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Factors Associated With Malaria, Intestinal Helminths, And Their Coinfection Among Pregnant Women Attending ANC In Kanduyi Sub-County, Kenya

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Abstract: ***Malaria and intestinal helminths are the most prevalent parasite diseases among children under five and pregnant women in impoverished countries, especially in Sub-Saharan Africa (SSA). They can induce anemia in pregnant women, and this can have significant repercussions for the kid as well. When malaria and intestinal helminth infections coexist, the symptoms and pathology might be more severe. The study adopted mixed methods for data collection and 423 pregnant women were interviewed and data analyzed using SPSS version 26. Bivariate analysis was conducted to examine possible associations between predictor variables and independent variables. This was done using Pearson's Chi Square. Association was considered significant when p-value is less than 0.05. Results indicated that Age (p=0.012), marital status (p=0.014), use of insect treated mosquito nets or repellents (p=0.033) and malaria chemoprophylaxis (p=0.0001) were significantly associated with malaria infection. Hand washing before meals (p=0.041) was significantly associated with intestinal helminths infection. Age (p=0.019), education level (p=0.017), hand washing before meals (p=0.031) and malaria chemoprophylaxis (p=0.0001) were significantly associated with coinfection. Malaria infection (p=0.015), intestinal helminths (p=0.039), and their coinfections (p=0.022) were significantly associated with anemia severity. In conclusion, the prevalence of anemia was high among pregnant women. The prevalence of malaria, intestinal helminths infection, and their coinfections was low. Malaria chemoprophylaxis, use of insect treated mosquito nets, and hand washing before meals was associated with malaria, intestinal helminth, and their coinfection.***

Keywords: ***Malaria, Intestinal helminths, Antenatal clinic, pregnant women, Anaemia, coinfections***

I. INTRODUCTION

Malaria and intestinal helminths infections are the most prevalent parasitic infections in developing countries, especially in Sub-Saharan Africa (SSA) affecting children under five years and pregnant women [1]. Heavy rainfall, stagnant waters, hot climate, and poor sanitation in the tropical and subtropical regions provide a good environment for the parasite to mature and continue breeding [2]. Infections with malaria and intestinal helminths are associated with anemia which can lead to maternal and perinatal complications [3]. In 2015, WHO estimated that globally approximately 32.4 million pregnant women are anemic with SSA having the highest prevalence of anemia at 57% [4]. In Kenya, the prevalence of anemia among pregnant women is 41.6% [5]. Malaria and intestinal helminths co-infection may have

considerable health effects leading to more severe clinical symptoms and pathology than infection with single parasite species. A study by Wekesa et al., (2018) in western Kenya noted expectant mothers who were coinfected with geohelminths and malaria were more likely to have low hemoglobin level (anemia) and microcytic hypochromic red blood cells compared to those who had geohelminths or malaria alone. Anemia during pregnancy is associated with maternal negative health effects such as fatigue, poor work capacity, impaired immune function, increased risk of cardiac diseases, and mortality [7], [8]. Perinatal complication includes fetal growth retardation, preterm birth, low birth weight babies, low APGAR score at 5minutes, impaired lactation, poor maternal and infant interaction behavior which are the leading causes of fetal and neonatal mortality in developing countries [9], [10].

Epidemiological data on the association of malaria and intestinal helminths coinfection and anemia severity among pregnant women living in an endemic area is missing. Most of the studies have focused on prevalence and risk factors associated with anemia, malaria, intestinal helminths, and their coinfections [6], [11], [12]. This study will therefore provide detailed information on the prevalence of malaria and intestinal helminths coinfection and their association with anemia severity among pregnant women.

II. RESEARCH PROBLEM

Kanduyi Sub- County is situated in Bungoma County which is a malaria-endemic zone with perennial malaria outbreaks. It has a tropical climate which is characterized by hot and humid conditions and two rainy seasons. Heavy rainfall and stagnant waters, hot climate, and poor sanitation provide a good environment for malaria and helminths parasites to mature and continue breeding. Kanduyi Sub-County has the highest prevalence of anemia with 50% of pregnant women attending ANC having low hemoglobin level (Hb<11g/dl). This is higher than 41.6% reported by the Kenya Demographic and Health Report [5]. Although pregnant women attending the ANC are routinely put-on iron supplementation in their first and second trimester through the third trimester, the prevalence of anemia remains high in the Kanduyi Sub-County.

