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Invasive Bacterial and Malaria Co-Infection and Associated Factors among Pregnant Mothers Attending a Private Tertiary Teaching Hospital in South Western Rural Uganda: Retrospective Review of Records between Feb 2014-Feb 2018

By Collins Atuheire, Nakibuuka Lydia, Mark Agaba, Justine Okello, Esther Itamba, Hilda Amolo Doreen & Paul Ssajakambwe

Makerere University

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Invasive Bacterial and Malaria Co-Infection and Associated Factors among Pregnant Mothers Attending a Private Tertiary Teaching Hospital in South Western Rural Uganda: Retrospective Review of Records between Feb 2014-Feb 2018

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Results: Of 367 pregnant women enrolled, the prevalence of Malaria-IBI co-infection was 26% (95%CI 22-31). Being of Muganda tribe was associated with reduced risk of IBI-malaria co-infection as compared to Munyankole; aOR= 0.33, [95% CI 0.11-1.02]. Mothers aged over 28 years were 56% less likely to experience IBI-malaria co-infection as compared to adult mothers below 22 years; aOR=0.44, [95% CI=0.21-0.92]. Those with history of blood transfusion were more likely to have IBI -malaria co- infection compared to those who have never had history of blood transfusion; aOR=1.65, [95%CI=0.96-2.84].

Conclusions & Recommendations: The prevalence of IBI-malaria co-infection was high among pregnant women attending Kampala International Teaching hospital of Western Uganda. Factors like age, tribe were significant predictors of the co-infection. There is need for emphasis on education of young mothers on issues of malaria prevention. Health care providers should prioritize attention towards young women especially non-indigenous ethnic groups in this setting as well as not undermining the history of blood transfusion regarding risk of IBI-Malaria co-infection.

Author α ρ ω: Department of Biosecurity, Ecosystems & Veterinary Public Health, College of Veterinary Medicine, Animal Resources & Biosecurity, Makerere University, P.O Box 7062, Kampala Uganda.
e-mails:atuheirecollinsgrace@gmail.com, agabamark123@gmail.com, justinokello01@gmail.com
Author σ: School of Public Health, College of Health Sciences, Makerere university, P.O Box 7072, Kampala Uganda.
e-mail: lnakibuuka@muwrp.org
Author α ¥ §: Department of Public Health, School of Allied Health Sciences, P.O Box 71, Bushenyi. e-mails: esthernastaha@gmail.com, agapegracee@gmail.com
Author χ: Department of Veterinary Pharmacy, Clinical & Comparative Medicine, College of Veterinary Medicine, Animal Resources & Biosecurity, Makerere University, P.O Box 7062, Kampala Uganda.
e-mail: paul.sajjakambwe@gmail.com

I. Introduction

Pregnant mothers with malaria and IBI have been associated with increased risk of adverse birth outcomes such as stillbirths, preterm, intrauterine growth restriction (IUGR) and Low Birth weight (LBW)[1]. Bacterial diseases contribute a big part towards sexually transmitted infection (STI) and reproductive tract infections (RTI) such as Treponema pallidum, Neisseria gonorrhoeae, Chlamydia trachomatis, Trichomonas vaginalis and bacterial vaginosis [2]. Also likely bacteria to be found in blood include; Staphylococcus aureus, Salmonella Typhi, Other Salmonella serovars, Viridans streptococci, Streptococcus pneumoniae, Brucella species, Streptococcus pyogenes, Haemophilus influenzae, Enterococcus faecalis , Pseudomonas aeruginosa, Clostridium perfringens Klebsiella strains, Anaerobic streptococci Escherichia coli, Proteus species, Bacteroides fragilis, Neisseria meningitides, Yersinia pestis [3]

In Sub-Saharan Africa, data on IBI and malaria co-infection among pregnant mothers is indeed scarce except data on Malaria and Bacteraemia that is independently available among pregnant mothers. The pooled prevalence of malaria among pregnant women in various regions show variation in a study by Chico *et al.,* peripheral malaria 32.0%, and placental malaria 25.8% in East and Southern Africa also peripheral

malaria 38.2% and placental malaria 39.9% in West and Central Africa[4].

