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Factors Associated With Hospitalization Outcomes for Cases of Anemia in Pregnancy at a Regional Level in Burkina Faso

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Abstract

Background: Complications related to anemia in pregnancy are common in referral hospitals of Burkina Faso. This study aimed to analyze the hospital discharge results of cases of anemia for the mother-pregnancy entity at a regional level in Burkina Faso.

Methods: A hospital-based historical cohort study was conducted on anemia cases identified from hospital records of pregnant women admitted between 2009 and 2011 in the maternity wards of public referral hospitals of the “Cascades” region in Burkina Faso. The hospitalization result was favorable if it was satisfactory for both the mother and the pregnancy, and unfavorable in the other cases. The factors associated with unfavorable hospital discharge were identified through multivariable logistic regression.

Results: A total of 1815 cases of biological anemia in pregnancy were included in the study. The result of hospitalization for the mother-pregnancy entity was unfavorable in 42.6% of cases. The factors associated with unfavorable hospital discharge were rural residence (OR = 1.32; 95% CI: 1.00-1.74), evacuation cases (OR = 1.96; 95% CI: 1.48-2.60), 1st or 2nd trimester of pregnancy (OR = 2.74; 95% CI: 2.03-3.68), severe anemia (OR = 2.46; 95% CI: 1.75-3.46), moderate anemia (OR = 1.39; 95% CI: 1.05-1.85) and poor quality of anemia prevention (OR = 2.81; 95% CI: 1.62-4.88). The unfavorable hospital discharge was less frequent in women in couple (OR = 0.46; 95% CI: 0.26-0.84), in nulliparous and primiparous (OR = 0.69; 95% CI: 0.54-0.88). Age, income level, and reason for admission were not associated with the unfavorable hospital discharge.

Conclusion: There was a high frequency of unfavorable hospital discharge of anemia cases for the mother-pregnancy entity in Burkina Faso. Multiple maternal factors were associated with these issues.

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Background

Anemia in pregnancy is a public health problem, particularly in low-income countries. According to the World Health Organization (WHO), more than 40% of pregnant women in Africa are anemic. The WHO defined anemia during pregnancy as a hemoglobin < 11 g/dL [1]. Anemia increases the risk of maternal and perinatal morbidity and mortality[2][3]. Iron and vitamin deficiencies, hemorrhage, and infections including malaria are the major causes of this blood abnormality [4]. The prevention of anemia is based on health promotion and malaria control associated with iron and folate supplementation. The curative treatment of anemia is based on oral or injectable iron therapy, blood transfusion, and treatment of potential causes [5]. Burkina Faso, with more than 50% of pregnant women with anemia, is classified at severe level of prevalence [1]. A study conducted in Burkina Faso in 2019 reported among hospitalized cases of anemia in pregnancy, 14.7% of severe cases [6]. Some significant proportions of unfavorable hospital discharges have been described; they were close to 3% and 20% for maternal and perinatal deaths, respectively. These analyses were conducted separately for either pregnancy outcome or maternal health. They did not provide a comprehensive overview of the hospital care system's response to anemia for both the mother and the pregnancy. Occupational category, number of prenatal visits, duration of iron/folate supplementation, history of malaria or hemorrhage, and low brachial circumference were the common factors associated with the unfavorable hospital discharges [6][7]. Our study aimed to quantitatively describe the outcomes and associated factors of hospitalization of anemia cases for the mother-pregnancy entity at a regional level in Burkina Faso. It should then contribute to strengthen the management of hospital care of anemia in pregnancy.

Methods

The study aimed to identify the factors associated with the unfavorable hospital discharge of anemia cases for the mother-pregnancy entity at a regional level in Burkina Faso.

Design: We conducted a hospital-based historical cohort study.

Setting: The study setting was the regional hospital and a district hospital of the "Cascades" region in Burkina Faso. The "Cascades" region has 3 health districts. This region was chosen because of the high prevalence of anemia in pregnancy, which contrasted with the good economic and food potential.

Participants: The study included the hospital records of pregnant women admitted for any reason to the maternity wards of the two hospitals between January 1, 2009, and December 31, 2011. An eligible hospital record was the one that reported a biological confirmation of anemia, i.e., a hemoglobin level below 11 g/dl.