The interaction between malaria and intestinal helminths confection among pregnant women present is poorly understood thus, it is not clear if malaria and intestinal helminths coinfection influence the prevalence and severity of anemia during pregnancy. To address this issue, this study will fill the knowledge gap by investigating malaria and intestinal helminths coinfection and anemia severity among pregnant women attending ANC in Kanduyi Sub-County.

III. METHODS

The research was carried out at Kanduyi Sub-County in Bungoma County. The study focused on all pregnant women attending ANC in selected governmental health facilities. Bungoma County is situated in a malaria-endemic zone with perennial malaria outbreaks. It has an estimated human population of 1,670,570 and an area of 2,206.9km squared. The study adopted a descriptive cross-sectional study that adopted both quantitative method (use interviewer administered questionnaire) and qualitative method (use of a key informant interview guide and FGDs). The study adopted a multistage sampling technique to select pregnant women. First, Bungoma level 5 County Referral hospital and Mechimeru health center were purposively selected in the Sub- County. Bukembe, Bulondo, Ekitela and Mayanja dispensaries were randomly selected out of twelve dispensaries in the Sub-County. Systematic sampling was used to selected the study subjects. First, started by calculating the sample interval (number of registered pregnant women in health facility divided by number of sample size required). First sample was randomly selected, then repeatedly using sampling interval the other samples were selected. Stool and blood samples were used to investigate the prevalence of malaria and helminths infections among pregnant women. The collected blood samples were also used to check the hemoglobin level to investigate maternal anemia. Peripheral blood film was done to differentiate the anemia from infections and nutritional anemia. Pearson Product Moment Correlation Co-efficient was used to establish reliability. Correlation coefficient of 0.75 was considered adequate to judge reliability of the instruments. The completed questionnaires were checked daily to ensure each question had been filled out correctly and that there is no gap. The questionnaires were numbered and coded for ease of handling. Quantitative data was coded and processed using SPSS version 25.0.

IV. RESULTS

A. SOCIO-DEMOGRAPHIC FACTORS ASSOCIATED WITH MALARIA INFECTION

Across different sociodemographic factors, age (χ^2=12.915; df=4; p=0.012) and marital status (χ^2=6.063; df=1; p=0.014) were significantly associated with malaria infection while the rest of the sociodemographic factors were not associated with malaria infection.

		Malaria infection		
		Yes n (%)	**No n (%)**	**Statistics**
Age	15-19 years	20(13.3)	53(19.4)	**χ^2 =12.915; df 3; p=0.012**
	20-24 years	60(40.0)	107(39.2)	
	25-29 years	41(27.3)	68(24.9)	
	≥30 years	29(19.4)	45(16.5)	
Marital status	Single	22(14.7)	68(24.9)	**χ^2 =6.063; df 1; p=0.014**
	Married	128(85.3)	205(75.1)	
Residence	Urban	68(45.3)	132(48.4)	χ^2 =0.354; df 1; p=0.552
	Rural	82(54.7)	141(51.6)	

Level of education	Primary	42(28.0)	84(30.8)	χ^2 =9.930; df 2; p=0.007
	Secondary	68(45.3)	150(54.9)	
	Tertiary	40(26.7)	39(14.3)	
Employment	Unemployed	77(51.3)	139(50.9)	χ^2 =0.007; df 1; p=0.934
	Employed	73(48.7)	134(49.1)	

Table 1: Socio-demographic factors associated with malaria infection

B. RISKS FACTORS ASSOCIATED WITH MALARIA INFECTION

Two hundred and thirty-eight (87.2%) pregnant women who used mosquito nets or repellant had no malaria infection. Two hundred and forty-three (89.0%) pregnant women who received malaria chemoprophylaxis had no malaria infection. Across different risk factors that were studied, all variables were significantly associated with malaria infection.