Malaria affects mainly young pregnant mothers. In area with a high endemicity, occupants tend to acquire high immunity with age against P. falciparum and it is usually asymptomatic in pregnancy, though the parasite may be present in the placenta and contribute to maternal anaemia [5], this was evidenced from a study by Namusoke *et al.,* at Mulago National referral hospital, Uganda where a prevalence of 9% and 13.9% using peripheral smear and placental histology respectively was obtained and anaemia was the major significant factor[6].

Invasive bacterial infections have not been documented among pregnant women in Uganda.

II. Materials and Methods

a) Study design

A cross-sectional study design involving a retrospective review of records was carried out. This study was conducted between the months of June and July 2018 among pregnant women who attended KIU-TH for antenatal services between February 2014 to February 2018.

b) Study area

Kampala International University Teaching Hospital is located in Ishaka town which is a municipality in Bushenyi District. Ishaka is found approximately 62 kilometers west of Mbarara town. Ishaka has a population of 16,646 where females are 8,840 (UBOS, 2014). Kampala International University Teaching Hospital has a bed capacity of 700, providing both out-patient and in-patient services. The catchment areas of Kampala International Teaching Hospital include Bushenyi, Sheema, Rubirizi, Mitooma and other neighboring districts of Western Uganda. The study was conducted in the records office of ante-natal clinic of KIU-TH.

c) Study population

Inclusion criteria: All records of adult pregnant women [from Bushenyi and neighboring districts; and who have stayed in this area for more than 2 years] and who attended KIU-TH for antenatal services from February 2014 to February 2018. Records with missing CBC results as well as results were excluded from the study.

d) Sample Size and Sampling Method

Consecutive enrolment of patients was carried out, that is, file by file of records was sampled consecutively. Sample size was determined using Daniel's formula.

e) Data Collection

Socio-demographic factors and laboratory data were obtained from patients' file. Complete Blood Count (CBC) records were used to determine whether an individual was invasively infected with bacteria. An individual was considered to have IBI when they had highly elevated neutrophil count (neutrophilia)[3]. A patient was considered malaria positive when they had their Rapid Diagnostic Test (RDT) positive and positive peripheral thick smear. At Kampala International teaching Hospital laboratory, microscopic examination of thick blood smears for malaria parasite was used as a gold standard and a confirmatory test for malarial infection. All preparations and testing were done following the Uganda Ministry of Health standard operating procedures[7].

f) Statistical analysis

Collected data were extracted from patient files onto data check lists and then entered into excel version 2010. Data was then exported and analyzed using STATA 14.2 (Statacorp 4905 Lakeway Drive, College station Texas 77,845 USA) to obtain the prevalence as frequencies and percentage and we constructed respective 95% confidence interval (95% CI). Crude binary and adjusted logistic regression were used to assess the association between malaria, IBI and co-infection (outcomes) and associated factors (predictors). Measures of association, that is; crude odds ratios (cOR) and adjusted odds ratios (aOR) were reported with their respective 95%CI and p-value. Those factors whose p-value $\leq$ 0.05 were considered statistically significant.

g) Ethical clearance

The fact that the study involved secondary data waiver of consent was sought from the two ethical committees, that is, School of Public Health, College Health Sciences, Makerere University and Research Ethics Committee of Kampala International University-Western Campus in order to conduct research.

III. Results And Discussion

a) Socio-demographic characteristics of pregnant women who participated in the study

Table 1: A total of 367 pregnant women were enrolled. A greater number of pregnant mothers were aged between 21-24 years, 31.3% and with majority being peasants, 60%. About 57%of the mothers had attained secondary school education. Most of these mothers were married 77.1%. Participants belonging to Banyankoletribe were the majority 51% as well as Catholics, 34.9%. About 59% of mothers were multiparous.

Table 1: Showing frequency of socio-demographic characteristics of participants attending antenatal care at KIU-TH, in Ishaka-Bushenyi district.