Variables: The hospitalization outcome for the mother-pregnant entity was the dependent variable. The hospital discharge for the mother was either favorable in the case of her health improvement, or unfavorable in the case of evacuation or referral, discharge without medical advice, or death. The outcome of hospitalization for pregnancy was favorable in cases of live birth or ongoing pregnancy, and unfavorable in cases of abortion or stillbirth. The global outcome of hospitalization was favorable if it was favorable for both the mother and the pregnancy, and unfavorable in the other cases. The independent variables were stage of anemia, type of hospital (regional or district hospital), patient age in years (categorized into adolescent girls 14-19 years, young adults 20-34 years, and adults 35 years and older), gestational age in trimesters, residence (urban or rural), marital status (single or in union) income level (low for housewives and high for employed women), parity (nulliparous/primiparous and multiparous), mode of admission to the maternity ward (evacuation, referral, direct admission), time to referral/evacuation, reason for admission (anemia or other reason), and quality of anemia prevention before admission. Anemia in pregnancy was defined regarding WHO, as a hemoglobin (Hb) < 11 g/dl [1]. It was classified into stages: mild anemia (10 ≤ Hb < 11 g/dl), moderate anemia (7 ≤ Hb < 10 g/dl), and severe anemia (Hb < 7 g/dl). Because gestational age was very poorly reported in the hospital records, it was estimated in trimesters using the symphysis-fundal height with reference to the literature [8]. The time of referral/evacuation was categorized into acceptable (< 24 hours) and long (≥ 24 hours). In the absence of consensus on the limits of time of referral to hospital, the categorization of the time frame took into account the risks related to pregnancy, the average distance to hospitals, the quality of the roads and means of transportation in the region, and the published experiences [9][10][11]. The quality of anemia prevention was considered as "good" if the patient had received at least one antenatal visit with both iron/folate supplementation and malaria preventive treatment. It was acceptable if the patient received only one of the two preventive treatments at the antenatal visit. Otherwise, the quality of anemia prevention was considered as "weak". The choice of the independent variables was made with reference to the literature related to anemia in pregnancy [6][12], assuming their possible association with the results of hospital discharge.

Data collection: All data were extracted from the pregnant women's hospital records using a standardized questionnaire by trained investigators. The standardized form had three sections devoted to sociodemographic characteristics, clinical data, and anthropometric measurements. The form has been approved by specialists in public health, epidemiology, and biostatistics from the *Université Libre de Bruxelles* in Belgium and the Nazi Boni University in Burkina Faso.

Bias management: To harmonize the understanding of the questionnaire, a pretest was conducted in a referral hospital in a neighboring region before the actual data collection. All questions were clarified with the investigators. At the end of the first day of data collection, a meeting was held to evaluate and correct the completion of the questionnaire; this evaluation was repeated once a week until the end of the data collection.

Sampling: All hospital records of pregnant women admitted between January 1, 2009, and December 31, 2011, were reviewed to retain those with a biological diagnosis of anemia. All records reviewed were for cases already discharged from hospital.

Statistical analysis: The data were entered in duplicate to reduce entry errors. The purpose of the data analysis was to identify factors associated with unfavorable hospital discharge of cases of anemia for the mother-pregnancy entity. The

variables were summarized with descriptive statistics (frequencies and percentages). The chi-square test was used to analyze the associations between independent and dependent variables. The odds ratios (OR) and their 95% confidence intervals (95% CI) were calculated to estimate these association strengths.

Two multivariable logistic regression models were constructed. In the first model (model 1) involving all subjects, only independent variables that were associated with the dependent variable in univariate analysis at a significance level of 0.20 were considered for inclusion. Variables in the final model were selected by a top-down stepwise procedure to retain only those with a p-value $<$ 0.05. The adjusted OR and their 95% CI were estimated from this model. The model was tested for fit and good specification using the Hosmer-Lemeshow test and the link test, respectively. Because gestational age was missing for 317 women (18%) and the proportion of unfavorable discharge was significantly higher in this case, the category of women with missing gestational age was considered in the analyses. The multivariable model included 1363 subjects (82% of the total sample); the proportions of unfavorable discharge did not differ between the subjects included in the analysis and those not included (43% vs. 40% respectively; p = 0.29). A second logistic regression model was constructed for the subgroup of evacuated or referred cases (model 2) to account for the effect of referral/evacuation time, following the same method as for model 1. The data were analyzed using SPSS Statistics version 24.