		Malaria infection Yes n (%)	No n (%)	Statistics
Use mosquitoes net or repellent	Yes	119(79.3)	238(87.2)	**χ^2 =4.526; df 1; p=0.033**
	No	31(20.7)	35(12.8)	
Malaria chemoprophylaxis	Yes	77(51.3)	243(89.0)	**χ^2 =74.606; df 1; p=0.0001**
	No	73(48.7)	30(11.0)	

Table 2: Risk factors associated with malaria infection among pregnant women

C. SOCIO-DEMOGRAPHIC FACTORS ASSOCIATED WITH INTESTINAL HELMINTHS INFECTION

Forty-seven (47.0%) pregnant women who aged 20-24 years had intestinal helminths infection. Seventy-six (76.0%) pregnant women who had intestinal helminths infection were married. Fifty-two (52.0%) pregnant women who had intestinal helminths infection were from rural area. Forty-eight (48.0%) pregnant women who had intestinal helminths infection had attained secondary school education. Fifty-two (52.0%) pregnant women were employed and had intestinal helminth infection. Across different sociodemographic factors that were studied, none of the variables were found to be associated with intestinal helminths infection.

		Intestinal helminths infection Yes n (%)	No n (%)	Statistic
Age group	15-19 years	18(18.0)	50(17.9)	χ^2 =4.283; df 3; p=0.232
	20–24 years	47(47.0)	103(36.9)	
	25–29 years	23(23.0)	73(26.2)	
	≥ 30 years	12(12.0)	53(19.0)	
Marital status	Single	24(24.0)	57(20.4)	χ^2 =0.558; df 1; p=0.455
	Married	76(76.0)	222(79.6)	
Residence	Urban	48(48.0)	131(47.0)	χ^2 =0.032; df 1; p=0.857
	Rural	52(52.0)	148(53.0)	
Level of education	Primary	26(26.0)	92(33.0)	χ^2 =5.476; df 2; p=0.065
	Secondary	48(48.0)	143(51.3)	
	Tertiary	26(26.0)	44(15.8)	
Employment	Unemployed	48(48.0)	144(51.6)	χ^2 =0.384; df 1; p=0.535
	Employed	52(52.0)	135(48.4)	

Table 3: Socio-demographic factors associated with intestinal helminths infection

D. RISK FACTORS ASSOCIATED WITH INTESTINAL HELMINTHS INFECTION

Two hundred and twenty-three (79.7%) pregnant women who did not a habit of biting their nails had no intestinal helminths infection. Thirty-seven (37.0%) pregnant women who had intestinal helminths used tap water for drinking. Seventy (70.0%) pregnant women who had intestinal helminths infection did not use any water preservation method. Across different risk factors studied, hand washing before meals (χ^2=5.974; df=1; p=0.015) was significantly associated with intestinal helminths infection while the rest of the risk factors were not associated with intestinal helminths infection.

		Intestinal helminths infection Yes n (%)	No n (%)	Statistic
Hand washing before meals	Yes	94(94.0)	241(86.4)	**χ^2 =4.165; df 1; p=0.041**
	No	6(6.0)	38(13.6)	
Hand washing after visiting toilet	Yes	93(93.0)	265(95.0)	χ^2 =0.553; df 1; p=0.457
	No	7(7.0)	14(5.0)	
Eating raw/unwashed vegetables	Yes	15(15.0)	53(19.0)	χ^2 =0.799; df 1; p=0.372
	No	85(85.0)	226(81.0)	
Eating soil/rocks	Yes	32(32.0)	98(35.1)	χ^2 =0.319; df 1; p=0.572
	No	68(68.0)	181(64.9)	
Biting of nails	Yes	23(23.0)	56(20.1)	χ^2 =0.383; df 1; p=0.536
	No	77(77.0)	223(79.9)	
Source of drinking water	Bore hole	17(17.0)	34(12.2)	χ^2 =2.226; df 3; p=0.527
	River	31(31.0)	79(28.3)	
	Tap water	37(37.0)	121(43.4)	
	Well	15(15.0)	45(16.1)	
Water preservation methods	Boiling	5(5.0)	15(5.4)	χ^2 =0.032; df 2; p=0.984
	None	70(70.0)	196(70.3)	
	Use of Chlorine	25(25.0)	68(24.4)	

