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Intestinal Parasites Infection among Pregnant Women in Nyeri County, Kenya

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ABSTRACT

Objectives: (i) To determine the prevalence of intestinal parasites infection among pregnant women in chosen antenatal clinics in Nyeri, County Nyeri. (iii) To determine the predictors of intestinal parasites among pregnant women in chosen antenatal clinics in Nyeri County. **Methodology:** The study was conducted from May-August 2015. Structured interview schedule was used to collect data. The collected stool samples were analysed in the laboratories using direct wet mount method and formol-ether concentration technique. Data was analysed using SPSS software. **Results:** All 260 pregnant women recruited in the study participated. Among 260 pregnant women, 67 (25.8%) were infected by intestinal parasites. Four (1.5%) had *Ascaris lumbricoides* infection, 4 (1.5%) had hook worm infection, 1(0.4%) had *Trichuris trichiura* infection and 3 (1.2%) had *Strongyloides stercoralis* infection. Forty three (16.5%) were infected by *Entamoeba histolytica*, 10(3.8%) *Entamoeba coli*, 3 (1.2%) *Giardia lamblia*, 1(0.4%) *Balantidium coli*, 3(1.2%) *Iodamoeba butschlii*, and 1(0.4%) *Chilomastix mesnili*. Treatment of drinking water (Adjusted Odds Ratio (aOR): 0.237; 95% CI: 0.078 – 0.718; p: 0.011) and use of tap water (aOR: 0.257; 95% CI: 0.083 – 0.791; p: 0.018) were protective against intestinal parasites infection. **Conclusions:** (i) in selected antenatal clinics in Nyeri County 67(25.8%) of 260 pregnant women had intestinal parasites infections (ii) treating drinking water and use of tap water were protective against infection by intestinal parasites among pregnant women attending antenatal clinics in Nyeri County. The study recommends routine diagnosis of intestinal parasites during antenatal care.

Keywords: [prevalence, intestinal protozoan parasites, pregnant women]

INTRODUCTION

Intestinal protozoan parasite infections commonly found in human are *Giardia lamblia*, *Entamoeba histolytica*, and *Cryptosporidium parvum*(1) while intestinal helminths are *Strongyloides stercoralis, hookworm(Necator americanus and Ancylostoma duodenale), Trichuris trichiura, and Ascaris lumbricoides*.(1) The main intestinal protozoan infections of public health importance globally are *Entamoeba histolytica* and *Giardia lamblia*.(2) In every year, approximately 50 million people across the world are infected by pathogenic amoeba.(3) About 200 million people are infected by *Giardia lamblia* globally and East Africa being considered an endemic area.(4) Pregnant women are vulnerable to intestinal parasites infection.(5) The common diseases caused by intestinal protozoan parasites are amoebiasis, giardiasis, cryptosporidiosis, cyclosporiasis and they are associated with diarrhoea.(1,6) Intestinal helminths

infection such as hookworm can cause anaemia.(5) This can lead to poor pregnancy outcomes among infected pregnant women. There is less focus on intestinal parasites research in Nyeri County, Kenya. As result epidemiological data on the burden of intestinal parasites infections among pregnant women in Nyeri County is insufficient. The study provides data on prevalence of intestinal parasites infection during pregnancy. The data provided by this study can be used as evidence for management of intestinal parasites to improve health of pregnant women. The study provides data that can be used in prevention of intestinal parasites infection.

Specific Objectives

1. To determine the prevalence of intestinal parasites infection among pregnant women in antenatal clinics in Nyeri County.
2. To determine the predictors of intestinal parasites among pregnant women in antenatal clinics in Nyeri County.