Results

1) Participants

A total of 5586 hospital records of pregnant women admitted between 2009 and 2011 were reviewed, including 5348 at the regional hospital and 238 at the district hospital. Of these, there were 1815 cases of biological anemia (32.5% of records). All cases of biological anemia for which the hospital discharge result was known (n =1635) were included in the analyses.

2) Characteristics of the study population

The majority of cases were women in union, of low income, under 35 years of age and in their 1st or 2nd trimester of pregnancy. Twenty-seven percent (27%) had severe anemia, 42% had moderate anemia, and 32% had mild anemia. Anemia accounted for more than one-tenth of the reasons for hospitalization. The common modes of hospital admission were evacuation and direct admission. The referral/evacuation time did not exceed 24 hours in the majority of cases. The prevention of anemia in the peripheral health facilities was good in the majority of cases (Table 1). Indeed, the number of antenatal visits per woman before hospitalization varied from 0 to 6 with a median of 2 visits; the majority of women had benefited from iron/folate supplementation and preventive treatment for malaria.

3) Hospitalization results for pregnant women admitted with anemia

An unfavorable hospital discharge for both the mother and pregnancy was reported in 42.6% of cases (Table 2). In 71.6%

of cases, the hospital discharge was favorable for the mother. In the remaining cases, the outcome was unfavorable, ending in evacuation or referral in 24.8% of cases, discharge without medical advice in 1.9% of cases, and death in 1.8% of cases.

For the cases received from the peripheral level of care system, 32.41% were again evacuated or referred to a higher level. Severe anemia was associated with referral/evacuation ($p < 0.001$), maternal death ($p = 0.003$), but not discharge without medical advice ($p = 0.09$). More than half (54.2%) of referred/evacuated cases had severe anemia on admission. The proportion of referred/evacuated cases was higher ($p < 0.001$) in the 2nd trimester (41.1%) than in the 1st trimester (18.2%) and 3rd trimester of pregnancy (20.2%). Sixty-one percent (61,0%) of cases admitted with severe anemia in the 2nd trimester of pregnancy were referred or evacuated again. There were more rural (78.0%) than urban (22.0%) cases whose hospitalization ended in referral/evacuation ($p < 0.001$). The majority of patients who died (23/30 deaths) were from rural areas. The referral/evacuation times of less than one day corresponded to obstetric emergency and anemia, and the hospitalization result was unfavorable in 83.2% of these cases. The longest delays were observed in free referral cases without medical transport.

The maternal mortality ratio among the studied cases was 30 per 804 live births (i.e., 3,732/100,000 live births). This ratio was 3 517/100 000 for severe anemia, 1,446/100,000 for moderate anemia, and 745/100,000 for mild anemia.

Concerning the prevention of anemia, unfavorable hospital discharge was observed in 72.6% of patients not supplemented with iron/folate, 64.5% of patients with no preventive treatment for malaria, and 78.6% of women who did not benefit any antenatal visit. The frequency of unfavorable hospital discharges decreased with increasing number of antenatal visits. Among patients who had at least four antenatal visits (15.7% of cases), an unfavorable hospital discharge was observed in 18.9% of cases.

Pregnancy outcome at hospital discharge was favorable in 77.7% of cases (with ongoing pregnancy in 46.1% and live birth in 31.6%) and unfavorable in 22.3% of cases (including abortion: 12.7% of cases; stillbirth: 8.7%; ectopic pregnancy: 0.9%). There were more abortions in moderate and mild anemia cases than in severe cases ($p = 0.03$). The stage of anemia was not associated with stillbirth ($p = 0.19$) and ectopic pregnancy ($p = 0.29$).

Of the 35 unfavorable outcomes of pregnancy in noncouple women, 32 cases (91.4%) were abortions. The marital status was not associated with maternal hospitalization outcome and stage of anemia.

The majority of maternal deaths and stillbirths (18 of 28 maternal deaths or 64.3% and 91 of 141 stillbirths or 64.5%) occurred in multiparous women; however, the frequency of severe anemia was higher in nulliparous women (30.7%).