Table 4: Risk factors associated with intestinal helminths infection

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E. SOCIO-DEMOGRAPHIC FACTORS ASSOCIATED WITH MALARIA AND INTESTINAL HELMINTHS COINFECTION

One hundred and five (50.5%) pregnant women were employed and had malaria and intestinal helminth coinfection. Across different sociodemographic factors, age (χ^2=11.784; df=4; p=0.019) and education level (χ^2=8.161; df=2; p=0.017) were significantly associated with malaria and intestinal helminths coinfection while the rest of the sociodemographic factors were not associated with malaria and intestinal helminths coinfection.

		Malaria and intestinal helminths coinfection		Statistics
		Yes n (%)	No n (%)	
Age	15-19 years	31(14.9)	42(19.5)	**χ^2 =11.784; df 3; p=0.019**
	20-24 years	89(42.8)	78(36.3)	
	25-29 years	53(25.5)	56(26.0)	
	≥30 years	35(16.9)	39(18.2)	
Marital status	Single	39(18.8)	51(23.7)	χ^2 =1.560; df 1; p=0.212
	Married	169(81.3)	164(76.3)	
Residence	Urban	96(46.2)	104(48.4)	χ^2 =0.209; df 1; p=0.648
	Rural	112(53.8)	111(51.6)	
Level of education	Primary	55(26.4)	71(33.0)	**χ^2 =8.161; df 2; p=0.017**
	Secondary	103(49.5)	115(53.5)	
	Tertiary	50(24.0)	29(13.5)	
Employment	Unemployed	103(49.5)	113(52.6%)	χ^2 =0.391; df 1; p=0.532
	Employed	105(50.5)	102(47.4)	

Table 5: Socio-demographic factors associated with malaria and intestinal helminths coinfection

F. RISK FACTORS ASSOCIATED WITH MALARIA AND INTESTINAL HELMINTHS COINFECTION

One hundred and ninety-seven (91.6%) pregnant women who had received malaria chemoprophylaxis had no malaria and intestinal helminths coinfection. Across different risk factors studied, hand washing before meals (χ^2=4.678; df=1; p=0.031) and malaria chemoprophylaxis (χ^2=60.596; df=1; p=0.0001) were significantly associated with malaria and intestinal helminths coinfection while the rest of the risk factors were not associated with malaria and intestinal helminths coinfection.

		Malaria and intestinal helminths coinfection		Statistics
		Yes n (%)	No n (%)	
Hand washing before meals	Yes	188(90.4)	179(83.3)	**χ^2 =4.678; df 1; p=0.031**
	No	20(9.5)	36(16.7)	
Hand washing after visiting toilet	Yes	199(95.7)	204(94.9)	χ^2 =0.146; df 1; p=0.702
	No	9(4.3)	11(5.1)	
Eating raw and unwashed vegetables	Yes	40(19.2)	35(16.3)	χ^2 =0.631; df 1; p=0.427
	No	168(80.8)	180(83.7)	
Eating soil/rocks	Yes	71(34.1)	73(34.0)	χ^2 =0.002; df 1; p=0.969
	No	137(65.9)	142(66.0)	
Biting of nails	Yes	41(19.7)	43(20.0)	χ^2 =0.006; df 1; p=0.941
	No	167(80.3)	172(80.0)	
Source of drinking water	Borehole	33(15.9)	25(11.6)	χ^2 =2.522; df 3; p=0.471
	River	63(30.3)	62(28.8)	
	Tap water	84(40.4)	91(42.3)	
	Well	28(13.5)	37(17.2)	
Water preservation methods	Boiling	11(5.3)	13(6.0)	χ^2 =0.183; df 2; p=0.913
	None	144(69.2)	150(69.8)	
	Use of Chlorine	52(25.5)	52(24.2)	
Use insect treated mosquitoes net or repellent	Yes	171(82.2)	186(84.5)	χ^2 =1.485; df 1; p=0.223
	No	37(17.8)	29(13.5)	
Malaria chemoprophylaxis	Yes	123(59.1)	197(91.6)	**χ^2 =60.596; df 1; p=0.0001**
	No	85(40.9)	18(8.4)	

