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Prevalence and factors associated with placental malaria in Lira District, Northern Uganda: a cross-sectional study

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Abstract

Background Malaria has a stable perennial transmission across Uganda. Placental malaria is associated with adverse maternal, fetal, and neonatal outcomes. The factors associated with placental malaria are poorly understood in the study setting. The aim of the study was to assess the prevalence of placental malaria and to determine its associated factors among parturient women in Lira District, Uganda.

Methods This was a cross-sectional study among 366 pregnant women who delivered at Lira Regional Referral Hospital. Data were collected from December 2018 to February 2019 using an interviewer-administered questionnaire. The variables were socio-demographic, obstetric characteristics, and malaria preventive practices. Standard Diagnostic Bioline Rapid Diagnostic Tests were used to detect placental malaria present in placental blood. Microscopy was used to quantify the grade of placental malaria parasitaemia. Logistic regression was used to assess factors associated with placental malaria.

Results The mean age of the participants was 25.34 years (standard deviation [SD] 5.73). The prevalence of placental malaria was [4.4% (16/366) 95% CI (2.5 to 7.0)]. Of these, only 7/16 were positive on microscopy, with 2/7 having moderate parasitemia and 5/7 having mild parasitaemia. Women aged less than 20 years [AOR 3.48, 95% CI (1.13 to 10.72)], and those not taking iron supplements during pregnancy [AOR = 3.55, 95% CI (1.02 to 12.31)] were associated with an increased likelihood of having placental malaria.

Conclusion The prevalence of placental malaria was low in this setting. This may have reflected the low malaria transmission rates following intensive indoor residual spraying. Placental malaria infection was associated with younger age and not taking iron supplements during pregnancy. Public health measures need to scale up and emphasise adherence to malaria preventive measures during pregnancy especially among teenage mothers.

Keywords Placental malaria, Prevalence, Associated factors

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Background

In Uganda, a stable malaria transmission occurs in 95% of the geographical area [1]. The second highest malaria transmission intensity worldwide has been reported in Northern Uganda [2]. In malaria endemic areas, pregnant women are more likely to suffer from severe malaria compared to the general population [3]. Pregnant women have a heightened risk of developing maternal anaemia, cerebral malaria and complications of malaria in pregnancy [4]. In addition, malaria in pregnancy is associated with an increased risk of developing adverse fetal outcomes such as spontaneous abortions, stillbirth, preterm birth, low birth weight and congenital malaria [4–6]. Maternal anaemia accounts for 10,000 maternal deaths, while low birth weight alone is reported to cause 200,000 neonatal deaths globally [4].

During pregnancy, physiological immune suppression occurs, and cell mediated immune response is reduced [4, 7]. In women living in malaria-endemic regions, and therefore have a degree of immunity to malaria by the time they become pregnant, the pregnancy-suppressed immune response enables the malaria parasite to survive [4, 7]. *Plasmodium falciparum*-infected red cells attach to the placenta, thus avoid spleen clearance and exposure to host immune responses [4, 7]. This triggers a cascade of inflammatory events which damage the placenta [7]. Consequently, placental insufficiency occurs hence intrauterine growth restriction, preterm delivery and low birth weight [7].

Uganda is one of the countries in the sub-Saharan region with the highest burden of malaria [8]. As such, Uganda adopted the three-pronged approach recommended by the World Health Organization to prevent malaria in pregnancy including the use of intermittent preventive treatment in pregnancy with sulfadoxine–pyrimethamine (IPT-SP), use of long-lasting insecticidal nets (LLINs), and effective case management of malaria [4, 9]. However, the coverage of these malaria preventive practices are sub-optimal and this increases the risk of malaria in pregnancy alongside other factors such as poor IPT-SP adherence and parasite resistance [10]. Despite the high (95%) attendance of antenatal care [11], only 41% of women received at least three doses of IPT-SP during pregnancy, while 65% of pregnant women used LLIN in 2019 [1]. From 2006 to 2021, when the indoor residual spraying (IRS) practice was implemented in the selected regions in Uganda [12], only 10% of the households had IRS [1]. In Northern Uganda, where the IRS campaign was intensified, indoor residual spraying was done in 57% of all the households [1, 12].

