

# Prevalence and Associated Factors for Post-Caesarean Delivery Blood Transfusion in Eastern Sudan: A Cross-Sectional Study

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**Background:** Obstetric haemorrhage is a leading cause of maternal mortality and morbidity worldwide. Caesarean delivery (CD) is associated with significant blood loss, which may require blood transfusions. This study aimed to determine the prevalence and associated factors for post-CD transfusion.

**Methods:** A cross-sectional study was conducted in Gadarif maternity hospital, eastern Sudan, from March to September 2020. Sociodemographic, obstetric and clinical data, including pre- and postoperative haemoglobin levels, were collected. A multivariate logistic regression analysis was performed.

**Results:** A total of 539 women were enrolled in the study; the median (interquartile range) age of these women was 28.0 (8.0) years. The overall post-CD transfusion rate was 8.2%. Emergency CD (adjusted odds ratio [AOR]=2.57, 95% confidence interval [CI]=1.25–5.28) and antepartum haemorrhage (AOR=44.70, 95% CI=11.18–178.76) were associated with increased risk of post-CD blood transfusion. Preoperative haemoglobin (AOR=0.48, 95% CI=0.36–0.64) and rural residence (AOR=0.45, 95% CI=0.22–0.93) were associated with reduced risk for post-CD blood transfusion.

**Conclusion:** The overall prevalence of post-CD transfusion in this part of Sudan is 8.2%. Women with emergency CD, low preoperative haemoglobin levels and antepartum haemorrhage were at higher risk for post-CD transfusion. Risk identification and correction of antenatal anaemia can reduce the hazard of blood transfusion among CD women.

**Keywords:** caesarean delivery, blood transfusion, haemoglobin, antepartum haemorrhage, Sudan

## Introduction

Postpartum haemorrhage (PPH) is a major public health problem that can lead to maternal near miss, mortality and morbidity.<sup>1</sup> Caesarean delivery (CD) is the main risk for both intraoperative and postpartum haemorrhage.<sup>2</sup> Blood loss of more than 1000 mL after CD is considered as a postpartum haemorrhage.<sup>3</sup> Consequently, blood transfusion following CD is not an uncommon practice in obstetrics.<sup>4–6</sup>

There is a global increase in the rate of CD, particularly in the Sub-Saharan African region.<sup>7</sup> The rate of post-CD blood transfusion varies from 0.36% in developed countries<sup>8</sup> to 25.2% in developing countries.<sup>9</sup>

There are several preoperative, intraoperative and postoperative factors such as anaemia, previous uterine scar, multiparity,<sup>4,5,10</sup> operation time, adhesions<sup>5,6,10</sup> and uterine atony<sup>10,11</sup> were associated with post-CD blood transfusion. Moreover, placenta previa and abruption, repeated scar, prolonged second stage CD and cephalopelvic disproportion were associated with post-CD blood transfusion.<sup>5,12,13</sup>

Blood transfusion is a life-saving procedure; however, it carries the risk of infections, transfusion reactions (including anaphylactic shock) and death.<sup>14</sup> These risks necessitates the use of blood transfusion only for genuine indications. A haemoglobin level of less than 8g/dl has been recommended as a cut-off for blood transfusion.<sup>15</sup>

In the Sub-Saharan African region, reservation of two units of blood for elective CD is commonly practiced.<sup>5</sup> Early detection of the risk factors for post-CD blood transfusion alerts physicians to prepare blood for timed interventions.

In Sudan, there is an increase in CD rates.<sup>16</sup> Haemorrhage following CD has been reported as the major cause of maternal near miss and mortality in Sudan.<sup>17,18</sup>

We aim to assess the prevalence of blood transfusion and its associated factors among Sudanese women who have undergone CD in Gadarif maternity hospital, eastern Sudan. Data from this study are expected to reduce maternal mortality and morbidity related to post-CD blood transfusion in Sudan. This can be achieved through risk identification and proper intervention.

## Methods

A cross-sectional study was conducted at Gadarif maternity hospital, eastern Sudan, during the period of March 1 to September 30, 2020.

