Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol.6, No.14. 2016

Socio-Demographic Factors Associated with Malaria-Geohelminth Co-Infection and Syndemics in Pregnancy: A Cross Sectional Study of Pregnant Women Attending Ante Natal Care at Nandi Hills Sub County Hospital, Kenya

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1. Abstract

Aim: The study investigated the effect of different socio-demographic factors on malaria-geo-helminth co-infections in pregnant women attending Antenatal care at Nandi Hills Sub County Hospital.**Methodology**: study area lies within latitudes 0^0 and $0^0$34' North and Longitudes $34^0$45'' and $35^0$25'' East. Study design was a cross sectional study and the participants who consented were selected randomly and requested to fill an informed consent form. About 5 grams of stool sample Stool was collected by the participants and processed immediately at the hospital using formal- ether concentration technique. Participants donated capillary blood sample by a finger prick. Thick and thin blood smears were prepared and stained using Field Stains A and B. Semi structured questionnaires were developed and administered to obtain information regarding individual socio demographics. Chi-square test and Phi and Cramer's V test of strength of association were used to analyse the data. **Results**: parasite co-infection was recorded for *P. falciparum-A. lumbricoides* and *P. falciparum*-hookworm. There were no co-infections of *P. falciparum-T.trichiura* parasites or infection with more than two parasites. Factors that significantly ($P<.05$) affected parasite co-infection by chi-square analysis were being married, residing in own home in the rural, having a small family size and being a middle income earner for *P. falciparum*-hookworm co-infections. *P. falciparum-A. lumbricoides* co-infection was significant only with being married. Parasites association by Phi strength of association was negative for *P. falciparum-A. lumbricoides* co-infection except with being single(r^{φ}=.019) and residing in urban rental(r^{φ}=.084). *P. falciparum*-hookworm co-infection association was positive except with being single (r^{φ}=-.006) and staying in the estate camp (r^{φ}=-.097).**Conclusion**: socio-demographic factors that were considered impacted differently on parasite co-infection. Association of *P. falciparum* and geo-helminths became variable with different socio-demographic factors.
Keywords: malaria geo-helminths socio-demographics co-infection syndemics pregnancy

2. Introduction

Parasitic diseases pose a major obstacle to health, growth and socio-economic development in developing countries (Brooker, *et al.,* 2007). They are life threatening as well as leading cause of mortality in endemic countries more especially those at risk such as pregnant mothers (Rosenfield and Maine, 1985). There are still controversies concerning biological association between helminths and protozoa parasites. It has been estimated that over a third of world's population, mainly in the tropics and sub-tropics is co-infected with parasitic helminths and protozoa parasites (Snow *et al*., 2005). Helminth infection may alter susceptibility to clinical malaria or malaria may alter clinical consequences of helminth infections (Brooker *et al*., 2007).

Syndemics are an aggression of two or more diseases or afflictions in a population where there is a synergistic relationship which enhances and exacerbates the negative health effects of any or all of the diseases. Disease co-occurrence without any interaction is known as comorbidity or co-infection as opposed to syndemics whereby co-occurring diseases additively increases negative ill health (Singer, 2013).

According to Singer, (2013), malaria and helminths have been classified as infectious syndemics of pregnancy in Africa and that vulnerability to syndemics involves factors that put groups in harm's way for cluster of diseases and those factors that contribute to the weakening of bodies or the degrading of the immune capacities. Others are the failing of the social support systems and the disruptions or inaccessibility of health care services. Social encumbrances have direct impact not only on disease development and progression but on deleterious disease interaction as well.

Presence of helminths is usually associated with socio-economic confounders. Inhabitants of thousands of rural impoverished villages throughout the tropics and the subtropics are often chronically infected with several different species of parasitic worms. Adding to global morbidity that results from human helminth infections are the observations that they have both direct and indirect effects on malaria and HIV/AIDS in developing countries (Hotez *et al*., 2008).

There has been continued spread of malaria parasites among different groups of vulnerable individuals such as the pregnant women despite global efforts to eradicate the parasite. Overlapping distribution of malaria and geohelminth parasites lead to high rates of co-infection in developing tropical countries and they have a significant and additive problem against the host (Degarege *et al*., 2010).