Table 1. Sociodemographic characteristics of cases of anemia in pregnant women admitted in public referral maternity wards

Variable	n	%
Age (year)		

Age (year)		
14-19 (adolescent)	355	21.9
20-34 (young adult)	1059	65.2
≥ 35 (adult)	209	12.9
Residence		
Urban	588	37.7
Rural	971	62.3
Marital status		
In union	1490	95.0
Not in union	79	5.0
Income level		
Low	1486	93.2
High	108	6.8
Gestational age		
1st and 2nd trimester	451	26.8
3rd trimester	912	54.3
Unknown	317	18.9
Parity		
Nulliparous or primiparous	782	49.2
Multiparous	809	50.8
Hospital		
Regional	1473	90.1
District	162	9.9
Mode of admission		
Evacuation	650	43.2
Referral	236	15.7
Direct admission	618	41.1
Time of referral/evacuation		
< 24 hours	541	82.2
≥ 24 hours	117	17.8
Reason of admission		
Anemia	222	13.6
Other	1413	86.4
Anemia		
Severe	439	26.9
Moderate	667	40.8
Mild	529	32.4
Quality of anemia prevention		
Weak	90	5.5
Acceptable	38	2.3

Good	1507	92.2

Table 2. Distribution of cases of anemia in pregnancy according to the hospitalization outcome

Hospitalization outcome	Mother		Pregnancy		Global outcome	
	n	%	n	%	n	%
Favorable	1205	71,6	1354	77,7	938	57,4
Unfavorable	479	28,4	389	22,3	697	42,6
Total	**1684**	**100,0**	**1743**	**100,0**	**1635**	**100,0**

4) Factors associated with hospitalization outcome for cases of anemia in pregnancy

Tables 3 and 4 present the results of univariate and multivariate analyses. In univariate analysis, the factors associated with unfavorable hospital discharge for the mother-pregnancy entity were rural residence, noncoupled status, referral or evacuation cases, anemia as reason for admission, the first two trimesters of pregnancy, multiparity, severe or moderate anemia, and low quality of anemia prevention.

In model 1 (Table 3), which did not include the time of referral/evacuation, unfavorable hospital discharge was more common among rural women, those admitted from an evacuation, patients in the 1st or 2nd trimesters of pregnancy, those with moderate or severe anemia, and those with poor quality of anemia prevention. The hospital discharge was less unfavorable in women in union, nulliparous, and primiparous women.

In the analysis of the subgroup of referred or evacuated cases (model 2, Table 4), factors associated with unfavorable hospital discharge were rural residence, evacuation cases with less than 24 hours' delay, first two trimesters of pregnancy, severe or moderate anemia, and poor quality of anemia prevention. Marital status and parity were not associated with unfavorable hospital discharge in this model.

The patient age, type of hospital, income level, and reason for admission were not associated with unfavorable hospital discharge of cases of anemia in pregnancy.

Table 3. Factors associated with unfavorable hospital discharge for cases of anemia in pregnancy (Model 1)

Variable	Unfavorable discharge (%)	OR (95%CI)	p	Adjusted OR (95%CI)	p
Hospital			0.25	NC	
Regional	42.2	0.82 (0.60-1.14)			
District	46.9	1			
Age (year)			0.76	NC	
14-19	44.8	1.01 (0.72-1.43)			
20-34	41.6	0.89 (0.66-1.20)			