### Inclusion Criteria

All women who underwent emergency or elective CD during the study period were included.

### Exclusion Criteria

Women who transfused intraoperatively and those with chronic haemolytic anaemia were excluded.

### Sample Size

Sample size (539) was calculated based on the assumption that prevalence of post-caesarean blood transfusion would be 20.0% (ratio of 4:1). This assumption was based on a similar study in the region.<sup>5</sup> Moreover, assumed that 40.0% of women who required blood transfusion had preoperative anaemia while 25.0% of women who did not require blood transfused had anaemia. This sample had a 95% confidence level and a 5% confidence limit. The sample size was calculated using the OpenEpi.<sup>19</sup>

### Data Collection

Two medical officers gathered sociodemographic information (age, parity, education, occupation and residence). Maternal weight and height were recorded, and body mass index (BMI) was calculated preoperatively. Preoperative data also included haemoglobin level, gestational age at time of delivery, history of uterine surgery and pregnancy complications (gestational or chronic hypertension and diabetes). Obstetric conditions such as placental abnormality (placenta previa and abruptio placenta) and history of previous scar were documented. Intraoperative data, such as indication of CD, emergency or elective CD and duration of operation, were recorded from the operation notes. The women were followed until discharge from the hospital. Operation time was calculated from skin incision to closure in minutes. Blood group and the number of transfused units were obtained from the medical records of the participants.

### Definitions and Measurements

The BMI was measured at time of delivery and recorded from preoperative notes. The BMI was categorized to <25 (reference) and >25.<sup>20</sup>

The term other indications of CD includes macrosomia, multiple gestations, malpresentations, post-term pregnancy with failed induction of labors and others.

Haemoglobin was estimated by an automated haematology analyser according to the manufacturer's instructions (Sysmex KX-21, Japan).

Anaemia was defined as haemoglobin <11.0 g/dL. Indications for blood transfusion were haemoglobin <8.0 g/dL with symptoms and signs suggestive of severe anaemia (such as palpitations, dizziness, shortness of breathing, severe pallor,

tachycardia and hypotension)<sup>21</sup> or active bleeding (more than 1000 mL). Women with haemoglobin level of <7.0 g/dL were transfused regardless of symptoms. Post-CD blood loss was estimated by visual inspection of active vaginal bleeding associated with hemodynamic instability of the pulse and blood pressure and weighting of the perineal pads. Moreover, digital weighing scale was used, with one gram is equal to one mL of blood volume.<sup>22</sup>

The patient was considered transfused in our study protocol if she received at least one unit of packed red cell or more after CD. All women in the study received only packed red cell.

## Statistics

Data were entered into a computer, and SPSS for Windows was used for data analysis. Continuous data were checked for normality using the Shapiro–Wilk test and were found to be not normally distributed. The median (interquartile range), frequency and percentages were used to present the characteristics of the participants. Univariate analyses were performed with blood transfusion (yes, no) as the dependent factor and sociodemographic data (age, education, occupation, residence, parity, blood group, BMI) and obstetric and medical conditions (diabetes, hypertension, placenta previa and abruption, history of previous scar, gestational age, emergency or elective surgery, duration of operation and haemoglobin) as independent variables. Variables in univariate analysis were compared with Mann–Whitney test, chi-squared test and Fisher exact test where applicable.

Variables with their  $P < 0.2$  were shifted to construct the multivariate analysis with backward likelihood ratio methods. The unadjusted and adjusted odds ratios and 95% confidence interval (CI) were computed to show the strength of the association. A two-sided  $p$ -value of  $< 0.05$  was considered statistically significant.

## Results

### Participant's Characteristics

A total of 539 women who underwent CD during the study period were recruited. Of these, 387 (71.8%) underwent elective CD and 306 (56.8%) were due to repeated scar. The medians (IQR) of age and parity were 28.0 (8.0) years and 3.0 (2.0), respectively. In total, 298 (55.3%) women resided in rural areas. Overall, 504 (93.5%) were housewives and 389 (72.2%) had a level of education lower than secondary. The median (IQR) of BMI, gestational age and duration of operation was 25.3 (4.3) kg/m<sup>2</sup>, 38.0 (1.0) weeks and 45.0 (15.0) minutes, respectively. The patients who had medical diseases and antepartum haemorrhage were 56 (10.4%) and 15 (2.8%), respectively. The median (IQR) preoperative and postoperative haemoglobin levels were 11.2 (1.7) g/dl and 10.3 (1.6) g/dl, respectively (Table 1).

