	1 (1.6)	
Religion				
Muslims n (%)	42 (33.3)	25 (39.7)	17 (27.0)	0.564
Christian n (%)	71 (56.3)	31 (49.2)	40 (63.5)	
Other (Hindu, Buddhist, Atheist) n (%)	13 (10.3)	7 (11.1)	6 (9.5)	
Education Level				
Primary n (%)	35 (27.8)	31 (49.2)	4 (6.3)	0.009

Secondary n (%)	32 (25.4)	20 (31.7)	12 (19.0)	
Tertiary n (%)	51 (40.5)	11 (17.5)	40 (63.5)	
Other (pre-primary) n (%)	8 (6.3)	1 (1.6)	7 (11.1)	
Parity				
Mean Parity	63	1.17	2.97	0.004
Standard dev	63	1.144	1.204	

Legend: N (%)- Number and proportion, p value-statistical significance

3.2. Causes of APH

The major causes of APH were analysed and recorded in table 2 below. Abruptio placentae and placenta previa were the major causes of APH recorded in 17 (27%) and 39 (61.9%) of APH patients, respectively. Other causes (uterine rupture, vasa previa and coagulopathy) accounted for 7 (11.1%) of the cases.

Table 2 Causes of APH

Causes of APH	**n (%)**
Abruptio Placentae	17 (27)
Placenta Previa	39 (61.9)
Others (vasa Previa, uterine rupture, coagulopathies)	7 (11.1)
Total	63 (100)

Legend: N (%)- Number and proportion

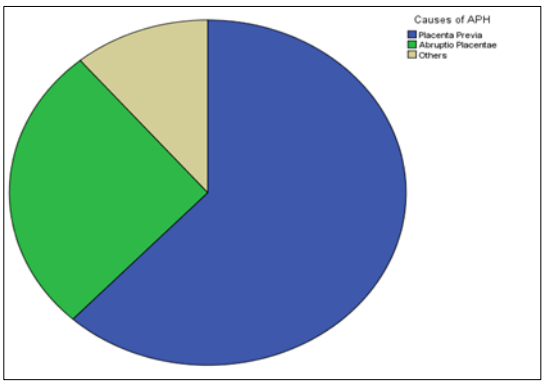

Figure 1 Causes of APH

3.3. Healthcare Services to mothers with APH

The healthcare services factors were analysed and presented in the table 4.3 below. The results showed that majorities of the patients had spontaneous delivery (n=69,). Among pregnant women who had APH, a large proportion delivered via caesarean section (n=42, 66.7%). On the other hand, majority of the mothers without APH had spontaneous delivery (n=48, 76.2%). There was a significant difference in the mode of delivery of the patients between the cases and controls (p=0.001) (Table 3).

Out of the pregnant women who had caesarean section, majority (n=31, 52.4%) were done as emergency. Non-reassuring fetal status (NRFS) was the major indication for Caesarean delivery in mothers with abruptio placentae documented in 12 (66.7%) of cases. Elective caesarean delivery was done in (n=26) of the cases. A larger proportion of the emergency caesarean sections had APH (n=22, 52.4%) followed by those who had elective surgery (n=20, 47.6%). The proportion distribution of patients' type of caesarean delivery did not differ between the cases and control groups (p=0.167) (Table 3).

Patients' referral status was analysed. Majority of the pregnant women enrolled in this study were from Home (were not referred from another facility) (n=67). Most patients who presented with APH were referred from another facility (n=42 (66.7%). Conversely, a larger proportion of pregnant women without APH came from home (n=46, 73.0%) with a smaller proportion being referrals from another facility (n=17, 27.0%). There was a significant difference in the referral status of the patients between the cases and controls (p=0.018) (Table 3).

Blood transfusion to pregnant mothers under study who had anaemia was analysed. A significant proportion of patients had anaemia requiring blood transfusion (n=54, 42.8%). All the pregnant women who had APH with blood transfusion indicated had transfusion done (n=38, 100%) and a significant proportion of women without APH who had blood transfusion indicated had the transfusion (n=15, 93.8%). A Fishers exact test analysis of the proportional distribution of blood transfusion between the cases and controls was not statistically significant (p=0.120) (Table 3).