≥ 35	44.5	1			
Residence			< 0.001		0.047
Rural	48.5	1.87 (1.51-2.31)		1.32 (1.00-1.74)	
Urban	33.5	1		1	
Marital status			0.036		0.012
In union	42.4	0.62 (0.39-0.97)		0.46 (0.26-0.84)	
Not in union	54.4	1		1	
Income level			0.20	NC	
Low	43.3	1.30 (0.87-1.95)			
High	37.0	1			
Mode of admission			< 0.001		<0.001
Evacuation	50.8	2.05 (1.63-2.56)		1.96 (1.48-2.60)	
Referral	45.8	1.46 (1.01-2.11)		1.21 (0.85-1.72)	
Direct	33.5	1		1	
Reason of admission			< 0.001	NS	
Anemia	62.2	2.51 (1.86-3.36)			
Other	39.6	1			
Gestational age (trimester)			< 0.001		<0.001
1st or 2nd	57.2	3.37 (2.66-4.27)		2.74 (2.03-3.68)	
3rd	28.4	1		1	
Unknown	65.5	4.78 (3.59-6.36)		4.79 (3.40-6.76)	
Parity			0.016		0.003
Nulliparous or primiparous	39.5	0.78 (0.64-0.96)		0.69 (0.54-0.88)	
Multiparous	45.5	1		1	
Anemia			< 0.001		< 0.001
Severe	62.4	3.76 (2.88-4.92)		2.46 (1.75-3.46)	
Moderate	39.1	1.46 (1.14-1.85)		1.39 (1.05-1.85)	
Mild	30.6	1		1	
Quality of anemia prevention			< 0.001		0.001
Weak	73.3	4.00 (2.48-6.45)		2.81 (1.62-4.88)	
Acceptable	44.7	1.18 (0.62-2.25)		0.84 (0.40-1.74)	
Good	40.7	1		1	

Model 1 (n = 1363, including 589 unfavorable outcomes): Hosmer-Lemeshow test: p = 0,06; NC: not considered; NS: not included because not significant

Table 4. Factors associated with unfavorable hospital discharge for cases of anemia in pregnancy (Model 2)

Variable	n	Unfavorable discharge (%)	OR (95%CI)	p	Adjusted OR (95%CI)	p
Hospital				0.97	NC	
Regional	767	49.4	0.99 (0.68-1.46)			
District	119	49.6	1			
Age (year)				0.73	NC	
14-19	193	50.3	0.91 (0.58-1.44)			
20-34	567	48.7	0.86 (0.58-1.27)			
≥ 35	120	52.5	1			
Residence				< 0.001		0.027
Rural	654	53.1	1.86 (1.34-2.57)		1.66 (1.06-2.59)	
Urban	201	37.8	1		1	
Marital status				1.00	NC	
In union	839	49.9	1.00 (0.43-2.33)			
Not in union	22	50.0	1			
Income level				0.07	NS	
Low	829	50.5	1.89 (0.97-3.76)			
High	37	35.1	1			
Mode of admission				0.19	NS	
Evacuation	650	50.8	1.22 (0.91-1.65)			
Referral	236	45.8	1			
Time of referral/evacuation				0.011		0.002
< 24 hours	496	50.6	1.72 (1.13-2.64)		2.08 (1.29-3.33)	
≥ 24 hours	110	37.3	1		1	
Reason of admission				< 0.001	NS	
Anemia	184	63.0	2.01 (1.44-2.81)			
Other	702	45.9	1			
Gestational age (trimester)				< 0.001		<0.001
1st or 2nd	245	64.1	2.95 (2.15-4.04)		1.78 (1.13-2.80)	
3rd	509	37.7	1		1	
Unknown	132	67.4	3.42 (2.28-		3.48 (2.04-5.92)	

			5.13)			
Parity				0.12	NS	
Nulliparous or primiparous	402	46.3	0.81 (0.62-1.06)			
Multiparous	464	51.5	1			
Anemia				< 0.001		<0.001
Severe	294	65.0	3.33 (2.34-4.74)		2.77 (1.67-4.60)	
Moderate	343	46.1	1.54 (1.10-2.15)		1.44 (0.92-2.23)	
Mild	249	35.7	1		1	
Quality of anemia prevention				< 0.001		<0.001
Weak	53	79.3	4.21 (2.14-8.30)		5.51 (2.16-14.09)	
Acceptable or good	833	50.0	1		1	

Model 2 (n = 589 including 283 unfavorable outcomes): Hosmer-Lemeshow test: p = 0.54; NC: not considered; NS: not included because not significant

Discussion

Compared with the isolated maternal and pregnancy hospitalization outcomes, there was a high proportion of unfavorable hospitalization outcomes for the mother-pregnancy entity in the two hospitals of the “Cascades” region. This comparison was possible thanks to the definition of the aggregate indicator "unfavorable outcome of hospitalization for the mother-pregnancy entity”. The factors associated with these unfavorable outcomes were the quality of anemia prevention, stage of anemia, gestational age, mode of admission, and residence.