### Caesarean Delivery Indications

The main indication for CD among the study population was repeated scar at 306 (56.8%), followed by other/combined at 120 (22.3%), cephalopelvic disproportion at 43 (8.0%), foetal distress at 28 (5.2%), pre-eclampsia/eclampsia at 19 (3.5%), second stage CD at 18 (3.3%) and placental abnormality at 5 (0.9%) (Table 2).

### Prevalence of Post-CD Blood Transfusion

Of the 539 enrolled women, 44 (8.2%) were transfused (Table 1).

### Univariate Analysis of the Study

The univariate analysis showed that women who received post-CD transfusion were older, had longer operation times, had emergency CD, reported antepartum haemorrhage as an indication of their CD and were from rural areas. The preoperative haemoglobin was significantly lower among the transfused group of women. There was no significant difference in the education, occupation, parity, blood group and BMI in the women who underwent post-CD transfusion and those who had no blood transfusion (Table 3).

**Table 1** Sociodemographic and Clinical Characteristics of the Women (Number =539) with Cesarean Delivery in Eastern Sudan, 2020

Variable		
<i>Median (interquartile range)</i>		
Age, years		28.0(8.0)
Parity		3.0(2.0)
Body mass index, kg/m <sup>2</sup>		25.3(4.3)
Gestational age, weeks		38.0(1.0)
Preoperative hemoglobin, g/dl		11.2(1.7)
Duration of operation, minutes		45.0(15.0)
Postoperative hemoglobin, g/dl		10.3(1.6)
<i>Frequency (proportion)</i>		
Residence	Rural	298(55.3)
	Urban	241(44.7)
Education level	< than secondary level	389 (72.2)
	≥ secondary level	150 (27.8)
Employment	Housewives	504 (93.5)
	Employee	35 (6.5)
Blood group	O	243 (45.1)
	None- O	296 (54.9)
Type of caesarean	Elective	387(71.8)
	Emergency	152(28.2)
Medical diseases	Yes	56 (10.4)
	No	483 (89.6)
Antepartum haemorrhage	Yes	15 (2.8)
	No	524 (97.2)
Blood transfusion	Yes	44 (8.2)
	No	495(91.8)
Repeated scar	Yes	306(56.8)
	No	233(43.2)

## Multivariate Logistic Analysis

A multivariable logistic regression analysis revealed a significant association between emergency CD (AOR=2.57, 95% CI=1.25–5.28) and antepartum haemorrhage (AOR=44.70, 95% CI=11.18–178.76) with post-CD transfusion. Preoperative haemoglobin (AOR=0.48, 95% CI=0.36–0.64) and rural residence (AOR=0.45, 95% CI=0.22–0.93) were associated with a lower risk of postpartum blood transfusion. After adjustment, there was no significant association between maternal age and operation time with post-CD transfusion (Table 4).

**Table 2** Indications for Cesarean Delivery in Eastern Sudan, 2020

Indications	Frequency	Proportion
Fetal distress	28	5.2
Cephalopelvic	43	8.0
Repeated cesarean	306	56.8
Placental abnormality	5	0.9
Preeclampsia/eclampsia	19	3.5
Second stage	18	3.3
Others/combined	120	22.3

**Table 3** Univariate Analysis of the Factors Associated with Blood Transfusion in Women with Cesarean Delivery in Eastern Sudan, 2020