In Uganda, a number of studies have attempted to study the factors associated with placental malaria [13–15]. These studies were mostly done from areas of low and high intensity of malaria transmission [13–15]. The study was conducted in a setting of moderate intensity of malaria transmission. The increasing use of strategies for malaria prevention during pregnancy may change the reported prevalence of placental malaria. The emerging malaria parasite resistance trends and non-adherence to anti-malarials may influence the traditionally-known factors associated with placental malaria [16]. The purpose of this study was to determine the prevalence and the factors associated with placental malaria among pregnant women at Lira Regional Referral Hospital.

Methods

Study design and study setting

This was a cross-sectional study conducted in Lira Regional Referral Hospital. The hospital is located in the central business area of Lira district. The district is located in Northern Uganda which is approximately 342 km by road North of Kampala, the capital city of Uganda.

Lira district has a tropical rainfall pattern which is bimodal in nature with two rainy seasons [17]. The two rainy seasons start from the months of March to June and August to November, while the dry season starts in December to February and the month of July [17]. The malaria transmission rates peaks following the rainy season in the months of May and November [17]. The study was conducted from December 2018 to February 2019. Although the highest malaria transmission rates in the world have been observed in Apac District in Northern Uganda with an entolomolical inoculation rate of more than 1500 infective bites a year, Northern Uganda as a region is a malaria mesoendemic area [1]. This region has a prevalence of malaria of 20% in children of less than 10 years [18]. *Plasmodium falciparum* is the predominant malaria parasites, and *Anopheles funestus* is the main vector [19].

Study population, sampling and sample size

The study was conducted among pregnant women who came to give birth in Lira Regional Referral Hospital. Women in the first stage of labor were recruited in the study after obtaining written informed consent. Women who were critically ill and those who presented to the maternity ward in the second and third stage of labour were excluded from the study.

The study sample size was 366 women which was determined using the Cochran formula. The 39% prevalence of placental malaria from a study in Tanzania was used to calculate the study sample size using 5% precision estimate and Z-score of 1.96 for the 95% confidence interval [11]. Consecutive sampling method was used to select study participants.

Data collection procedure

Upon admission for delivery at Lira Regional Referral Hospital, the interviewer-administered paper based questionnaires were used to collect the independent variables in the study which included socio-demographic factors, obstetric factors, and malaria preventive practices. The age of a woman (> 20 or < 20 years), marital status (married/non-married), religion, ethnicity, level of education (< primary/ > secondary), occupation (employed/unemployed), area of residence (rural/urban), type of house (temporary/semipermanent or permanent) and fuel for cooking (charcoal/wood) were the corresponding socio-demographic variables. The malaria preventive practices included the use of IPT-SP (yes/no), number of IPT-SP doses (< 3/ > 2), dose interval of last IPT-SP dose from delivery (1/ ≥ 2 months), concomitant use of antimalarial drugs (yes/no) and directly observed therapy IPT-SP (yes/no) were extracted from the antenatal card, while use of bed net (yes/no), type of bed (LLIN/ordinary net), duration of bed net use (< 1/ > 1 year) and indoor residual spraying (yes/no) were collected from self-reports. The obstetric characteristics collected included parity (1–2/ ≥ 3, gestational age at delivery, iron supplementation, number of antenatal care (ANC) visits (< 4/ > 4 visits), ANC attendance (yes/no), the timing of first ANC (< 20/ > 20 weeks), history of malaria during pregnancy (yes/no), HIV status (yes/no) and iron supplementation (yes/no). Following delivery, a sample of placental blood was taken for malaria testing.

Process of sample collection

The placenta prick method was used to collect the placental blood [20]. The placental blood was collected immediately within the first 10 min after the placenta had been delivered. The placental blood, one to two millilitres, was aspirated from the center of the placenta along the maternal side of the placenta. The blood sample was stored in the Ethylenediaminetetraacetic acid sterile collection tube. The blood sample was labelled to correspond with the participant identification number on the questionnaire. The samples were then taken to the laboratory for sample processing.