Variable	Frequency	percentage
Age in yrs		
16-20	80	21.8
21-24	115	31.3
25-29	98	26.7
30-34	55	15.0
>35	19	5.2
Education		
primary	96	37.6
secondary	210	57.2
tertiary	61	5.2
Occupation		
Trader	20	5.4
Teacher	34	9.2
Peasant	220	60.0
other	93	35.0
Tribe		
Banyankole	187	51.0
Baganda	39	10.6
Bakiga	88	24.0
other	53	14.4
Religion		
Catholic	128	34.9
Protestant	103	28.1
Muslim	91	24.8
SDA	45	12.2
Marital status		
Married	283	77.1
Not married	84	22.9
Gravidity		
Prime gravida	152	41.4
multigravida	215	58.6

b) *Prevalence of invasive bacterial infection, malaria and co-infection among pregnantattending antenatal care at KIU-TH, Western Uganda*

Table 2 Of the 367 participants enrolled into the study, 97 (26%) had co-infection of malaria and invasive bacterial infection. About 69% had malaria infection and 57% of the mothers had invasive bacterial infection.

Table 2: Prevalence of invasive bacterial infection and malaria among pregnant women attending antenatal care at KIU-TH, Ishaka-Bushenyi district, Western Uganda

Variable	Frequency	Percentage	95%CI
Confection			
Yes	97	26.4	22.1-31.2
No	270	73.6	68.8-77.9
Malaria infection			
Yes	255	69.4	64.4-74.0
No	112	30.6	26.0-35.5
Invasive bacterial infection			
Yes	209	57.0	51.9-62.0
No	158	43.0	38.0-48.1

c) *Bivariate analysis of factors that influence invasive bacterial and malaria co-infection among pregnant mothers attending KIU-TH, Western Uganda*

Table 3: Pregnant mothers aged over 28 years were 3 times more likely to have malaria and invasive bacterial infection(IBI) compared to those aged 18-21 years, (cOR=3.07, 95% CI1.56-6.03) and also those aged 21–28 years were almost as twice as likely to have IBI-malaria co-infection as adult mothers aged less than 22 years (cOR=1.84, 95%CI0.99-3.43).

Participants with previous history of Blood transfusion were 2 times more likely to have malaria and invasive bacterial infection compared to those who were not previously transfused, (cOR=1.80, 95%CI1.07-3.02). Mothers who belonged to Baganda ethnic group were 77% less likely to have malaria and invasive bacterial infection compared to their counterparts that belonged to Banyankole ethnic group (cOR=0.23, 95%CI0.08-0.68). Individuals who had completed tertiary level of education were 55% less likely to experience malaria and invasive bacterial infection compared to those who had completed primary level of education (cOR=0.45, 95%CI0.20-1.0). Additionally, mothers who attended full antenatal care (n=4 visits) were 26% less likely to have malaria and invasive bacterial infection compared to those who never attended full ANC (n<4 visits), (cOR=0.74, 95%CI0.29-1.89), likewise also those who were married, were less likely to have IBI-malaria co-infection as compared to unmarried mothers, (cOR=0.9395% CI 0.53-1.62).

Table 3: Bivariate and Multivariate analysis of factors affecting invasive bacterial and malaria co infection among pregnant mothers attending KIU TH