The limitations of such a study were inherent in the retrospective nature of data collection from hospital records, which were summarily filled out and sometimes poorly archived. However, the extension of the period covered by the data collection made it possible to have a representative number of subjects included in the analyses despite the extent of the missing data.

A selection bias may have been introduced by including only records with a positive diagnosis of anemia. This shortcoming was mitigated by checking the similarity of the results with the national references and those in the literature.

The aggregation of outcomes had the particularity to include referral/evacuation and discharge without medical advice. This allowed for a more comprehensive assessment of hospital performance in providing care for anemia in pregnant women.

Thus, referrals and evacuations accounted for the largest part of unfavorable outcomes. More than one in five patients were referred or evacuated to a higher level of the care system. One-third of the cases received from referral/evacuation were again evacuated to a higher level, even though regional hospitals were supposed to take care of the majority of

cases received and refer only a small proportion (*Ministry of Health. National Guide to Referral and Counter-referral. 2005. Unpublished document*). The proportion of discharges against or without medical advice was high, but the study design did not allow to explore their motivations. In 2012, 5.12% of patients were discharged without or against medical advice in Burkina Faso hospitals [13]. Exploring these motivations could help reduce the frequency of these unplanned hospital discharges. In studies conducted in African hospitals, most authors have found high proportions of discharges without or against medical advice. The main reasons for these discharges were the lack of improvement in health, financial difficulties, poor hospital conditions, and disagreements with caregivers [14].

The maternal mortality ratio in our sample was very high (3,732/100,000 live births). It thus reached 26 times the in-hospital maternal mortality of 144 per 100,000 live births reported in Burkina Faso in 2012 [13]. The maternal mortality in our study was rather close to the 2,800/100,000 live births reported among cases of anemia in pregnancy in the same regional hospital in 2014 by Savadogo et al [7]. It was higher than that of the study by Ouédraogo et al. done at the hospital of the “Nord” region of Burkina Faso in 2019; they reported 1,581 maternal deaths per 100,000 live births among cases of anemia in pregnancy [6]. According to Bailey et al., the case fatality of anemia in pregnancy reaches 2.3% in low-income countries [15]. In our study, the proportion of maternal deaths showed a downward trend over the triennium: 3.5% in 2009, then 0.9% in 2010 and 1.8% in 2011.

The unfavorable hospital discharge for pregnancy were marked by high proportions of abortions and stillbirths. The proportion of abortions of 127‰ in our study was higher than that reported by the overall health facilities of Burkina Faso in 2012 [13]. According to a 2011 estimate by Sedgh et al. in Burkina Faso, 25‰ pregnancies ended in abortion[16]. This rate reported by the same author was 31‰ for all West African countries [17]. However, these estimates did not target only cases of anemia and took into account nonhospital data. Nonetheless, abortion is identified in the literature as a cause and not a consequence of anemia in pregnancy, particularly through its complications (hemorrhage, sepsis) [18].

The proportion of stillbirths reflected that observed in whole hospitals (6.5%) in Burkina Faso in 2012[13]. It was close to that of Savadogo et al., who reported a stillbirth rate of 9.4% in 2014 among cases of severe anemia in pregnancy at the regional hospital of “Cascades” [7]. In contrast, Ouédraogo et al. found a higher stillbirth rate (13.76%) at the regional hospital of the “Nord” region of Burkina Faso in 2019 [6]. In a systematic review published in 2017 by Bailey et al., the in-hospital stillbirths ranged from 0.58% to 11.65% in low-income countries [15]. We did not find an association between stillbirth and stage of anemia, although the association between maternal anemia and stillbirth is well affirmed in the literature. On this subject, Rahman et al. in a meta-analysis published in 2016, attributed 18% of stillbirths (RR = 1.51; CI95%: 1.30-1.76) to maternal anemia.

For ectopic pregnancies, the frequency in our study was lower than that of the whole country (1.38% of pregnant women hospitalized), but close to that of the “Cascades” region (1.04%) in 2018 [13]. In studies conducted in West Africa, this frequency was between 1 and 2% [19][20][21]. Of course, ectopic pregnancy is not a consequence of anemia, but it could be the etiology, especially in cases of rupture [22].