Decision to delivery interval for patients who had indication for emergency caesarean section was analysed. Majority of the emergency caesarean section were done within 30 minutes from the time the decision to deliver had been made (n=17, 54.8%). This was followed by delivery via caesarean section done between 30 minutes and one hour (n=10, 32.2%). Majority of patients who had APH had emergency caesarean section done by 30 minutes from the time the decision was made (n=14, 63%) followed by between 30minutes and one hour (n=7, 31.8%). A large proportion of patients in the control group had caesarean section done in less than an hour from the time decision was made (n=6, 66.7%). There was no significant statistical difference in the decision to delivery interval between the controls and cases (p=0.876) (Table 4.3).

The number of antenatal clinic visits were recorded and analysed in the table 4.3 below. A large proportion of pregnant patients enrolled in the study had attended at least 4 antenatal clinics (n=39, 31.0%) followed by those that attended one antenatal clinic (n=29, 23.0%) and then those that attended 3 antenatal clinic visits (n=24, 19.0%). Majority of patients who had APH had attended one antenatal clinic (n=26, 41.3%) followed by 2 antenatal visits (n=16, 25.4%) and then 4 antenatal visits (n=14, 22.2%). On the other hand, majority of pregnant women without APH had attended at least 4 antenatal visits (n=35, 55.5%) followed by 3 antenatal clinic visits (n=18, 28.6%). There was a significant difference in the number of antenatal clinic visits of the patients between the cases and controls (p<0.001) (Table 3).

Drug availability at the time of presentation the facility was also analysed. A large proportion of the pregnant women (n=112, 88.9%) had major drugs (Tranexamic acid, oxytocin, etamsylate, misoprostol, dexamethasone and normal saline) available during the time of presentation. A small proportion had only a few drugs available and were forced to buy from without the facility (n=14, 11.1%). There was no significant statistical difference in the drug availability at the time of presentation at the facility between the controls and cases (p=0.100) (Table 3).

The available staff on duty at the time of admission was analysed. Majority had adequate staff (Consultants, registrars, Medical officer interns and nurses) available and attended to them (n=102, 81.0%). There was no significant statistical difference in the number of staff available at the time of presentation at the facility between the controls and cases (p=0.120) (Table 3).

Table 3 Health Service Factors

Characteristic	**Total**	**Case**	**Control**	**p-value**
	N	**N**	**n**	
Mode of Delivery				
Cesarean Delivery n (%)	57 (45.2)	42(66.7)	15(23.8)	0.001
Spontaneous Vaginal Delivery n (%)	69 (54.8)	21(33.3)	48(76.2)	
Type of Caesarian Delivery				
Emergency n (%)	31 (54.4)	22(52.4)	9(60)	0.167
Elective n (%)	26 (45.6)	20(47.6)	6(40)	
Prior Obstetric Care				
Came from Home n (%)	67 (53.2)	21(33.3)	46(73)	0.0185
Referred from Facility n (%)	59 (46.8)	42(66.7)	17(27)	

Characteristic	Total	Case	Control	p-value
	N	N	n	
Was Blood Transfusion Prescribed				
Yes, n (%)	53 (98.9)	38(100)	15(93.8)	0.120
No n (%)	1 (0.9)	0	1(6.2)	
DDI (n = 31 with emergency cesarean section)				
0-30 Mins n (%)	17 (54.8)	14(63)	3(33.3)	0.876
30Mins-1hour n (%)	10 (32.2)	7(31.8)	3(33.3)	
1hr-2Hours n (%)	3 (9.6)	1(4.5)	2(22.2)	
Above 2Hours n (%)	1 (3.4)	0	1(11.1)	
Antenatal Clinic visits				
0 n (%)	1 (0.7)	1 (1.6)	0 (0)	<0.001
1 n (%)	29 (23.0)	26 (41.3)	3 (4.8)	
2 n (%)	23 (18.3)	16 (25.4)	7 (11.1)	
3 n (%)	24 (19.0)	6 (9.5)	18 (28.6)	
4 n (%)	39 (31.0)	14 (22.2)	35 (55.5)	
Drug Availability				
Yes, n (%)	112 (88.9)	56 (88.9)	56 (88.9)	0.100
No n (%)	14 (11.1)	7 (11.1)	7 (11.1)	
Adequate Staffing				
Yes, n (%)	102 (81.0)	51 (81.0)	51 (81.0)	0.120
No n (%)	24 (19.0)	12 (19.0)	12 (19.0)	