	Co-infection							
Variable n (%)	No=267	Yes=95	Bivariate analysis			Multiple analysis		
Age in years			cOR	95%CI	p-value	aOR	95%CI	p-value
18-21	87(83.6)	17(16.4)	1.00			1.00		
22-28	125(73.5)	45(26.5)	1.84	0.99-3.43	0.05	0.72	0.40-1.29	0.27
>28	55(62.5)	33(37.5)	3.07	1.56-6.03	0.001	0.44	0.21-0.92	0.03
Blood transfusion								
No	211(76.5)	65(23.5)	1.00			1.00		
Yes	56(64.4)	31(35.6)	1.80	1.07-3.02	0.03	1.65	0.96-2.84	0.07
Tribe								
Munyankole	124(67.0)	61(33.0)	1.00			1.00		
Muganda	35(89.7)	4(10.3)	0.23	0.08-0.68	0.008	0.33	0.11-1.02	0.05
Mukiga	63(72.4)	24(27.6)	0.77	0.44-1.36	0.37	0.93	0.51-1.69	0.81
Other	45(86.5)	7(13.5)	0.32	0.13-0.74	0.008	0.34	0.13-0.84	0.02
Toilet use								
No	7(58.3)	5(41.7)	1.00					
Yes	260(74.1)	91(25.9)	0.49	0.15-1.58	0.23			
Education								
Primary	65(69.2)	29(30.8)	1.00			1.00		
Secondary	152(72.7)	57(27.3)	0.84	0.49-1.43	0.52	1.12	0.63-1.97	0.70
Tertiary	50(83.5)	10(16.7)	0.45	0.20-1.00	0.05	0.69	0.29-1.62	0.39
Full Antenatal care visits								
No (n<4 visits)	245(73.1)	90(26.9)	1.00					
Yes (n=4 visits)	22(78.6)	6(21.4)	0.74	0.29-1.89	0.53			
Marital status								
Un married	205(73.2)	75(26.8)	1.00					
Married	62(74.7)	21(25.3)	0.93	0.53-1.62	0.79			
Occupation								
Trader	14(70.0)	6(30)	1.00					
Teacher	26(78.8)	7(21.2)	0.63	0.18-2.24	0.47			
Peasant	160(73.1)	59(26.9)	0.86	0.32-2.34	0.77			
Other	67(73.6)	24(26.4)	0.84	0.29-2.42	0.74			
Smoking & alcohol								
No	175(71.7)	69(28.3)	1.00					
Yes	92(77.3)	27(22.7)	0.74	0.45-1.24	0.26			

d) *Multivariate analysis for factors that influence invasive bacterial and malaria co-infection among pregnant mothers attending KIU-TH*

Table 3: After multivariate analysis, participants aged over 28 years were 56% less likely to have malaria and invasive bacterial infection compared to adult mothers aged less than 22 years, (aOR=0.44, 95% CI0.21-0.92). Mothers belonging to Baganda ethnic group were 67% less likely to have malaria and invasive bacterial infection compared to those of Banyankole origin, (aOR=0.33, 95%CI0.13-0.84). Participants who had previous history of blood transfusion were about 2 times more likely to have malaria and invasive bacterial co-infection compared to those who were not previously transfused (aOR=1.65, 95%CI0.96-2.84). Mothers with tertiary education where less likely to be co-infected compared to those with primary education (aOR=0.69, 95%CI0.29-1.62), however, the association was not statistically significant.

IV. Discussion

Several studies in literature have investigated the burden of malaria and invasive bacterial infection in children living in Sub-saharan Africa with no study reporting the same in pregnant women[8]. In our study, the prevalence of IBI-malaria co-infection was 26.4%. This is much higher than IBI-malaria co-infection in Sub-saharan African children [9]. There are no comparable literature concerning IBI-malaria co-infection among pregnant women in Uganda. In many studies Malaria has been responsible for Invasive Bacterial infection. During malaria illness, lysis of red blood cells is possible and Iron released may act as nutrients for bacteria [10-12].

We used Complete Blood Count (CBC) neutrophilia picture to predict invasive bacterial infection since limited records for blood cultures were available which were for the study period set for this study. During bacteriaemia, there is usually neutrophilia with left shift[3]. However other causes that can led to increase neutrophils including viral infections, all kinds of stress,pregnancy, Connective tissue diseases, tissue necrosis, acidosis of various etiologies, (e.g., nephrogenic diabetes insipidus),medications[13]. Hence these may account for the high prevance obtained in this study.

The prevalence of malaria in our study was high, 69.4%. Malaria burden in this area could be due to much vegetation cover that facilitate mosquito breeding[14]. Our findings about malaria burden are higher than those obtained among pregnant women in Mulago national referral hospital Kampala[6]. The discrepancy is due to several factors including poorer coverage on insecticide mosquito treated Mosquito nets as well as health education regarding malaria prevention[15].

The prevalence of Invasive Bacterial infection among pregnant women was 57%. This is could be attributed to poor hygiene practices in semi-urban setting. The elevated IBI reported could be an over estimation since classifying IBI was based on raised neutrophils in Blood under febrile conditions, neutrophils may not be necessarily due to Bacteremia [16, 17]. As envisaged, this study area is endemic with malaria that contributes to Invasive Bacterial Infection through several mechanisms such as increase in the permeability of the gut [18]. This enables the breakdown of the gut-blood barrier providing a way for invasion by bacteria. Also sequestration of the Parasite has been demonstrated in the intestines of patients suffering fatal cerebral malaria [19].