Table 6: Risk factors associated with malaria and intestinal helminths coinfection

V. DISCUSSION

Infection with intestinal helminths is attributed to contamination of soil and water with cysts, ova and larvae, poor person hygiene and poor sanitation. The ova of intestinal helminths are transmitted by ingesting contaminated fingers, food, water or soil/rocks. From the study, the prevalence of intestinal helminths infection was 26.4%. The low prevalence can be attributed to good personal hygiene such as washing hands, use of latrines/toilets for human waste disposal and environmental sanitation. The prevalence was lower than findings of studies in Ethiopia (51%) and Nepal (33.1%) but slightly higher than findings of studies in Nigeria (12.0%) and Western Kenya 24.7%) [6], [12]–[14]. The difference in prevalence of intestinal helminths can be attributed to the fact that different communities are exposed to different parasitic infection and also the soil type in different counties. Age was not significantly associated with intestinal helminths infection among pregnant women. This agrees with findings of studies in Coastal, Kenya, Nigeria and Ethiopia which noted the age was not significantly associated with geohelminth infection [13], [15], [16]. On contrary, findings of studies in Ghana and Northern Rift Valley, Kenya noted age was significantly associated with geohelminth infection [12], [17].

Source of drinking water such as wells and boreholes can be contaminated from poor human waste disposal or sewage and this can be a risk for transmission of intestinal helminths infection. This concurs with findings of a study in Coastal, Kenya which noted pregnant women who used water from wells and boreholes had higher risk of infection than women

who used tap water [15]. Pregnant women should be advised to treat their domestic water before using it as this will reduce intestinal helminths infection. Water preservation methods was not significantly associated with intestinal helminths infection among pregnant women. This agrees with findings of a study by Njeru et al., (2019) in Coastal, Kenya which noted water treatment methods were not significantly associated with geohelminth infection.

Coinfection with malaria and intestinal helminths may have considerable health effects leading to more severe clinical symptoms and pathology such as anemia than infection with single parasite species. From the study, the prevalence of malaria and intestinal helminths coinfection among pregnant women was 9.9%. This was lower than findings of studies in Nigeria but higher compared to findings of studies in western Kenya and Ethiopia which was 43.1%, 11.5%, 6.8% and 7.7%% respectively [6], [11], [18], [19]. The higher prevalence can be attributed to factors such as geographical region, climatic conditions and risks associated with transmission of the infection. In malaria endemic areas, malaria immunity will strongly develop. However, this can be affected by intestinal helminths coinfection. With helminth coinfection, malaria immunity will less develop hence the effects of intestinal helminth coinfection will be minimal when transmission intensity is low. Findings of a study conducted in Ethiopia noted helminths infection affected the epidemiology of clinical malaria [20].

Age was significantly associated with malaria and intestinal helminths coinfection among pregnant women. This agrees with findings from studies in Nigeria and Ghana which noted age was significantly association with malaria and intestinal helminths coinfection [12], [13]. On contrary, findings of studies in Nigeria and Ethiopia noted age was not significantly associated with malaria and intestinal helminths coinfection among pregnant women [18], [19].

VI. CONCLUSIONS

The study revealed that the prevalence of malaria, intestinal helminths and their coinfection was high despite measures that have been put in place by the government to reduce the infection. Malaria chemoprophylaxis, use of insect treated mosquito nets and hand washing before meals was associated with malaria, intestinal helminth infection and their coinfection. Malaria, intestinal helminths and their coinfection was found to be associated with anemia severity. These variables were significantly associated with ORS use. The study recommended that:

- ✓ Pregnant women attending to antenatal clinics should be screened for intestinal helminths infection through routine stool tests and offer appropriate treatment in case of infection.
- ✓ Provision of malaria chemoprophylaxis, insect treated mosquito nets and antihelminth therapy to protect pregnant women from malaria and intestinal helminths infection. Health education on good personal hygiene i.e., washing hands before and after visiting toilet. Prompt treatment of pregnant women who have malaria and intestinal helminths infection to prevent anemia.

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