Legend: N (%)- Number and proportion, p value-statistical significance

3.4. Neonatal Outcomes and Maternal health outcomes

The neonatal outcomes and the maternal outcomes of patients under the study were analysed and presented in the table 4.4 below. Admission status to New-Born Unit (NBU) was analysed and results showed that a significant proportion were admitted to NBU (n=58, 46.0%) while a large proportion were not admitted at NBU (n=68, 54.0%). Majority of new-borns of patients who had APH were admitted to NBU (n=42, 66.7%). The major reason for admission to NBU was prematurity and low APGAR score. Among the mothers without APH, a small proportion were admitted to NBU (n=16, 25.4%) while a large proportion of mothers without APH had no indication for admission to NBU (n=47, 74.6%). A chi-square analysis of the number of neonates admitted to NBU in the case versus control groups was significant (p=0.017) (Table 4).

The life outcomes of new-borns of the patients that were enrolled in the study was analysed. A large proportion of neonates were discharged alive (n=111, 88.1%) while the overall neonatal mortality was 11.9% (n=15). Amongst neonates born to mothers with APH, majority were discharged alive (n=51, 81.0%) while neonatal death occurred in 19% (n=12). Similarly, a large proportion of neonates among mothers without APH were discharged home alive (n=60, 95.2%) and a neonatal mortality of 4.8% (n=3). There was a significant difference in the neonatal life outcomes of the patients between the cases and controls (p=0.045) (Table 4).

Birth weights of new-borns of patients in the study were taken and analysed. Majority of the new-borns had birth weight above 2500gms (n=62, 50.2%) followed by birth weight between 2000 to 2500gms (n=45, 35.7). A significant proportion of new-borns of mothers with APH had a birth weight between 2000 to 2500gms (n=31, 49.2%). This was followed by new-borns with very low birth weight (less than 2000gms). Majority of new-borns of mothers without APH had normal birth weight (above 2500gms) (n=46, 73.0%) followed by birth weight between 2000 to 2500gms

(n=14,22.2%). There was a significant difference in the neonatal life outcomes of the patients between the cases and controls (p=0.019) (Table 4).

APGAR scores of neonates born to patients under the study were assessed and analysed. Majority of the neonates had APGAR score of more the 7 at 5minutes (n=92, 73.0%) and a small proportion who had APGAR sore less than 7 at 5minutes (n=34, 27%). A significant proportion of new-borns of mothers with APH had APGAR score of more the 7 at 5minutes (n=34, 54.0%) while an equally significant proportion had APGAR score of less the 7 at 5minutes (n=29, 46.0%). Most babies born to mothers without APH had a good APGAR score (APGAR score of more the 7 at 5minutes) (n=58, 92.1%). While only 7.9% (n=5) of the new-borns born to mothers without APH had APGAR score less than seven. There was a significant difference in the Apgar core of neonates of the patients between the cases and controls (p=0.048) (Table 4).

The gestation period of pregnant women enrolled in the study was recorded and analysed. The overall majority had delivery at term (above 37 weeks) (n=74, 58.7%). Majority of patients who had APH delivered before term (less than 37weeks) (n=42, 66.7%). Conversely, a larger proportion of patients without APH had delivery after 37 weeks' gestation (n=58, 92.1%). There was a significant difference in the gestation of the patients at the time of delivery between the cases and controls (p=0.048) (Table 4).

Maternal outcomes of pregnant women enrolled in the study were recorded, analysed and presented in table 4.4 below. A large proportion of patients did not have any complications (n=64, 50.9%). Anaemia was the most common complication (n=41, 32.5%) followed by others (renal failure, hypovolemia, shock) (n=24, 19%). A significant proportion of pregnant women with APH had anaemia (n=23, 36.5%) while only a small proportion did not have complication (n=16, 25.4%). Hysterectomy was done to mothers with APH (n=3, 4.8%) and only 1 hysterectomy was done to the control group. The major reason for hysterectomy was due to postpartum haemorrhage. Two mothers were admitted to ICU among the patients with APH (n=2, 3.2%) while one was admitted to ICU among the control group. A small proportion of mothers without APH had anaemia (n=8, 12.7%). A Fishers exact test analysis of the maternal complications between the cases and controls was statistically significant (p=0.015) (Table 4).