Within the limits of our knowledge, the published literature has not yet documented the aggregate indicator of

hospitalization outcome for the mother-pregnancy entity. This lack of information limited the discussion of our result without altering its relevance. The high proportion of unfavorable hospital discharges for anemia cases indicated the extent of unmet need for anemia care in hospitals in Burkina Faso. Several factors explained these unfavorable outcomes. The most important were severe anemia, admission from evacuation, poor quality of anemia prevention, and 1st or 2nd trimester of pregnancy.

Severe anemia was the most frequent reason for evacuation to the next level of the care system and was associated with maternal death as documented by several authors [2][3][7]. The hospitalization for severe anemia in the 2nd trimester of pregnancy ended in referral/evacuation in nearly two-thirds of cases, with anemia as the reason in more than half of the cases. The care system was therefore sufficiently alert to detect but not to manage the severe anemia, particularly in the 2nd trimester of pregnancy. This excess of "repetitive" referral/evacuation of cases of severe anemia was explained by the low availability of blood for transfusion and the nonuse of injectable iron in Burkina Faso hospitals. severe cases of anemia near the end of pregnancy respond poorly to oral iron treatment [5]. This issue also explained the high case fatality of severe anemia in pregnancy.

Unfavorable hospital discharges were also associated with marital status and the determining parameter was the high frequency of abortion (91.4%) among women not in couple. In a multisite study in Ghana and Mozambique published in 2018, Dickson et al. identified an association between nonunion status of women and high abortion frequency [23]. Furthermore, Klutsey and Ankomah showed that women who were not in union were at the greatest risk of induced abortion [24].

Moreover, multiparity was associated with a higher frequency of unfavorable hospital discharges, with a higher proportion of stillbirths (64.5%) and maternal deaths (64.3%) in multiparous women. This observation has also been made by several authors, especially in West Africa and South Asia, but also elsewhere [25][26][27].

Besides these factors, rural residence was associated with unfavorable hospital discharge of cases of anemia in pregnancy. This association was consistent across all logistic models. The majority of referrals/evacuations, severe anemia cases, and maternal deaths were patients residing in rural areas. In an historical cohort (2008-2010) conducted in Niger in 2017, the authors made the same conclusion that the majority (74.9%) of maternal deaths occurred in patients from rural areas [28]. In a "three delay model" analysis of maternal death, Sombié et al. summarized the main factors contributing to maternal mortality, including poor access to emergency obstetric care, especially in rural areas [29][30].

The low quality of anemia prevention was due to inadequate iron/folate supplementation, malaria preventive treatment, and obstetric coverage. In a previous study conducted in the “Cascades” region in 2012, we observed in addition, insufficient knowledge of measures to prevent anemia in pregnancy. This insufficiency concerned 75% of health care providers and 66% of community health workers of the sample. [31]. Anemia was still the second most common reason for hospitalization of pregnant women in Burkina Faso in the health statistics yearbook published in 2018 [32].

In summary, the residence in a rural area, the status of women not in union, admissions from medical evacuation, the first two trimesters of pregnancy, multiparity, moderate or severe stage of anemia and low quality of anemia prevention were

the determining factors of the unfavorable hospital discharge of pregnant women with anemia in the “Cascades” region between 2009 and 2011. Thus, surprisingly, the technical platform of the hospital and the income level of the patients were not decisive in the results of hospitalization of cases of anemia in pregnancy.

Conclusion

Unfavorable of hospital discharges of the mother-pregnancy entity were common among cases of anemia in pregnancy in the “Cascades” region of Burkina Faso. Taking into account the factors associated with these unfavorable outcomes could help improve the hospitalization results for pregnant women.

Statements and Declarations

Ethics approval and consent to participate

The protocol of the study was in accordance with the Declaration of Helsinki and has been approved by the Ethics Committee of *Centre Muraz* (Ref. 022-2014/CE-CM, 22 October 2014) in Burkina Faso. The study was also approved by the local health authorities. The data gathered was anonymous and the hospital records were kept under lock and key at the hospital.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request. Corresponding author name: Bernard Ilboudo; email: bernardilboudo@gmail.com

Competing interests

The authors declare that they have no competing interests.

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