Sample processing

The rapid diagnostic test (RDT) was used to diagnose placental malaria, while microscopy was used to quantify the parasitaemia of placental malaria infection. The RDT is an accurate proxy to diagnose placental malaria [21, 22]. Although placental histology is considered the gold standard for diagnosing placental malaria [23], RDT was used for practical reasons [4, 21, 22]. In a resource limited settings with a shortage of expertise and equipment required in microscopy [4], evidence has shown RDTs to be more superior than microscopy in detecting malaria in pregnancy [21, 22]. Microscopy are often limited by the low placental densities that tend to occur in pregnancy which compromise their accuracy [23]. Given the accuracy of RDTs [23], previous studies have also used RDTs as the end point for defining malaria in pregnancy [15, 24]. In this study, the SD Bioline (Ref: 05FK60) RDT was used to test for placental malaria infection. The RDT detects both the histidine rich protein 2 antigen specific for *P. falciparum* and the pan-lactate dehydrogenase antigen found in all *Plasmodium* species [21]. The RDT manufacturer's instructions were strictly followed for testing for malaria. The RDT result was then entered into the questionnaire. The positive RDT samples were then subjected for microscopy to grade the parasitaemia of placental malaria.

The thick smear of placental blood was prepared to quantify the parasite density [25]. The smears were fixed in methanol for 5 s, then stained with 5% Giemsa for 30 min [25]. After staining, the blood smear was examined under the × 100 objective lens. The result was considered positive when the asexual forms of malaria parasites were observed [25]. Based on the standard criterion of classifying severe malaria in the setting, the degree of parasitaemia was graded as mild (1–999/μL), moderate (1000–9999/μL), and severe (> 10,000) [25]. The result was considered negative after a thorough examination of 100 fields was made without observation of the parasites [25]. The microscopy smear findings were interpreted by two qualified laboratory technicians. A third independent laboratory technician read the slides when a discrepancy occurred between the two readers. The study considered the test findings when the two laboratory technicians provided the same reading of the test including whether the test was negative or positive and the degree of parasitaemia.

Statistical analysis

The data for the study were entered and analysed using SPSS (version 16.0). The mean and standard deviation was used to describe the age of the study participants. Frequencies and percentages were used to describe the categorical variables in the study. The prevalence of placental malaria was determined by dividing the number of women with a positive finding for placental malaria by the total sample. The factors likely to be associated with placental malaria were identified from literature [26, 27]. Bivariable logistic regression analyses was used to determine the factors associated with placental malaria. The odds ratios were used as a measure of association between independent variables and placental malaria. Socio-demographic variables, malaria preventive

practices, and obstetric characteristics were adjusted for cofounding. The respective crude odds ratios (COR) and adjusted odds ratios (AOR) of the variables were determined.

Results

Description of the study participants

The mean age of the participants was 25.34 years (standard deviation [SD] 5.73). The majority of the participants were of primary level or no formal education (61.8%). Nearly all the participants were either unemployed (22%) or self-employed (69%) (Table 1).

Obstetric and malaria related characteristics

More than one-half (58.5%) of the women were either primigravidae or secondigravidae (Table 2). Nearly one-half (45.6%) of the participants reported having had malaria infection during pregnancy with nearly one-fifth (19%) of them reporting at least three episodes of malaria infection during pregnancy.

Table 1 Socio-demographic characteristics of the participants (n = 366)

Variable	Frequency	Percentage
Age (in years)		
15–19	63	17.2
20–34	267	73.0
35+	36	9.8
Tribe		
Langi	333	91.0
Others*	33	9.0
Marital status		
Non-married	22	6.0
Married	344	94.0
Religion		
Christian	358	97.8
Muslim	8	2.2
Level of education		
None	28	7.7
Primary	198	54.1
Secondary	100	27.3
Tertiary	40	10.9
Occupation		
Unemployed	82	22.4
Self-employed	252	68.9
Formal employment	32	8.7
Area of residence		
Rural	179	48.9
Urban	187	51.1

* Others: Iteso, Acholi, Muganda, Mugishu, Musoga, Japadhola, Alur, Musamya, Madi, Munyoro, Munyakole and Mugwere

Table 2 Obstetric characteristics of the participants

Variable	Frequency n = 366	Percentage
Parity		
1	124	33.9
2	89	24.3
3+	151	41.3
Missing data	02	0.5
ANC attendance		
Yes	360	98.4
No	6	1.6
Timing of ANC attendance		
< 4 months	100	27.5
4–7 months	254	70.0
8+ months	9	2.5
Missing data	3	0.8
Number of ANC contacts		
1–3	133	36.4
4+	232	63.6
Missing data	1	0.3
Iron-folate supplementation		
Yes	321	87.9
No	44	11.8
Missing data	1	0.3
Malaria infection during pregnancy		
Yes	167	45.6
No	199	54.4
Number of malarial episodes (n = 167)		
1–2	148	88.6
3+	19	11.4
Use antimalarial drugs during pregnancy (n = 167)		
Quinine	89	53.3
Coartem	42	25.1
Others*	36	21.6
HIV infection (n = 364)		
Negative	326	89.6
Positive	38	10.4
Missing data	2	0.5

* Others: Duocortexin, Artesunate/Artemether and Fansidar; ANC: Antenatal Care

Malaria preventive practices

Close to one-half (44%) of participants who were eligible for IPT-SP reported taking at least three doses of IPT-SP, while 90% of HIV-infected participants were taking co-trimoxazole prophylaxis (Table 3). The majority (80%) of the women had indoor residual spraying protection and used long-lasting insecticidal nets during pregnancy.