The maternal life outcomes of the patients in the study were analysed. Majority of the patients were discharged home alive (n=124, 98.4%). Two patients died during the antepartum period due to hypovolemic shock secondary to prolonged bleeding (1.6%). There was no mortality among the control group. There was no significant statistical difference in the maternal life outcomes between the controls and cases (p=0.147) (Table 4).

For patients who presented with bleeding, the median time of bleeding of the mothers with APH and presentation to the facility was 12hours with the shortest time being 4 hours and the longest being 25hours.

Table 4 Neonatal Outcomes and Maternal Outcomes

Characteristic	**Total**	**Case**	**Control**	**p-value**
	n=126	**n=63**	**n=63**	
Neonatal Outcomes				
Admission to NBU				
Yes, n (%)	58 (46.0)	42 (66.7)	16 (25.4)	0.017
No n (%)	68 (54.0)	21 (33.3)	47 (74.6)	
Neonatal Life Outcome				
Discharged Alive n (%)	111 (88.1)	51 (81)	60 (95.2)	0.045
Neonatal Death n (%)	15 (11.9)	12 (19)	3 (4.8)	
Birth Weight				
Less than 2000gms n (%)	19 (15.1)	16 (25.4)	3 (4.8)	0.019
2001-2500gms n (%)	45 (35.7)	31 (49.2)	14 (22.2)	
Above 2500gms n (%)	62 (50.2)	16 (25.4)	46 (73)	

Characteristic	Total	Case	Control	p-value
	n=126	n=63	n=63	
Apgar Scores at 5 minutes				
Less than 7 n (%)	34 (27.0)	29 (46)	5 (7.9)	0.048
Above 7 n (%)	92 (73.0)	34 (54)	58 (92.1)	
Gestation Period				
<37 Weeks n (%)	52 (41.3)	42 (66.7)	10 (15.9)	<0.001
>37 Weeks n (%)	74 (58.7)	21 (33.3)	53 (84.1)	
Maternal health outcomes				
Complications				
Anemia n (%)	41 (32.5)	23 (36.5)	8 (12.7)	0.0154
Hysterectomy n (%)	4 (3.2)	3 (4.8)	1 (1.6)	
Admission to ICU n (%)	3 (2.4)	2 (3.2)	1 (1.6)	
Others (renal failure, shock) n (%)	24 (19.0)	19 (30.2)	5 (7.9)	
No Complication n (%)	64 (50.9)	16 (25.4)	48 (76.2)	
Life Outcome				
Discharged Alive n (%)	124 (98.4)	61 (96.8)	63 (100)	0.147
Maternal death n (%)	2 (1.6)	2 (3.2)	0	
Median Bleeding time				
	Mean	**Maximum**	**Median**	**Minimum**
Time of Bleeding to Presentation at Facility in hours	12	25	12	4

Legend: N (%)- Number and proportion, p value-statistical significance.

3.5. Logistic regression analysis

Binary and multivariable logistic regression results of factors associated with maternal neonatal outcomes among women with APH was done. Binary and multivariable logistic regression analysis, descriptive statistics and odds ratio with 95% confidence interval were calculated to see related predictor variables with perinatal and maternal adverse outcomes and associated predictor variables. p value < 0.05 was included in multivariable logistic in both fetal and maternal, and the model fitness of Hosmer-Lemeshow test (HL test) result used for both perinatal and maternal models, respectively.

The model revealed that mode of delivery, number of antenatal visits, prior obstetric care and availability of blood for transfusion remained as the significant factors associated with APH. (table 5)

Logistic regression analysis shows that women who had caesarean delivery were 3.22 more likely to have adverse maternal outcomes (OR=3.22, 95%CI=1.21-8.77, P= 0.001) while those who had vaginal delivery were 62% less likely to have adverse maternal outcomes (OR=0.22, 95%CI=0.12-0.39, P< 0.0001) (Table 5).