Variable	Women Who Received Blood Transfusion (44)	Women Who Did Not Receive Blood Transfusion (495)	OR (95.0% CI)	P	
<i>Median (interquartile range)</i>					
Age, years	30.0(9.75)	28.0(9.0)	1.05(1.01–1.11)	0.048	
Parity	3.0(2.0)	3.0(2.0)	1.11(0.93–1.32)	0.227	
Body mass index, kg/m <sup>2</sup>	24.4(3.8)	25.3(4.5)	0.99 (0.92–1.06)	0.906	
Preoperative hemoglobin, g/dl	10.0(2.0)	11.2(1.5)	0.53(0.41–0.68)	< 0.001	
Gestational age, weeks	38.0(1.0)	38.0(1.0)	0.86 (0.66–1.10)	0.238	
Duration of operation, minutes	50.0(15.0)	45.0(15.0)	1.03(1.01–1.06)	0.009	
<i>Frequency (proportion)</i>					
Type of caesarean	Elective	22(50.0)	365(73.7)	Reference	
	Emergency	22(50.0)	130(26.3)	2.80(1.50–5.24)	0.001
Medical diseases	Yes	4 (9.1)	52 (10.5)	0.85(0.29–2.47)	0.769
	No	40 (90.9)	443 (89.5)	Reference	
Antepartum haemorrhage	Yes	10 (22.7)	5 (1.0)	28.80(9.32–89.1)	<0.001
	No	34 (77.3)	490 (99.0)	Reference	
Repeated scar	Yes	21(47.7)	285(57.6)	0.67(0.36–1.24)	0.209
	No	23 (52.3)	210(42.4)	Reference	

## Discussion

This cross-sectional study was conducted at a tertiary maternity hospital in Gadarif, Eastern Sudan, to determine the prevalence of post-CD blood transfusion and its associated factors. To our knowledge, this is the first study addressing the prevalence and risk factors for transfusion among Sudanese women who underwent CD.

In this study, the prevalence of post-CD transfusion was 8.2%. This is comparable with previous studies published in southwestern Nigeria (8.68%)<sup>23</sup> and Dhaka, Bangladesh (8.9%).<sup>24</sup> This rate of post-CD transfusion (8.2%) in our study is

**Table 4** Multivariate Analysis of the Adjusted and Non- Adjusted Factors Associated with Blood Transfusion in Women with Cesarean Delivery in Eastern Sudan, 2020

Variable		Non-Adjusted		Adjusted	
		OR (95.0% CI)	P	OR (95.0% CI)	P
Age, years		1.03(0.97–1.09)	0.414	1.03(0.97–1.09)	0.414
Preoperative hemoglobin, g/dl		0.48(0.36–0.64)	<0.001	0.48(0.36–0.64)	<0.001
Duration of operation, minutes		1.03(1.01–1.07)	0.061	1.03(1.00–1.07)	0.061
Residence	Rural	0.46(0.22–0.94)	0.035	0.45(0.22–0.93)	0.030
	Urban	Reference		Reference	
Type of caesarean	Elective	Reference		Reference	
	Emergency	2.62(1.27–5.40)	0.009	2.57(1.25–5.28)	0.010
Antepartum haemorrhage	Yes	41.15(10.19–166.20)	<0.001	44.70(11.18–178.76)	<0.001
	No	Reference		Reference	

lower than the rate in Lagos, Nigeria (20.8%).<sup>5</sup> Our result for blood transfusion rate (8.2%) was higher than those reported from developed countries, eg in Australia (0.36%)<sup>8</sup> and in New York, USA (3.5%).<sup>25</sup>

We have previously reported that 13.6% of the admitted children in the same settings (Gadaref, eastern Sudan) had blood transfusions.<sup>26</sup> A possible explanation for this variation is the presence of different types of hereditary anaemia during childhood. Sickle cell anaemia, for example, is a common indication for recurrent transfusion in paediatrics.

In the present study, emergency CD (AOR=2.57, 95% CI=1.25–5.28) was significantly associated with the requirement for blood transfusion. This finding is consistent with published data from South Western Nigeria<sup>27</sup> and Pakistan.<sup>28</sup> However, other studies did not show this association.<sup>8,29</sup> Emergency CD carries the risk of intraoperative complications and haemorrhage with an increased need for blood transfusion.