According to Singer (2013), there is limited literature on helminth and malaria syndemics and that pregnant women in sub-Saharan Africa are an understudied group but are more vulnerable to infections because of suppression of immune system during pregnancy. While amplified vulnerability is recognized, epidemiological, biomedical and social sciences of health research about pregnant women have tended to be characterised by a single disease approach. This research is therefore geared towards examining the nature of the relationship(s) between malaria infection and geohelminth infection during pregnancy under varied socio-demographics of the pregnant women.

It has increasingly been speculated that helminth infections may alter susceptibility to clinical malaria (Nacher, 2001) and there is now increasing interest in investigating the consequences of this co-infection (LeHesran *et al*., 2004). This research therefore explored whether malaria and geohelminth co-infection were counter syndemics or whether they interacted to enhance or exacerbate ill health among pregnant women attending ante-natal care at Nandi-Hills Sub-County hospital considering their different socio-demographic factors.

This study therefore provides information which can be utilised in preventing malaria and geo-helminth infection outbreaks in highland areas which is greatly neglected by many researchers and there is no information available in this region on malaria and geohelminth parasites. It is therefore imperative to understand the syndemics of geo-helminth/malaria co-infections in the epidemic zones and come up with ways of preventing the infections.

3. Methodology

3.1. Study area

The study was carried out in Nandi Hills Sub-County Hospital in Nandi County. It lies within latitudes 0^0 and $0^034'$ North and Longitudes $34^045''$ and $35^025''$ East (District Development Plan, Nandi East, 2008-2012). The Sub County has a cool and moderately humid climate with an average rainfall of between 1200 mm to 2000 mm in a year. Most parts of the Sub County experience temperatures ranges between 18^0C and 22^0C during rainy seasons while high temperatures (23^0C) are recorded during the dry spell in the highlands. Access to economic resources is low for women owing to the traditional division of labour that places women at the household level for domestic chores. Common diseases within Nandi County are malaria, upper respiratory tract infection, skin diseases and diarrhea. Period with highest outpatient cases is March and October when the area experiences heavy rains (Nandi County-CIDP, 2013-2017).

3.2. Study design and sample size

The study was a cross sectional survey study of pregnant women attending ANC at Nandi Hills Sub-County hospital. Pregnant women were randomly selected by lottery method whereby specific numbers were written on small pieces of paper, folded into small sizes, placed in a hat then mixed thoroughly. Individuals who picked a number similar to that picked by the researcher formed the subjects of the study. The data was collected from April to December 2015 to obtain enough information that enabled drawing of inferences. Sample size was determined using Fisher's formula (Rosner, 1995); $N=\frac{Z^2p\ (100-p)}{d^2}$

Where; Z=1.96, d= any value between 5 and 10 and p value was based on the average malaria and geo-helminth infection prevalence in Nandi-Hills Sub-County hospital which was 20%. Sample size therefore was found to be 245 individuals but it was expanded to 300 individuals because according to Montresor *et al*., (1998), a larger sample is used, when research is to evaluate other parameters other than prevalence and intensity.

3.3. Sample collection

Each participant was provided with a labelled screw caped stool container and informed on how to collect about 5 grams of stool sample. Stool was processed immediately at the hospital using formal- ether concentration technique as described by Cheesbrough, (2006). Microscopic examination was done using X10 objective magnification after staining with 1% lugol's iodine and results recorded in terms of presence/absence of ova in stool.

Consenting participants donated capillary blood sample by a finger prick. The finger was cleansed with alcohol moistened swab then dried with a piece of cotton. It was then punctured with a disposable blood lancet. Thick and thin blood smears were prepared and stained using Field Stains A and B. Microscopic examination was done under oil immersion at x100 objective to identify parasite species following the method of Strickland *et al*., (2000). The results were recorded as either positive or negative. Haemoglobin concentration was determined by drawing blood into the cuvettes and tested using diaspect haemoglobin test machine and results were recorded as either hb≥11 or hb<11.

Semi structured questionnaires were developed and administered to obtain information regarding individual demographics and socio-economic status of the pregnant women. Each variable was coded and responses were accorded numerical values when recording the data in SPSS work sheet. Age was categorized into five numerical groups namely; 1 (16-20 years), 2 (21-25 years), 3 (26-30 years), 4 (31-35 years) and 5 (36-40 years). Marital status was coded as m.s and responses were numbered as 1(married), 2(single) 3(widowed) and 4(divorced). Categories in education were numbered as (1) primary, (2) secondary and (3) tertiary. Settlement area was categorized as (1) own home, (2) urban rental and (3) estate camp. Family size was coded as F. Size and categorized as (1) 0-2, (2) 3-5 and (3) >5. Income per month was determined by the occupation of the respondents for those who did not have formal employment and all the categories were recorded as (1) >ksh 20,000, (2) ksh 10,000-20,000 and (3) ksh<10,000.