LITERATURE REVIEW

Globally, parasitic infections remain a public health challenge. Developing countries are the most affected.(7) Malaria and intestinal parasitic infections are the most prevalent in Africa. Estimated 1.5 billion people are infected with intestinal parasites.(8) A study conducted in Colombia showed that 0.9% of 331 pregnant women had *Giardia lamblia* infection, 1.5% of had *Entamoeba histolytica/dispar* infection and 0.3% had *Ascaris lumbricoides* infection .(9) In developing countries with low level of education, low income, poor personal and environmental sanitation and lack of safe water supply, intestinal parasitic infections are among the most common public health problems.(1) Pregnant women are vulnerable to parasitic infections because their physiological systems of the body are affected by reduced body immunity.(10) Increased risk of adverse pregnancy outcomes and complications has been observed among pregnant having malaria and amoeba infections.(11,12) Globally malaria is leading cause of death, followed by amebiasis among parasitic diseases.(13), while the leading cause of parasitic diarrhoea is giardiasis.(9) A study involving 201 pregnant women in Papua New Guinea showed that 39% are infected by *Giardia lamblia* and 43% *Entamoeba histolytica,* 18% hookworm *(Necator americanus),* 14% *Ascaris lumbricoides, 3% Strongyloides stercoralis* and 2% *Trichuris trichiura.*(14) According to a registry based cross-sectional study in Tanzania, pregnant women have amoeba infection.(13) In Ethiopia 9.6% of 384 pregnant women are infected by *Entamoeba histolytica* , 8.9% *Giardia intestinalis,* 8.6% *Ascaris lumbricoides,* 5.2% *hookworm,* 3.6% *Taenia species,* 1.3% *Strongyloides stercoralis and* 1.04% *Schistosoma mansoni.* (1) Another study in Ethiopia had reported 7.8% of pregnant women have *Entamoeba histolytica* infection, 13.3% have *Giardia lamblia*, 2.9% *Ascaris lumbricoides*, 5.5% hookworm, 1.6% *Strongyloides stercoralis*, 2.9% *Schistosoma mansoni*, 0.8% *Taenia* species and 0.3% *Hymenolepis nana.* (15) In Ghana, 30.5% of 334 pregnant women have giardiasis infection and 0.6% have schistosomiasis. (8)

MATERIALS & METHODS

Study design

Analytical cross sectional study was conducted to determine prevalence and factors associated with intestinal parasites among pregnant women in antenatal clinics. This design was appropriate because data was collected one point in time.

Setting: The study was conducted between May-August 2015 in Nyeri County found within Latitude 0^{o} 38’ south and east within the equator and Longitudes 36^{o} 57’. Public health facilities in Nyeri County included thirty level 3 hospitals, four level 4 hospitals and one level 5 hospital.(16) Nyeri County was chosen because of insufficient data on burden of intestinal parasites infection among pregnant women.

Participants: The study population consisted of pregnant women attending

antenatal clinic in selected health facilities in Nyeri County. Pregnant women attending antenatal clinic were recruited to participate in the study after consenting. Women who were sick according to assessment by the healthcare provider in antenatal clinic were excluded from participating in the study. Systematic random sampling was used to select participants. Antenatal records were used as sampling frames. These records showed that approximately 650 pregnant women attended antenatal clinic every month in chosen public health facilities. The estimated number of pregnant women attending antenatal clinics every month (650) was divided by sample size (260) to give a sampling interval of approximately 3.

Variables: Independent variables age, marital status, education, occupation, income, treat drinking water, and latrine ownership. Dependent variable was infection with intestinal parasite.

Data measurement: Data on age, marital status, education, occupation, income, treat drinking water, and latrine ownership were measured using interview schedules. Pregnant women were interviewed as they exited antenatal clinic. This was done after ethical approval by Kenyatta University Ethical Review Committee. Universal stool containers were used for collecting stool samples for laboratory investigation. The specimens were processed using formol-ether concentration techniques and direct wet mount method and examined under microscope according Cheesbrough.(6)

Bias: to eliminate selection bias participants were selected using systematic randomly sampling. To reduce response, bias the questions were clarified to the participants by the interviewer when difficulties arose.

Sample size

Two hundred and sixty pregnant women participated in this study. The sample size was determined using formula by.(17) Using P = 65%, reported proportion of pregnant women with intestinal protozoan infection in Papua New Guinea, a sample size of 350 was computed. Since the population from where the sample was to be drawn (650) was less than 10,000 the desired sample size was adjusted and the minimum sample size required was 228. To accommodate non-response 10% of the sample was added to make sample size 251. However, 260 pregnant women were recruited and participated in the study. The sample size was distributed proportionate to the estimated number of newly enrolled pregnant women per month in selected health care facilities.