The number of antenatal clinics attended also determined occurrence of maternal complications and neonatal outcomes. Pregnant mothers with APH who had less than 3 ANC visits had 9.5 likelihood of getting maternal and neonatal complications (OR=9.48, 95% CI=4.53-21.84, P< 0.0001) (Table 5).

Pregnant mothers' prior obstetric care also influenced the neonatal and maternal outcomes. Those who were referred from another facility were 3.16 times likely to have poor neonatal outcomes and maternal complications (OR=3.16, 95%CI=1.34-5.57, P< 0.0001)

The availability of blood transfusion products also influenced occurrence of maternal outcomes. The patients who had transfusion were 22% less likely to have maternal complications (OR=0.22, 95% CI= 0.12-0.39, P< 0.0001)

Table 5 Logistic regression analysis

Variables	Category	OR	95% CI	*p*-value
Mode of Delivery	Cesarean Delivery	3.22	1.21-8.77	0.001
	Spontaneous Vaginal Delivery	0.62	0.39-1.01	0.007
Prior Obstetric Care	Came from Home	0.32	0.25-1.03	0.062
	Referred from Facility	3.16	1.34-5.57	<0.0001
Number of antenatal visits	Less than 3 times	9.48	4.53-21.84	<0.0001
	3 times and more	1.73	0.71-3.42	0.0056
Availability of blood for transfusion	Yes	0.22	0.12-0.39	<0.0001
	No	1.37	0.54-0.87	<0.0001
Decision to delivery time	Less than 30 minutes	0.12	0.41-1.21	<0.0001
	More than 30 minutes	1.40	1.53-1.89	0.0012

Legend: OR- Odds Ratio, 95% C.I- Confidence interval set at 95%, p value-statistical significance determined by logistic regression tests.

4. Discussion

APH complicates 2-5% of pregnancies globally. This study evaluated the influence of health system factors on maternal and neonatal outcomes among women presenting with Antepartum haemorrhage at the Jaramogi Oginga Odinga Teaching and Referral Hospital (JOOTRH), Kisumu County, Kenya.

A large proportion of patients presenting with antepartum haemorrhage (APH) were younger, aged between 20-29 years (n=37, 58.7%), with an overall mean age of 26.22. Conversely, a higher percentage of pregnant women without APH were older (30-39 years, n=33, 52.4%), with an overall mean age of 35.54 (p=0.001). This was similar to a study done in India that showed that 61% of APH cases were aged 26 -30 years and to another study by Adekanle et al in which 40% APH patients were between 25-29 years.

We observed that majority of patients with APH were mostly single mothers (n=29, 46.0%). The results showed that majority of the patients attained a tertiary (college, university, or higher) level of education (n=51, 40.5%). Cases with APH were mostly patients who attained a primary level of education (n=31, 49.2%), while most patients in the control group reported having attained a tertiary level of education (n=40, 63.5%). This shows that majority of patients who had APH were illiterate. That is comparable to a study done in Kenyatta Hospital that had the highest level at secondary level for patients with APH (Njoroge, Pinckie L N 2017). Our study finding was also similar to a study done in India that reported cases of APH that were illiterate to be 45.1% (Dibaba B, 2021). From the study, literacy levels are a major determinant of maternal and neonatal outcomes with patients with higher qualifications exhibiting better outcomes for both the control and case groups.

Cases with APH had a lower mean parity (1.17), while pregnant women without APH had a higher mean parity (2.97) in our study. This is opposed to a study done in India that recorded high parity as a risk to APH. (Dibaba B, 2021).

The leading cause of antepartum haemorrhage in this study was found to be placenta previa followed by abruptio placenta as opposed to findings in a study done in Northern Nigeria in which abruptio placenta was found to be the leading cause.(Adegbola, 2010). These findings were similar to a study done in Garissa referral hospital Kenya, in 2010 that recorded placenta previa (27%) and abruptio placenta (26%) as major causes of APH. There were two reported cases of uterine rupture, one systemic coagulopathy and one vasa previa. This indicates that the major causes of APH were placenta abruptio and placenta previa in our study.