3.4 Data analyses:

Data was recorded in a laboratory notebook and later transferred to excel spreadsheet**.** Data was processed using statistical package for social sciences (SPSS Version 16). For demographic data, descriptive statistics was used. Comparison of prevalence of geohelminthes and malaria co-infection between different variables was done using chi-square test. Synergistic and antagonistic relationships of parasites were determined using Phi and Cramer's V test of strength of association by mainly considering Phi (r^{φ}) value. The test was used to determine the strength of interaction of geohelminth and malaria parasites in consideration of socio-demographic factors.

4. Results

The study took place in Nandi-Hills sub county hospital where stool and blood samples were collected from 300 randomly selected pregnant women who gave oral and written consent to participate in the study. Questionnaires were administered to obtain socio-demographic information of the participants. Parasites detected in the pregnant were *Plasmodium falciparum*, *A. lumbricoides*, *Ancylostoma duodenale* and *Trichiuris trichiura*.

Table 1: socio-demographic characteristics affecting *P. falciparum*-geohelminth co-infection and their association

		P. falciparum-A. lumbricoides				*P. falciparum*-hookworm			
characteristics	n	present	absent	P value	r^{φ}	present	absent	P value	r^{φ}
Age (years)									
16-20	10	3(30%)	7(70%)	.805	-.033	3(30%)	7(70%)	.445	.101
21-25	5	0	5			2(40%)	3(40%)	**.048**	.183
26-30	6	0	6			2(33%)	4(67%)	.307	.116
31-35	2	0	2			0(0%)	2(100%	.581	-.098
>36	0	0	.			.	.	.	
Marital status									
Married	17	1(6%)	16(94%	**.028**	-.135	6(35%)	11(65%	**.016**	.148
single	6	2(33%)	4(67%)	.912	.019	1(17%)	5(83%)	.973	-.006
Education									
Primary	13	0(0%)	13(100	**.013**	-.181	3(23%)	10(77%	.338	.069
Secondary	9	3(33%)	6(67%)	.708	.041	4(44%)	5(56%)	.063	.205
tertiary	1	0(0%)	1(100)	.547	-.118	0(0%)	1(100%	.773	-.055
Settlement									
Own home	12	1(8%)	11(92%	.102	-.119	5(42%)	7(58%)	**.004**	.211
Urban rental	3	1(33%)	2(67%)	.552	.084	1(33%)	2(67%)	.241	.166
Estate camp	8	1(13%)	7(87%)	.095	-.213	1(13%)	7(87%)	.451	-.097
Family size									
0-2(small)	19	3(16%)	16(84%	.169	-.095	6(32%)	13(68%	**.024**	.156
3-5(medium)	3	0(0%)	3(100%	.234	-.133	1(33%)	2(67%)	.509	.074
>5(large)	1	0(0%)	1(100%	.598	-.167	0(0%)	1(100%	.725	-.111
Income per month			.						
>Ksh 20,000	0	0		.		.		.	.
Ksh10,000-20,000	3	0(0%)	3(100%	.117	-.211	3(100%	0(0%)	**.001**	.455
Ksh <10,000	20	3(15%)	17(85%	.254	-.075	4(20%)	16(80%	.450	.050

Values in bold are significant at 0.05; r^{φ}=Phi value; n=total by P. falciparum, present=within P. falciparum, absent=within P. falciparum; blanks= no co-infections recorded, hence no statistics computed.

4.1. Co-infection and syndemics in relation to age

Majority of the pregnant women were aged between 21-25 years (39%), those aged between 16-20 years, 26-30 years, 31-35 years and 36-40 years were 19%, 26%, 11% and 5% respectively.

Thirty percent (30%; 3 out of 10) of the individuals in the young age category of 16-20 years who were positive for *P. falciparum* were co-infected with *Ascaris lumbricoides*. None of the pregnant women in the subsequent age categories were co-infected with *P. falciparum* and A. *lumbricoides*. The proportion of those co-infected with *P. falciparum* and *A. lumbricoides* was not statistically significant (*P=.81;* Table 1).