Health facilities were selected using stratified random sampling method in all health facility levels. Levels of the health facilities represented various strata. Health facilities in stratum 1, 2 and 3 were randomly selected while Nyeri level five hospital was purposively selected. The health facilities in level four included in the study were Mt Kenya, Karatina, and Mukurweini. Level three hospitals include in the study were Mweiga, Narumoru, Kiganjo, Nyeri Town, Belevue, Endarasha, Kinunga, Kamoko, Karaba, Thangathi, Ngorano, Ruguru, Island Farm and Warazo Jet. Systematic random sampling was used to select study participants.

Statistical Analysis

The quantitative data collected was processed using Statistical Package for Social Sciences (SPSS) software (version 20). Exploratory statistics such as frequencies was used to find out missing data. After running frequencies the variables where the missing data were 5 or less than 5, the missing data was considered not to have significant effect and was ignored. For the variables that had more than 5 missing data values the variable was excluded from analysis. Cross tabulations and odds ratio statistic were used to determine the association between variables at bivariate analysis. Predictors of intestinal parasites infection among pregnant women was determined using binary logistic regression.

RESULT

Study Participants

The minimum required sample size was 228 participants. To accommodate non response 10% of the desired sample size was added making the sample size to be 251 participants. However, 260 participants were recruited in the study. Response rate was 100%.

Descriptive data

On average study participants were 26.56± 6.11 years old. The distribution of participants by age was 25 (9.6%) in 15-19 years, 89(34.2%) in 20-24 years, 67(25.8%) in 25-29 years, 49(18.8%) in 30-34 years, 21(8.1%) in 35-39 years, 7(2.7%) in 40-44 years and 2(0.8%) in 45-49 years old category. Among 260 participants, 220(84.6%) were married, 2(0.8%) separated, 1(0.4%) widowed, and 37(14.2%) single. Distribution of participants by level of education was 2(0.8%) non-formal education, 103(39.6%) primary education, 124(47.7%) secondary education and 31(11.9%) college/university education. Fifteen participants (5.8%) were students, 30(11.5%) employed, 103(39.6%) self-employed and 112 (43.1%) unemployed. One hundred and one participants (38.8%) earned less than Kshs 1000 monthly, 102(39.2%) earned between Kshs 1001-5000, 40 (15.4%) earned between Kshs 5001-10000, and 16(6.2%) earned above Kshs 10000. Distribution of respondents by source of water was 80(30.8%) tap, 96(36.9%) river, 26(10%) bore hole and 58(22.3%) rain water. Two hundred and nine participants (80.4%) had seen or heard about intestinal parasites while 51(19.6%) had not. One hundred and two participants (39.2%) received information on intestinal parasites from hospital while 158(60.8%) did not receive the information from hospital. Twenty participants reported that they learnt about intestinal parasites from radio while 240 (92.3%) reported that radio was not their source of information. Nine participants (3.5%) reported that television was the source of information on intestinal parasites while 251(96.5%) reported that television was not source of information. Fifty seven participants (21.9%) reported that they learnt about intestinal parasites from school while 203(78.1%) reported that school was not the source of information. Sixty participants (23.1%) reported that they learnt about intestinal parasites from a family member while 200 (76.9%) reported family member was not source of information. One and sixty participants (61.5%) were able to correctly define intestinal parasite while 100 (38.5) were not able to define. One hundred and sixty one participants (61.9%) knew that *Entamoeba histolytica* is an intestinal protozoan while 99(38.1%) did not know. Fourteen participants (5.4%) knew that *Giardia lamblia* is an intestinal protozoan while 246 (94.6%) did not know. Three participants (1.2%) knew that *Balantidium coli* is an intestinal protozoan while 257 (98.8%) did not know. One hundred and sixty four participants (63.1%) knew that chronic diarrhoea can be a sign of intestinal parasites infection while 96 (36.9%) did not know. Seventy participants (26.9%) knew that inflammation of the intestines can be a sign of intestinal infection while 190(73.1%) did not know. One hundred and twenty eight participants (49.2%) knew that excess production of mucus in stool can be a sign of intestinal parasite infection while 132 (50.8%) did not know. One hundred and twenty participants knew that presence of blood in stool can be a sign of intestinal parasite infection while 140 (53.8%) did not know. Ninety four participants (36.2%) knew that burning sensation before passing out stool can be a sign of intestinal parasite infection while 166 (63.8%) did not know. One hundred and ninety nine participants (76.5%) knew that eating food contaminated with cyst and or ova is a means of intestinal parasite infection while 61 (23.5%) did not know. Two hundred and ten participants (80.8%) knew that drinking water contaminated with cyst and or ova is a means to infection with intestinal parasite infection while 50 (19.2%) did not know. Two hundred and fifteen participants (82.7%) knew that eating unclean hands is a means to infection with intestinal parasites