Caesarean section rate was high among pregnant women who had APH (n=42, 66.7%). (p=0.001). Out of these, 32 (52.4%) were done as emergency. Non-reassuring fetal status (NRFS) was the major indication for Caesarean delivery in mothers with abruptio placentae documented in 12 (66.7%) of cases in our study. Similar findings were seen in a

study from Sokoto, Nigeria that had higher rates of caesarean sections as high as 83.3% for placenta previa, (Article, 2020)

Most patients who presented with APH were referred from another facility (n=42 (66.7%) in our study. Risks of perinatal and maternal mortality were higher for patients who came from outside of JOOTRH compared to patients from JOOTRH indicating the potential role of delay in receiving care (OR=3.16, 95%CI=1.34-5.57, P< 0.0001). This was comparable to a study done on determinants of uterine rupture and its management outcomes among mothers who gave birth at public hospitals of Tigray, North Ethiopia showed that mothers referred from remote health institutions were significantly associated with uterine rupture and worse fetomaternal outcomes (Mengesha et al., 2020). Late referral and lack of transport facilities contributes to poor outcomes in developing countries like Kenya (Maoulidi, 2015)

A significant proportion of patients had anaemia requiring blood transfusion (n=54, 42.8%). All the pregnant women who had APH with blood transfusion indicated had transfusion done (n=38, 100%). From our study, blood transfusion products and services was not a major determinant as majority who required transfusion got blood (p=0.120). In a study carried out in a tertiary care hospital, Mumbai, India, 75% of patients required blood transfusion (Naiknaware, 2015). Blood transfusion is a lifesaving component of comprehensive emergency obstetric care for mothers who present with obstetric haemorrhage as a complication.

Majority of the emergency caesarean section were done within 30 minutes from the time the decision to deliver had been made (n=17, 54.8%) in our study. The decision to delivery time interval is recommended to be less than 30 min by the Royal College of Obstetricians and Gynaecologists as well as the American College of Obstetricians and Gynaecologists which was where the majority in our study were. This was better compared to a study done in Ethiopia that showed that only 19.6% of women had a decision to delivery time interval below 30 min (Temesgen et al., 2020). Another study in in Northern Tanzania had a median DDI of about 60 mins (Hirani et al., 2017). Decision to delivery interval is a key health system factor that influences the maternal and neonatal outcomes.

Majority of patients who had APH had attended one antenatal clinic (n=26, 41.3%) followed by 2 antenatal visits (n=16, 25.4%) and then 4 antenatal visits (n=14, 22.2%). A study done on determinants of uterine rupture and its management outcomes among mothers who gave birth at public hospitals of Tigray, North Ethiopia showed that mothers who visited once for antenatal care were significantly associated with uterine rupture and worse fetomaternal outcomes (Mengesha et al., 2020). The current study indicated that women who attended ANC more than 4 times were generally less likely to develop complications as compared to those who did attend less than 4 times. This therefore calls for ANC visits for all the pregnant mothers and skilled birth attendance (Rukiya et al., 2015)

Analysis of drug availability, adequate staffing and lab services did not pose a statistical difference since JOOTRH being a teaching and referral hospital had registrars covering the hospital fully with availability of drugs similar to both control and cases groups (p=0.100). A study done Factors associated with postpartum haemorrhage maternal death in referral hospitals in Senegal and Mali showed that Hospitals with a gynaecologist-obstetrician were associated with a decreased risk of death by 45 % when compared to hospitals that did not have (Tort et al., 2015).

Majority of new-borns of patients who had APH were admitted to NBU (n=42, 66.7%) (p=0.017). The major reason for admission to NBU was prematurity and low APGAR score. A study done in New York demonstrated that Prematurity and IUGR are major complications associated with placental abruption (Ananth et al., 1999). Though another study reported a different finding where Neonatal jaundice was the most common complication (26.8%) amongst the neonates of APH followed by prematurity (22.3%), birth asphyxia (2.67%) and hyaline membrane disease were (0.9%) according to a study by Mangal Chand.

The neonatal mortality was 19% (n=12) amongst patients with APH while the control group had a neonatal mortality of 4.8% (n=3). (p=0.045). Perinatal outcome was poor in Abruptio placenta as compared to placenta previa, 37.3% perinatal mortality in placenta previa as against 30 % in placenta previa. A study in India had perinatal mortality at 53%(Devkare et al., 2017). Which was very high compared to our study. Another study done in Pakistan found perinatal mortality of 37% (Ahmed, 2014).