Similarly, 30% of those in the young age category (16-20 years) were co-infected with *P. falciparum* and hookworm parasites. 40% in the 21-25 years category and 33.3% in the 26-30 years category had *P. falciparum* and hookworm co-infections. Co-infection of *P. falciparum* and hookworm in relation to age was not significant ($p>0.05$; Table 1). There were no *Plasmodium* parasites and *T. trichiura* co-infections in all age categories.

There was insignificant negative association between *P. falciparum* and *A. lumbricodes* co-infection in all the age categories. Co-infection of *P. falciparum* and hookworm had a positive association in the first three age categories and the kind of association among those aged 21-25 years was strong/significant ($r^{\varphi}=.18$; *P=.05*). The other age categories had insignificant positive association (Table 1).

4.2. Co-infection and syndemics in relation to marital status of the pregnant women

The young aged pregnant women who were singles/not married constituted 12% of the study participants, while 88%were married. There were no widows or divorcees among the subjects.

Among the 17 married pregnant women who were positive for *P. falciparum*, only 1 (5.7%) was co-infected with *A. lumbricoides* and the difference in co-infection proportions in this category was significant (*P=.03*). There was a significant negative association between *P. falciparum* and *A. lumbricoides* co-infection among the married pregnant women ($r^{\varphi}=-.135$). Out of the 6 pregnant women who were single and positive for *P. falciparum* 2 (33.3%) were co-infected with *A. lumbricoides* but the difference in co-infection proportion in this category was not significant (*P=.92*). There was insignificant positive association between *P. falciparum-A. lumbricoides* co-infection among the single pregnant women ($r^{\varphi}=.02$) (Table 1).

Out of the 17 malaria parasites positive married pregnant women, 6 (35.3%) were co-infected with hookworm and out of the 6 malaria parasites positive single pregnant women, only 1(16.7%) was co-infected with hookworm. Co-infection proportions between malaria parasites - hookworm and marital status of pregnant women was significant among the married (*P=.02*) and insignificant among the singles (*P=.97*). There was a significant positive association between malaria parasites-hookworm co-infection and being married ($r^{\varphi}=.15$), and an insignificant negative association between malaria parasites- hookworm co-infection and being single ($r^{\varphi}=-.10$) (Table 1).

4.3. Co-infection and syndemics in relation to education levels of the pregnant women

Most of the pregnant women had only primary education. Of the possible 300 individuals, 191 (64%) had primary education, 82 (27%) had secondary education while only 27 (9%) had tertiary education.

There was no co-infection of malaria parasites and *A. lumbricoides* among the pregnant women with primary education and among those with tertiary education. Out of the 9 who had malaria parasites in the secondary school category, 3 (33.3%) were co-infected with *A. lumbricoides* and this was statistically insignificant (*P=.71*). There was an insignificant positive association in malaria parasites-*A. lumbricoides* co-infection among those in secondary school category (Table 1).

Malaria parasites and hookworm co-infection proportions with regard to education levels of pregnant women was insignificant. Among the 13 participants infected with malaria parasites in the primary level category, 3 (23.1%; *P=.34*) were co-infected with hookworm whereas 4(44.4%; *P=.07*) was a co-infection of malaria parasites and hookworm among those in secondary level category. Association of malaria parasites-hookworm co-infection was in significantly positive among those who were in either primary or secondary education categories (r^{φ}= and r^{φ}=) (Table 1).

4.4. Co-infection and syndemics in relation to settlement areas

Study participants who resided in their homes from the villages around Nandi-Hills town such as Kipsigak, Kipkoror, Kipsebwo, Kosoiywa, and Chebarus were 63%, while 16.7% and 20.3% resided in urban rental and estate camps respectively.

Differences in *P. falciparum-A. lumbricoides* co-infections were insignificant in all the three settlement areas. Out of the 12 malaria parasites infected pregnant women who resided in their own homes, 1 (8.3%; *P=.10*) was a co-infection with *A. lumbricoides*, whereas 1 (33.3%; *P=.55*) of malaria parasite case among those in urban rental was a co-infection with *A. lumbricoides* and 1(12.5%; *P=.10*) of malaria parasite infection in estate camp was a co-infection with *A. lumbricoides* (Table 1).

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Malaria parasites infected pregnant women who were co-infected with hookworm among those who resided in their own homes was 5 (41.7%) and the difference in co-infection proportion in this category was significant (*P=.01*). There was insignificantly different proportions of malaria parasites-hookworm co-infections among those who resided in urban rental and estate camps (33.3%; *P=.24* and 12.5%; *p=.45* respectively) (Table 1).