The results from this study revealed that antepartum haemorrhage was associated with increased risk (AOR=44.70) for post-CD blood transfusion. Several other studies are in accordance with our results.<sup>6,30–32</sup> This is probably due to the recurrent antepartum haemorrhage of placenta previa that can lead to preoperative anaemia. The interplay between antepartum haemorrhage and antenatal anaemia increased the risk for transfusion in our study. Furthermore, invasive placenta previa and disseminated intravascular coagulopathy of abruption have been associated with massive blood loss.<sup>13,30</sup>

The findings of this study indicate that each increase in preoperative haemoglobin decreased the risk of blood transfusion by 52.0% (AOR=0.48). Preoperative anaemia as a risk factor for transfusion has been reported in many studies.<sup>5,12,29,30</sup> Women who had preoperative anaemia were less tolerant of any amount of blood loss during surgery. A recent meta-analysis showed that the pooled prevalence of anaemia among pregnant women in Sudan was 53%.<sup>33</sup> In our study, antepartum haemorrhage was suggested as another factor for preoperative anaemia. This risk factor is modifiable; healthcare practitioners can correct antenatal anaemia preoperatively to reduce the risk of post-CD transfusion.

In the current study, rural residence reduced the risk for post-CD transfusion by 55.0% (AOR=0.45). Consistent with this observation, a study from Finland reported a higher rate of postpartum transfusion among those residing in urban areas.<sup>34</sup> A possible explanation is that the majority of those residing in rural areas were referred for elective CD at our tertiary hospital. Women who resided in rural areas underwent emergency CD at peripheral hospitals near their residence. This meant that most of the women from rural areas who were included in our study were of the elective type. According to this study and other studies,<sup>8,35,36</sup> the risk of transfusion among elective surgery patients is less than among emergency CD patients. However, in contrast to our results, rural residence was associated with an increased risk for blood transfusion in previous studies.<sup>37,38</sup> The patients in those studies had their emergency surgery in the same study settings unlike this study.

In the univariate analysis, maternal age was higher among transfused patients than among non-transfused patients. After adjustment of this confounder, no association was detected. Results recorded from previous published studies reported advanced maternal age as a risk factor for post-CD transfusion.<sup>5,20,35</sup> Advanced maternal age is associated with postpartum haemorrhage due to weak uterine contractions.<sup>39</sup> Furthermore, advanced maternal age is a risk factor for placenta previa and abruption.<sup>31</sup>

The current study indicates that operation time was longer among transfused patients than non-transfused patients in the univariate analysis. This finding disappears after adjustment to other confounders. Studies from Nigeria<sup>5</sup> and Pakistan<sup>6</sup> observed longer operation times among transfused women who underwent CD. Prolonged operation time is associated with adhesion and intraoperative complications that increase the need for blood transfusion.<sup>6,40</sup>

## Strengths and Limitations

The strength of the study comes from the novelty of being the first study in Sudan that addressed the prevalence and associated factors of post-CD blood transfusion. The study has enough power and adequate sample size. However, women with vaginal delivery and women who received intraoperative blood transfusion were not included in the study. Moreover, the study was conducted in one hospital, unlike multicentric studies which could produce different results.

In conclusion, the prevalence of post-CD blood transfusion among Sudanese women in Gadarif, eastern Sudan, was 8.2%. The need for transfusion was significantly associated with preoperative anaemia, antepartum haemorrhage and emergency CD. Women who resided in rural areas were found to have fewer blood transfusion requirements. Blood preparation for those at risk is of paramount importance, and correction of preoperative anaemia can assist in the reduction of transfusion rate.

## Abbreviations

PPH, postpartum haemorrhage; CD, caesarean delivery; BMI, body mass index; CI, confidence interval; IQR, interquartile range; AOR, adjusted odds ratios.

## Ethics Approval and Informed Consent

This study complies with the Declaration of Helsinki. Ethics approval was obtained from the Ethics Committee of the Faculty of Medicine of Gadarif University, Sudan (Reference number #2020.07). Written informed consent was collected from each participant.

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## Disclosure

The authors report no conflicts of interest in relation to this work.

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