infection while 45 (17.3%) did not know. Seven participants (2.7%) disagreed with the statement that people get sick when infected with intestinal parasites, 11(4.2%) were neutral, 105 (40.4%) agreed, 135(51.9%) strongly agreed and 2 (0.8) did not respond. Two participants (0.8%) strongly disagreed with the statement that intestinal parasites can be prevented by always using latrines/toilets for defecation, 20 (7.7%) disagreed, 16(6.2%) were neutral, 90 (34.6%) agreed, 127 (48.8%) strongly disagreed and 5 (1.9%) did not respond. Nine participants (3.5%) disagreed with the statement that intestinal parasites can be prevented by always washing hands with water and soap after defecation and before eating any food, 16(6.2%) were neutral, 90 (34.6%) agreed, 142(54.6%) strongly agreed and 3 (1.2%) did not respond. Five participants (1.9%) disagreed with the statement that intestinal parasites can be treated, 10 (3.8%) neutral, 89 (34.2%) agreed, 154 (59.2%) strongly agreed and 2 (0.8%) did not respond. One participant (0.4) strongly disagreed with the statement that medical doctor is the right person to prescribe treatment for intestinal parasites infection, 5 (1.9%) disagreed, 16 (6.2%) were neutral, 89 (34.2%) agreed, 146(56.2%) strongly agreed and 3 (1.2%) did not respond. One participant (0.4%) disagreed with the statement that hospital /health centre is the right place for seeking treatment for intestinal parasite infection, 16 (6.2%) were neutral, 88(33.8%) agreed, 152(58.5%) strongly agreed and 3 (1.2%) did not respond. One participant disagreed with the statement that hospital/health centre support in managing intestinal parasites infection among pregnant women, 17 (6.5%) were neutral, 98 (37.7%) agreed, 141 (54.2%) strongly agreed and 3 (1.2%) did not respond.

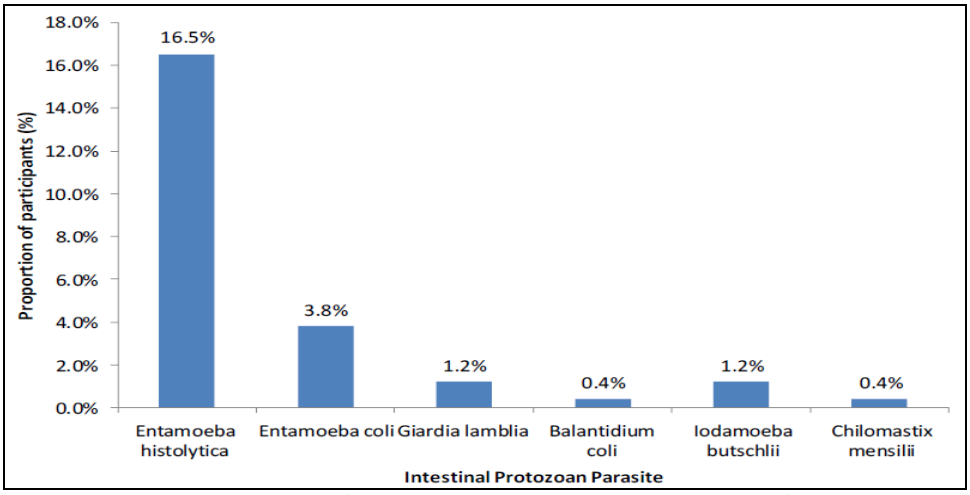

Figure 1: Distribution of respondents by intestinal protozoan parasite infection

Among 260 participants, 259 (99.6%) used latrine/toilet for defecation while 1(0.4%) reported using bush for defecation. Two hundred and twenty one participants (85%) always maintained the latrine/toilet clean, while 39(15%) did not. Two hundred and two participants (77.7%) always washed hands with soap before eating food while 58 (22.3%) did not. Two hundred participants (76.9%) always washed hands with soap after visiting toilet while 60(23.1%) did not. Two hundred and eighteen participants (83.8%) always maintained food hygiene while 42 (16.2%) did not. One hundred and seventy one participants (65.8%) treated drinking water while 89 (34.2%) did not. Among all pregnant women (260) who participated in this study 67(25.8%) had intestinal parasite infection. Among 260 pregnant women, 56 (21.5%) were infected with intestinal protozoan parasites. Among those infected with intestinal protozoan, 43 (16.5%) were infected by *Entamoeba histolytica, 10 (3.8%) Entamoeba coli*, 3