Association between malaria parasites- *A. lumbricoides* co-infection in relation to settlement was insignificantly negative among those who resided in their own homes (r^{φ}=-.12) and estate camps (r^{φ}-.21). Association was insignificantly positive for malaria parasites-*A. lumbricoides* co-infection among those from urban rentals (r^{φ}=.08). Association between *P. falciparum* and hookworm co-infections was significantly positive (r^{φ}=.21) among those who resided in their own homes, insignificantly positive among the urban dwellers (r^{φ}=.17) and insignificantly negative among the estate camp dwellers (r^{φ}=-.10) (Table 1).

4.5. Co-infection and syndemics in relation to family size

Out of the 300 pregnant women, 210 (70%) had small family sizes, 27% had medium family size, while only 3% had large family size.

Out of the 19 *P. falciparum* infections in the small family size category, 3(15.8%) were co-infections with *A. lumbricoides*, while 6(31.6%) were co-infections with hookworm. Co-infection was not significant (*P=.17*) for malaria parasites-*A. lumbricoides* but it was significant for malaria parasites-hookworm in the small family size category (*P=.02*). There were no malaria parasites and *A. lumbricoides* in the other two family size categories. Malaria parasites-hookworm co-infection in the medium family size category was statistically insignificant at 33.3% (*P=.51*) (Table 1).

There was a negative association between malaria parasites and *A. lumbricoides* co-infection in all three categories of family size where no co-infections were recorded for the medium and large family size categories. Malaria parasites-hookworm co-infection association with small family size and medium family size was positive (r^{φ}=.16 and r^{φ}=.01 respectively), though co-infection in the latter was insignificant. In large family size, where Malaria parasites-hookworm co-infection was not recorded (Table 1).

4.6. Co-infection and syndemics in relation to income per month of the respondents

Most of the respondents were those who earned less than ksh 10,000 representing 76.7% while those who earned between ksh 10,000-20,000 and above ksh 20,000 were 18.3% and 5% respectively.

There were no co-infections for *P. falciparum* and *A. lumbricoides* in the high and middle income categories while 3 out of the 20 malaria parasite positive cases (15%) in the low income category were co-infected with *A. lumbricoides* but this was statistically insignificant (*P=.25*). There appeared an insignificant negative association between malaria and *A. lumbricoides* parasites in the low income category (r^{φ}=*-.07*) (Table 1).

There were no co-infections of malaria parasite-hookworm in the high income category while all the three malaria parasite positive cases (100%) in the middle income category were co-infected with hookworm and this was significant (*P=.00*). 4 out of 20 (20%) of malaria positive cases in the low income category were co-infections with hookworm but this was statistically insignificant (*P=.45*). There was a significant positive association between malaria parasite-hookworm co-infection in the middle income (r^{φ} = 0.46) group and an insignificant positive association (r^{φ} = 0.05) in the low income category (Table 1).

5. Discussion

Pregnant women aged 21-25 years were significantly co-infected with *P. falciparum* and *A. duodenale.* This age category is described in the Nandi County-CIDP (2013-2017) as a group with many diverse needs following their completion of secondary education, this could make them more vulnerable to parasitic co-infections Significant effect of age category 21-25 years on *P. falciparum -A. duodenale* co-infection, resulted in a significant positive association of the two parasites in relation to age as opposed to the weak association in the other age categories.

Marital status of the pregnant women resulted in a negative association between *P. falciparum* and *A. lumbricoides* co-infection. In the study area, a single pregnant woman is one who became pregnant without intention, and this group constitutes mainly the school dropouts who probably have no resources of taking good care of themselves during pregnancy exposing them to parasitic infections. Married pregnant women get more exposed to infective stages of *A. duodenale* as they work in farms, or they could be too busy with household chores and responsibilities to even get time for their own wellbeing. Women often acquire helminths in the process of growing family food (Wekesa *et al*., 2014). There was a weak negative association between *P. falciparum- A. duodenale* co-infection and the single group of pregnant women. This could suggest that those who were single were less likely to be exposed to *A. duodenale* infective stages probably in the farms leading to low rates of co-infection as opposed to their married counterparts.