A significant proportion of new-borns of mothers with APH had a birth weight between 2000 to 2500gms (n=31, 49.2%) while Majority of new-borns of mothers without APH had normal birth weight (above 2500gms) (n=46, 73.0%). Majority of the new-borns of the cases had APGAR score of less the 7 at 5minutes (n=29, 46.0%). A study done in New York demonstrated that Prematurity and IUGR are major complications associated with placental abruption (Ananth et al., 1999).

Anaemia was the most common complication (n=41, 32.5%) followed by others (renal failure, hypovolemia, shock) (n=24, 19%). Hysterectomy was done to mothers with APH (n=3, 4.8%) and only 1 hysterectomy was done to the control group. The major reason for hysterectomy was due to postpartum haemorrhage. Two mothers were admitted to ICU among the patients with APH (n=2, 3.2%) while one was admitted to ICU among the control group. The reason for admission to ICU was hypovolemic shock. A study done in Sokoto, Nigeria recorded peripartum hysterectomies (2.1%) and postoperative anaemia (7.3%), (Article, 2020). In Thailand, Bhutia et al found out the prevalence of previa at 0.7% with outcomes of maternal blood loss >500ml (Pema C B, Triphop L, Thanyarat W, 2011). Caesarean hysterectomy rate from our study was less than the incidence of 5.3% in SOGC clinical practice guidelines and 5% in study by Nasreen et al. (Nasreen F. 2011)

As illustrated from our analysis and as a conformation of the literature reviewed, the relationship between feto-maternal outcomes and health system factors in patients with antepartum haemorrhage (APH) is complex and interrelated which can be explained by:

- Access to timely and appropriate prenatal care and delivery services can impact the detection and management of APH and thus, improve feto-maternal outcomes.
- The quality of prenatal care received by pregnant women can impact the detection and management of APH and thus, improve feto-maternal outcomes.
- Adequate availability of resources, such as trained healthcare providers, blood products, and medical equipment, is essential for effective management of APH and can improve feto-maternal outcomes.
- Lack of health insurance coverage can result in delayed or inadequate prenatal care and delivery services, which can increase the risk of APH and have negative impacts on feto-maternal outcomes.
- The level of training and expertise of healthcare providers can impact their ability to diagnose and manage APH effectively and thus, improve feto-maternal outcomes.
- The infrastructure of the healthcare system, including the availability of hospitals, clinics, and medical equipment, can impact the management of APH and thus, improve feto-maternal outcomes.

A limitation for our study was our inability to obtain information regarding the care given to mothers who did not make it to JOOTRH, and those who passed away before they arrived at JOOTRH, and follow discharged mothers and new-borns until day seven after delivery constitutes a significant limitation of this study. If more deaths among discharged patients happened at home, neonatal and maternal mortality might have been understated.

5. Conclusion and Recommendations

In conclusion, APH is a common pregnancy complication and a major factor in maternal and perinatal death. It is primarily brought on by abruptio placentae and placenta previa.

Compared to findings from other our control group, JOOTRH cases of APH have a higher risk of unfavourable maternal and infant outcomes, including maternal mortality, perinatal mortality, and low birth weight. In order to enhance mother and infant outcomes in JOOTRH, actions must be taken to increase geographic accessibility, referral services, and the calibre of comprehensive emergency obstetric treatment. Various health system factors can impact the incidence and management of APH, including access to healthcare, quality of prenatal care, availability of resources, health insurance coverage, health literacy, health worker training and expertise, and health system infrastructure.

It is important to diagnose and manage APH promptly to minimize its impact on maternal and perinatal outcomes. This may involve close monitoring of the mother and the neonate, as well as delivery when appropriate. Some health system factors can impact the incidence and management of APH and thus, feto-maternal outcomes, including access to healthcare, quality of prenatal care, availability of resources, health insurance coverage, health worker training and expertise, and health system infrastructure. Improving these factors can lead to better feto-maternal outcomes for patients with APH.

Compliance with ethical standards

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Disclosure of conflict of interest

The author states that he has no competing interests, financial or otherwise.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study. Participants were communicated to about purpose, risk and benefits of the study. Ethical clearance was obtained from JOOTRH ethics committee.

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