Table 3 Malaria prevention practices among study participants

Variable	Frequency	Percentage (%)
IPT-SP (n = 350)*		
Yes	319	91.1
No	31	8.9
Number of IPT-SP doses (n = 349)		
0–2	195	55.9
3+	154	44.1
Directly observed uptake of IPT-SP (n = 315)		
Yes	182	57.8
No	133	42.2
Interval of last SP dose & delivery(n = 303)		
< 1 month	141	46.5
> 1 month	162	53.5
Co-trimoxazole use (n = 38)		
Yes	34	89.5
No	4	10.5
Concomitant antimalarial drugs use (n = 363)		
Yes	248	68.3
No	115	31.7
Bed net use (n = 366)		
Yes	339	92.6
No	27	7.4
Type of bed net (n = 341)		
Long lasting insecticide treated nets	294	86.2
Ordinary nets	47	13.7
Duration of bed net use (n = 340)		
< 1 year	134	39.4
> 1 year	206	60.6
Indoor spraying (n = 362)		
Yes	289	79.8
No	73	20.2

(n* = 16): participants were instead taking co-trimoxazole

Prevalence of placental malaria

The overall prevalence of placental malaria, as determined by RDT, was 4.4% (16/366). The positive RDT result was subjected to microscopy to grade the parasitaemia of the infection. The microscopy smear showed that only 43.7% (7/16) of the positive RDT samples were positive. For the positive microscopy smear, 31.3% (5/16) had mild, 13% (2/16) had moderate parasitaemia. More than half 56.3% (9/16) were negative for the microscopy smear.

Factors associated with placental malaria infection

The age of the woman, marital status, parity, and iron supplementation were associated with placental malaria (Table 4). At multivariable analysis, young age and not receiving iron therapy during pregnancy were associated with placental malaria (Table 5). Women less than 20 years had 3.5 times the odds of having placental malaria as compared to women 20 years and above. Women who did not take antenatal iron-folate drugs had 3.5 times the odds of having placental malaria as compared to women who took iron-folate.

Discussion

The purpose of this study was to assess the prevalence and the associated factors of placental malaria in Lira District, Northern Uganda. In this study, the prevalence of placental malaria was low (4.4%). The prevalence in the study was lower than the 20% [28], 33% [29], 44.6% [13] and 66.2% [30] in other areas in Uganda. This prevalence was also lower than the average prevalence reported in systematic reviews done in East Africa 27% (16.7–36.4%), Central Africa [31], sub-Saharan Africa 28% [10] and other developing countries 20–30% [32]. The study was conducted during the period of intensive IRS in Northern Uganda. The low prevalence of placental malaria in the study setting could be related to reduced incidence of malaria infection following IRS [33]. Evidence has shown resurgence of malaria infection following discontinuation of IRS [33]. Furthermore, the variation could be attributed to differences in the diagnostics tests, intensity of malaria transmission, the season, characteristics of the participants, and the use of malaria preventive strategies among participants in the different studies. For example, a higher prevalence of 66.2% was reported from a setting with one of the highest malaria transmission [30]. Studies that used placental histology also found higher prevalence rates compared to the RDT used in this study [34]. However, the prevalence in this study was comparable to the 4% in Western Uganda, a low malaria transmission area [35] and 4.6% in a high malaria transmission area in Eastern Uganda [29]. The prevalence of placental malaria in this study was consistent with the range of 0.0–47.1% in a systematic review and meta-analysis of 57 studies conducted in Sub-Saharan Africa [32]. The findings in the study are typical of prevalence found in asymptomatic populations [4]. This implies that placental malaria occurs in asymptomatic patients during pregnancy and, therefore, suggests a need for routine screening of malaria among pregnant women.