Socio-economic status and education are intricately linked since those who are well educated are likely to achieve a higher socio-economic status. high prevalence of intestinal helminth infection has been found among those who had only primary basic education (Wekesa *et al.,* 2014) and that parasite infestation is less with higher level of education and this may be related to knowledge of personal hygiene, better quality of life and proper food preparation (Shinondo and Mwikuma.2009). *P. falciparum* and geo-helminth co-infection was also insignificant among pregnant women of the three education categories.

Weak positive association between *P. falciparum-A. lumbricoides* co-infection among those with secondary level of education was suggestive of lack of protection from parasite infection by the pregnant women. *P. falciparum* and *A. duodenale* co-infection had positive association, though insignificant in relation to the education levels of the pregnant women. Education level of an individual has a bearing on one's ability to understand and access information regarding control of parasitic infections (Worrall *et al.,* 2003). The level of education of the subjects in the current study could not probably be relied upon as a factor to reduce parasite infection in the pregnant women and therefore other factors needed to be considered.

Rural location can be associated with increased malaria risk for both epidemiologic and socio-economic reasons and that urban residence can be accompanied by potentially protective socio-economic factors against malaria (Rashid *et al.,* 2000). Malaria and soil transmitted helminths are highly prevalent in the rural communities as a result of poor sanitary conditions prevailing there (Ojurongbe *et al*., 2011). *P. falciparum* and *A. duodenale* co-infection proportion was insignificant in the other two settlement categories. *P. falciparum* and *A. lumbricoides* co-infection remained counter-syndemic with own home and estate camp types of settlements. It is worth to note that a majority of the estate camp dwellers are the casual labourers in the tea plantations and tea factories who according to the Nandi county-CIDP, 2013-2017 are the most vulnerable population.

There was insignificant parasite infection proportions in all family size categories. This was probably due to the fact that any pregnant woman irrespective of the number of children they had was predisposed to the conditions which were not investigated in this study that led to infection and these factors were not associated in any way with the size of the family.

In large family size category *P. falciparum* and *A. duodenale* co-infection association was negative. Probably, those in this family size category are more cautious of their surrounding and are able to protect themselves. Presumably, a large family size comprises individuals who are grownups or who can understand basic hygiene practices that ensure a salubrious home environment and would probably decimate parasite transmission among the family members.

There were no co-infections of *P. falciparum* and *A. lumbricoides* in the middle and high income categories. This suggested that pregnant women in the low income category were not able to access preventive measures against parasitic infection due to limited resources. Low income can also make individuals not to use preventive measures in the most effective or appropriate manner due the seasonability of availability of financial resources (Worrall *et al.,* 2003)

According to Yatich *et al.,* 2009, low income heightened rates of dual infections. Low income in many homes deny pregnant women access to protective measures against malaria and helminth parasites infections as most of the resources are directed to more pressing needs such as food and education of the children. In Nandi County access to economic resources is low for women owing to the traditional division of labour that places women at the household level for domestic chores Nandi County-CIDP, 2013-2017). Pregnant women with low income are subject to complex syndemics involving more than two diseases Singer 2013.

6. Conclusion

Young age (16-20 years) was significantly associated with parasite co-infection. Being married on the other hand did not reduce the chances of parasite co-infection. Strength of association between malaria and geohelminth parasites in relation to socio-demographics of the pregnant women was variable. In the current study, malaria and *A. duodenale* infections were positively associated, that is, they were syndemic or synergic among the pregnant women. Malaria -*A. lumbricoides* infection were counter syndemic, that is, they were antagonistic.

7. Recommendation.

Pregnant women should undergo diagnosis for both malaria and geohelminth parasites and they should be given anti-malarial and anthelmintic drugs in the course of their pregnancies to reduce the consequences of infection. There is need for the county government of Nandi to embark on improving socio-economic standards of women and carry out public education regarding prevention of malaria and geohelminth infections.

Conflict of Interest

There authors declare that there is no conflict of interest regarding the publication of this paper.

Authors' contribution

Author 1 designed the study, wrote the protocol and performed statistical analysis. Authors 2 and 3 managed the analysis of the study and literature searches and all the authors read and approved the final manuscript.

Consent to participate
Pregnant mothers gave consent to participate by signing an informed consent form which was read to them and translated in mother tongue when it was necessary.
Ethical approval
The research protocol was read and approved by Ethics and Research Committee (ERC) of Jaramogi Oginga Teaching and Referral Hospital (JOOTRH) accreditation number 01713.

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