(1.2%) *Giardia lamblia*, 1(0.4%) *Balantidium coli*, 3(1.2%) *Iodamoeba butschlii, and 1(0.4%) Chilomastix mesnili* (Figure 1).

Among 260 pregnant women, 12 (4.6%) had intestinal helminths infection where 4 (1.5%) had *Ascaris lumbricoides* infection, 4 (1.5%) had hook worm infection, 1(0.4%) had *Trichuris trichiura* infection and 3 (1.2%) had *Strongyloides stercoralis* infection. (Figure 2). The intestinal helminths were reported in Mukurweini sub-county Nyeri.

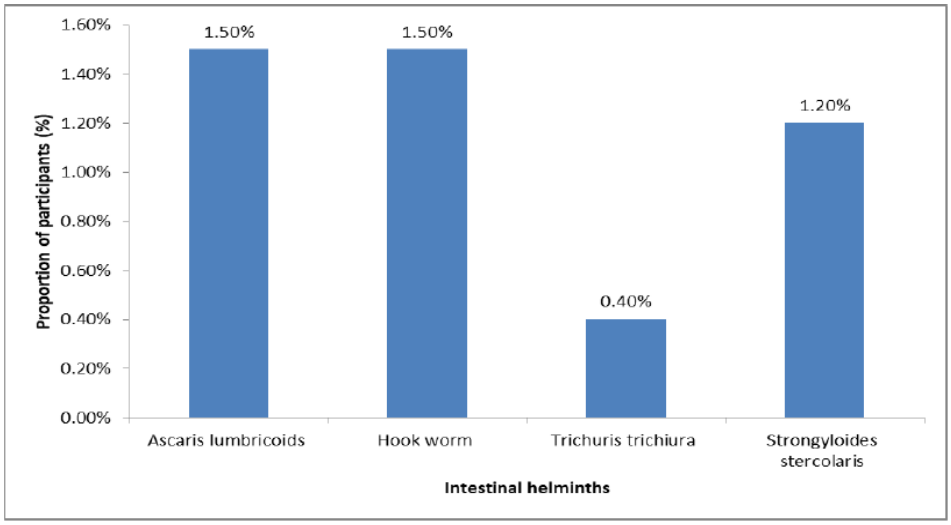

Figure 2: Distribution of respondents by intestinal helminths parasite infection

Bivariate analysis

At bivariate analysis, treating of drinking water was found to be protective against intestinal infection (Crude Odds Ratio (cOR) = 0.274, 95% CI 0.154-0.489, P = 0.0001). Use of tap water for drinking was also protective (cOR=0.23, 95% CI 0.089-0.594). Taking treatment against intestinal worms was protective (cOR= 0.402, 95% CI 0.222-0.727). Always maintaining food hygiene was protective against intestinal parasites infection (cOR = 0.302, 95% CI 0.152 – 0.600, P= 0.0001). Using water and soap to wash hands after defecation protected pregnant women against intestinal parasites infection (cOR = 0.411, 95% CI 0.222 – 0.761, P =0.004). Always using water and soap to wash hands before eating protected pregnant women against intestinal parasites infection (cOR = 0.424, 95% CI 0.227- 0.790, P = 0.006). Always maintaining latrine/toilet clean was protective against intestinal protozoan parasites infection (cOR) = 0.378, 95% CI 0.187 – 0.767, P = 0.006).