In this study, there was insufficient evidence to determine whether first time pregnancies had increased odds of having placental malaria. This could have

Table 4 Bivariable analysis of the factors associated with placental malaria infection

Variable	Malaria positive Frequency (%)	Malaria negative Frequency (%)	OR (95% CI)	*p*-value
Age of the participant				
< 20	9 (56.3)	54 (15.4)	1	
20+	7 (43.7)	296 (84.6)	7.05 (2.52–19.73)	0.001*
Marital status				
Non-married	4 (25.0)	18 (5.1)	1	
Married	12 (75.0)	332 (94.9)	6.15 (1.80–20.97)	0.004*
Level of education				
< Primary	11 (68.7)	215 (61.4)	0.72 (0.25–2.13)	0.557
> Secondary	5 (13.3)	135 (38.6)	1	
Occupation				
Unemployed	14 (87.5)	232 (66.3)	0.28 (0.06–1.26)	0.097
Employed	2 (12.5)	118 (33.7)	1	
Area of residence				
Rural	10 (62.5)	169 (48.3)	0.56 (0.20–1.57)	0.272
Urban	6 (37.5)	181 (51.7)	1	
Parity				
1–2	15 (93.7)	198 (56.9)	0.09 (0.01–0.67)	0.019*
3+	1 (6.3)	150 (43.1)	1	
Timing of ANC				
< 20 weeks	9 (56.2)	185 (53.8)	0.90 (0.33–2.48)	0.846
> 20 weeks	7 (43.8)	159 (46.2)	1	
Number of ANC visits				0.536
< 4	7 (43.8)	126 (36.1)	0.73 (0.264–1.20)	
4+	9 (56.2)	223 (63.9)	1	
Iron supplementation				0.021*
Yes	11 (68.7)	310 (89.1)	3.71 (1.22–11.25)	
No	5 (31.3)	38 (10.9)	1	
Malaria during pregnancy				0.387
Yes	9 (56.2)	158 (45.1)	0.64 (0.23–1.76)	
No	7 (43.8)	192 (54.9)	1	
Malaria episodes				0.499
1	6 (66.7)	87 (55.1)	0.69 (0.15–2.54)	
> 1	3 (33.3)	71 (44.9)	1	
Fansidar intake				0.474
Yes	13 (81.2)	306 (87.4)	1.60 (0.44–5.86)	
No	3 (18.8)	44 (12.6)	1	
Doses of Fansidar				0.897
0–2	9 (56.2)	202 (57.9)	1.07 (0.39–2.9)	
3+	7 (43.8)	147 (42.1)	1	
Directly observed therapy (IPT-SP)				0.091
Yes	10 (83.3)	173 (57.1)	0.27 (0.06–1.23)	
No	2 (16.7)	130 (42.1)	1	
Interval of last IPT-SP dose & delivery				0.490
< 2 months	5 (41.7)	151 (51.9)	1	
2+ months	7 (58.3)	140 (48.1)	1.51 (0.47–4.87)	
Indoor spraying				0.623
Yes	12 (75.0)	277 (95.8)	1	
No	4 (25.0)	69 (94.5)	1.34 (0.42–4.28)	
Concomitant antimalarial drug use				0.970

Table 4 (continued)

Variable	Malaria positive Frequency (%)	Malaria negative Frequency (%)	OR (95% CI)	*p*-value
Yes	11 (68.8)	237 (68.3)	1	
No	5 (31.2)	110 (31.7)	1.02 (0.33–2.89)	
Bed net use				0.090
Yes	13 (81.2)	326 (93.1)	3.13 (0.84–11.76)	
No	3 (18.8)	24 (6.9)	1	
Type of net				
LLIN	10 (76.9)	284 (87.6)	1	
Ordinary net	3 (23.1)	44 (13.4)	1.94 (0.51–7.31)	0.330
Duration of bed net use				0.284
< 1 year	7 (53.8)	127 (38.8)	1	
> 1 year	6 (46.2)	200 (61.2)	0.54 (0.18–1.66)	
HIV infection				0.629
Positive	1 (6.7)	37 (10.6)	1	
Negative	14 (93.3)	312 (89.4)	0.60 (0.08–4.71)	