In our study, several factors were found to be associated with Malaria-Invasive bacterial infection among pregnant mothers in Kampala International University-Teaching Hospital.

In this study, it was found that pregnant women with tertiary level of education were less likely to have IBI-malaria co-infection as compared to those with primary education. This is can be explained by insufficient knowledge, low income and economic status of primary education holders and hence cannot afford timely medical care. Lack of timely medical care often complicates bacterial infection to invasive stages [15, 19, 20].

Mothers aged 18-21years were more likely to contract Malaria-Invasive bacterial co-infections as compared to mothers aged 28 years and above. This may have been attributed to low knowledge and laxity of young mothers concerning hygiene and other preventive methods of bacterial and malaria infections. Young mothers in this setting tend to go night clubbing with their non-pregnant peers and eventually get mosquito bites. Also, most young mothers of this age group in Bushenyi-Ishaka have no official husbands that could support them financially and so do indulge in hard and unhygienic activities that have potential of predisposing them to Malaria and bacterial infections simultaneously.

Pregnant mothers with previous history of blood transfusion were more likely to experience IBI-Malaria co-infection compared to those that had not had previous history of IBI-malaria co-infection. In the study setting, malnutrition is on a higher tide among pregnant women and anemia is not uncommon in the pregnant mothers that in most cases calls for blood transfusion. Transfused patients in this area may not recover well from anemia since house hold food basket is constant. Persistent anemia facilitates lowered immunity and hence capable of propagating Malaria-IBI co-infection [21].

Also mothers who attended all the antenatal care visits throughout the period of pregnancy were less likely to get IBI-malaria co-infection compared to those who attended less than the minimum recommended

(i.e less than 4 visits). During these antenatal visits, patients receive health services such IpT and health education regarding prevention methods about malaria and bacterial diseases during pregnancy[4].

Furthermore, our study that shows that the co-infection was associated with tribes/ethnicity. Baganda are less likely to be diagnosed with Malaria-IBI infection as compared to Banyankole tribe. Baganda migrate from central Uganda to Bushenyi (study area) to conduct business and so majority of them stay in towns not surrounded by potential breeding places for mosquito. Most Banyankole women stay in remote villages where mosquito bites are not uncommon.

V. Weaknesses and Strengths

Being secondary data, critically important variables like result for culture and sensitivity were absent, no data on clinical signs and symptoms were obtained. Also, a number of socio-demographic factors and clinical factors such as hemoglobin level were not obtained. This limited, comprehensiveness of our work. However, variables that we so far analyzed are potential of providing findings that can guide clinical approaches and can simultaneously provoke further research.

Additionally, we did not achieve sample size calculated due to limited study records. However, this sample size is moderately sufficient for the few variables (inherent with secondary data studies) and so internal validity is likely [22]. Our work, though does not consist culture and sensitivity, is the first of its kind to be done in South Western Uganda and is consistent with treatment approaches of fevers other than Malaria in our resources constrained health setting.

VI. Conclusions

The prevalence of invasive Bacterial and malaria co-infection among pregnant women attending Kampala International University Teaching Hospital of peri-urban Western Uganda is high. Education level, previous history of blood transfusion and being of Munyankole tribe were potential predictors of Invasive Bacteria-Malaria co-infection.

There is a need for Uganda ministry of health to train antenatal health care providers about awareness and management of IBI-Malaria among pregnant women in Uganda especially those from rural areas where there is possibility of malaria endemicity. Also there is need to equip peripheral health facilities with laboratories that can carry out culture and sensitivity tests for the diagnosis of Invasive bacterial infections.

There is need to sensitise communities about the issue of IBI-Malaria co-infection especially among the mothers with primary level education and lower concerning possible prevention strategies of IBI-Malaria co-infection.

Further studies are recommended using more specific and more sensitive techniques such as culture and sensitivity in identification of the IBI inabnormally raised neutrophils in pregnant women.

Data Availability

Data used to support these findings are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding publication of this article.

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