Multivariate analysis

The factors treating of drinking water, use of tap water for drinking, food hygiene, hand washing with water and soap after defecation and before eating, latrine/toilet cleanliness were included in binary logistic regression model to control for confounding. At multivariate analysis, treating drinking water (Adjusted Odds Ratio (aOR) = 0.237, 95% CI 0.0.078 – 0.0.718) and source of drinking water (aOR= 0.257, 95% 0.083-0.791) were found to be protective against intestinal parasites infection

DISCUSSION

Key results:

Among pregnant women who participated in this study, 21.5% were infected by intestinal protozoan parasites. Always maintaining the latrine/toilet clean, using water and soap to wash hands after defecating and before eating any food, maintaining food hygiene, and treating drinking water protected pregnant women against infection by intestinal parasites.

Limitations: The limitation of this study is that it was hospital based and therefore could not give complete picture of prevalence of intestinal parasites among pregnant women in the study area. The other limitation is that the diagnosis of the intestinal parasites was done using direct smear method and formol-ether concentration techniques and was not confirmed by using Polymerase Chain Reaction method.

Interpretation:

Participants in this study were on average approximately 27 years old and 43.8% were less than 25 years old. This finding is similar to results reported in Ethiopia on mean age of pregnant women. (18) In this study, the percentage of pregnant women below 25 years old is lower than that found in Papua New Guinea where 56% of respondents was 25 years old and below.(14) The distribution by marital status shows that 84.6% of participants in this study were married. This per cent is lower than that reported in Ethiopia where 93.2% of pregnant women were married .(18) Approximately 60% of participants had completed secondary education. The finding implies that participants in this study had a minimum of secondary education although there was 0.8% without formal education at all. Pregnant women with secondary education reported in this study are more compared to those in Papua New Guinea where 52% had secondary education.(14) Approximately 43% of participants were unemployed and considering that about 6% participants were students; then close to half of the participants were unemployed. Seventy three per cent of participants were low income earners who earned monthly income of Kshs 5,000 or less. One reason that can explain this observation is a high proportion (39.6%) of participants engaging in small businesses with low returns. A high proportion (46.9%) of respondents obtained their water from rivers and bore holes which may not be safe for drinking without treatment. Majority of participants had heard about intestinal parasites by the time of participating in this study.

The intestinal parasites found among pregnant women in this study included: *Entamoeba histolytica, Entamoeba coli, Giardia lamblia, Balantidium coli, Iodamoeba butschlii and Chilomastix mesnili, Trichiura trichuris, Ascaris lumbricoides, Strongyloides stercoralis and* hook worm. These findings are similar to results reported by others studies, for instance in Papua New Guinea pregnant women were infected with *Entamoeba histolytica, Giardia lamblia* and *Pentatrichomonas hominis, Trichuris trichiura, Strongyloides stercoralis, hookworm, Ascaris lumbricoides.*(14) and in Ethiopia had *Ascaris lumbricoides, Strongyloides stercoralis,* hookworm, *Entamoeba histolytica,* and *Giardia intestinalis.*(1) In Nepal pregnant women were infected with *Entamoeba histolytica* and *Giardia lamblia.*(19) In Colombia pregnant women were infected by *Giardia lamblia, Entamoeba histolytica, Endolimax nana, Blastocystis hominis, Entamoeba coli* and *Iodamoeba butschlii.*(9)

In this study, the most common intestinal protozoan parasites infections *Entamoeba histolytica and Entamoeba coli* and while *Giardia lamblia* and *Entamoeba histolytica* were the most common in Papua New Guinea.(14) The results also differ with those reported in Ethiopia where *Giardia lamblia* had the highest prevalence (13.3%). (18) The prevalence of *Entamoeba histolytica* (7.8%) reported in Ethiopia.(18) is lower than 16.5 % found in this study. The prevalence of amoeba infection among pregnant women in this study is high compared to 0.7% reported in Tanzania.(13)

Intestinal parasites are transmitted through fecal - oral route when a person ingests water or food polluted with cysts or ova. Poor individual hygiene practices and environmental sanitation can therefore predispose somebody to intestinal parasites infection. In this study, 34.2% of pregnant women drunk untreated water. This proportion of pregnant women drinking

untreated water is less than 50.8% reported in Nigeria.(20) In this study 99.6% of participants reported that they used latrine for defecation. The results are like those found in Ethiopia.(18) where 96.7% of respondents reported presence of a toilet facility. This study reported 85% of participants always maintained their latrine/toilet clean which protected them from getting infected by intestinal protozoan parasites.