Table 5 Multivariable analysis of factors associated with placenta malaria

Variable	COR (95% CI)	P value	AOR (95% CI)	P Value
Age (in years)		< 0.001		0.030
< 20	7.05 (2.517–19.730)		3.48 (1.131–10.726)	
20+	1		1	
Marital status		0.004		0.080
Non-married	6.15 (1.802–20.971)		3.53 (0.859–14.496)	
Married	1		1	
IPT-SP doses		0.474		0.977
Yes	1		1	
No	1.61 (0.440–5.857)		1.02 (0.216–4.8490)	
Bed net use		0.090		0.574
Yes	1		1	
No	3.14 (0.836–11.758)		1.53 (0.350–6.652)	
Parity		0.019		0.073
1–2	1		1	
3+	0.09 (0.011–0.674)		0.14 (0.017–1.197)	
Iron-folate use		0.021		0.046
Yes	1		1	
No	3.71 (1.223–11.246)		3.55 (1.022–12.315)	

Adjusted for age, parity, marital status, occupation, iron supplementation during pregnancy, IPT-SP use, directly observed IPT-SP and bed net use

COR: Crudes odds ratios and AOR: Adjusted odds ratios

resulted from the few outcomes of placental malaria positivity, which reduced the power to detect such an association. Other studies have found primigravidae to be more likely to have placental malaria [11, 28]. In this study, placental malaria was found to be higher among women who were less than 20 years of age as compared to women who were 20 years and older. This association was also found by earlier studies [11, 28]. The reduced risk of malaria infection among the older women is plausible since the older women tend to develop immunity from repeated malaria infections [36].

Previous clinical trial studies conducted in children have indicated that iron supplementation in iron-replete non-anaemic children increases the risk of malaria infection [37]. The plausibility of the associated increased odds of acquiring malaria infection has been extended to pregnant women who receive iron supplements during pregnancy [38]. Iron deficiency reduces the risk of peripheral parasitaemia in pregnancy [38]. In this study, however, not taking antenatal iron supplements during pregnancy increased the odds of getting placental malaria. This may be due to the fact that iron supplements are given together with malaria prophylaxis. As such, not taking iron supplements could be a proxy of not taking anti malarials.

There was insufficient evidence to prove that taking atleast three doses of IPT-SP was associated with decreased odds of having placental malaria. Other studies in Uganda have have not found evidence supporting prophylactic IPT-SP to be protective against placental malaria [30, 35]. This could be attributed to the high (93%) parasite resistance to IPT-SP [35, 36].

Limitations of the study

The study had a small proportion of women who had a positive placental malaria finding. The relatively small sample size in this study may have reduced the statistical power of the study to detect the associations between the dependent and independent variables. The inherent limitations of the RDT could have led to under reporting of the prevalence of placental malaria in this study (35). The design of this study limits it from reporting the burden of malaria across seasons. Antenatal cards were used alongside self-reports to collect data for HIV status and malaria preventive practices. Recall bias and social desirability bias may have limited the validity of the study findings.

Conclusion

The prevalence of placental malaria was low in the study. This may be related to low malaria transmissions rates during the period of intensive indoor residual spraying. Placental malaria infection was associated with younger age and not taking iron supplements during pregnancy. Public health measures need to scale up and promote adherence to malaria preventive measures during pregnancy especially among teenage mothers.

Abbreviations

ANC	Antenatal care
AOR	Adjusted odds ratios
COR	Crude odds ratios
IPT-SP	Intermittent preventive treatment of malaria in pregnancy with sulphadoxine pyrimethamine
WHO	World Health Organization
RDT	Rapid diagnostic test
HRP2	Histidine rich protein 2
HIV	Human immunodeficiency virus
UBOS	Uganda Bureau of Statistics
UMSI	Uganda Malaria Indicative Survey
SD	Standard deviation

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Author contributions

JE, JKT and GN were involved in the conceptualization of the study. JE designed the study, collected and analyzed the data, and drafted the manuscript. DM, JT, FO were involved in reviewing the manuscript. CRN and LK provided the overall oversight in the design and implementation of the study. All authors have read and approved the manuscript.

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Data availability

Data will be made available upon reasonable request.

Declarations

Ethics approval and consent to participate

Ethical approval was obtained from the Makerere University, School of Health Science Ethics and Research Committee (reference number: 2018-049). Permission to conduct the study in the hospital was obtained from the hospital administration. Written informed consent was obtained from the potential study participants who were in their first stage of labor. The researchers addressed cultural values regarding placental handling. Participants were informed of the test results and those with positive test results were linked to care in the hospital.

Competing interests

The authors declare no competing interests.

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