In this study, age is not a risk factor for intestinal parasite infection among pregnant women. Similarly age was not a risk factor for intestinal parasite infection among pregnant women Papua New Guinea.(14) The result is also like that found in Ethiopia (18) where age was not a risk factor. Marital status was not associated with intestinal parasite infection in pregnant women in this study. This finding is similar to that reported in Ethiopia (18) where marital status was not an independent factor associated with intestinal parasites infection. Education was not a risk factor for intestinal parasite among pregnant women in this study. This result is similar to that reported in Tanzania (13), and Papua New Guinea (14) that low education was not a risk factor for intestinal parasites infection in pregnancy. Lack of employment was not a risk factor for intestinal parasites infection among pregnant women in this study. The result differs with the results reported in Tanzania (13) that unemployment was significantly associated with amebiasis in pregnancy. In this study treating drinking water protected pregnant women from being infected by intestinal parasites infection. The result differs with findings in Cameroon (21) where those who drunk treated water had high prevalence of *Entamoeba histolytica*.

The study, therefore, provides important information on intestinal parasite infection among pregnant women that can be used to improve maternal health. Therefore, there is need to increase public health education to stop transmission of the intestinal parasites found in this study. Diagnosis of intestinal parasites should be considered as the basis for management during antenatal care.

External Validity: However, the results cannot be generalized to all pregnant women because this study was a facility based.

CONCLUSION

It was concluded that: (i) among pregnant women who participated in this study 25.8% had intestinal parasite infection, (ii) predictor of intestinal parasites infection among pregnant women was treating drinking water and source of water. Pregnant women who drank treated water and those who drink water from tap were protected from intestinal parasites infection. Recommendation: Diagnosis of intestinal parasites infection should be considered a routine practice in antenatal care.

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Ethical Approval: Approved

REFERENCES

1. Alula GA, Munshea A, Nibret E. Prevalence of Intestinal Parasitic Infections and Associated Risk Factors among Pregnant Women Attending Prenatal Care in the Northwestern Ethiopia. Biomed Res Int. 2021 Dec 23;2021:3387742.
2. Organization WH. Nutrition profile of the WHO South-East Asia region. World Health Organization, Regional Office for South-East Asia: New Delhi, India. 2000;
3. Haque Rashidul, editor. Human Parasites. J HEALTH POPU NUTR. 2007;4:387–91.
4. Ignatius R, Gahutu JB, Klotz C, Steininger C, Shyirambere C, Lyng M, et al. High Prevalence of Giardia duodenalis Assemblage B Infection and Association with Underweight in Rwandan Children. Ghedin E, editor. PLoS Negl Trop Dis. 2012 Jun 12;6(6):e1677.

5. Soil-transmitted helminthiases [Internet]. [cited 2022 Jun 19]. Available from: https://www.who.int/health-topics/soil-transmitted-helminthiases
6. Cheesbrough M. District laboratory practice in tropical countries. Part 1 Part 1 [Internet]. Cambridge; New York: Cambridge University Press; 2005 [cited 2022 Jun 18]. Available from: http://public.ebookcentral.proquest.com/choice/publicfullrecord.aspx?p=321074
7. Haque R. Human Intestinal Parasites. J Health Popul Nutr. 2007 Dec;25(4):387–91.
8. Ahenkorah B, Nsiah K, Baffoe P, Ofosu W, Gyasi C, Owiredu EW. Parasitic infections among pregnant women at first antenatal care visit in northern Ghana: A study of prevalence and associated factors. PLOS ONE. 2020 Jul 24;15(7):e0236514.
9. Espinosa Aranzales AF, Radon K, Froeschl G, Pinzón Rondón ÁM, Delius M. Prevalence and risk factors for intestinal parasitic infections in pregnant women residing in three districts of Bogotá, Colombia. BMC Public Health. 2018 Dec;18(1):1071.
10. Taylor SM, van Eijk AM, Hand CC, Mwandagalirwa K, Messina JP, Tshefu AK, et al. Quantification of the Burden and Consequences of Pregnancy-Associated Malaria in the Democratic Republic of the Congo. J Infect Dis. 2011 Dec 1;204(11):1762–71.
11. Constantine G, Menon V, Luesley D. Amoebic peritonitis in pregnancy in the United Kingdom. Postgrad Med J. 1987 Jun;63(740):495–6.
12. Kalilani L, Mofolo I, Chaponda M, Rogerson SJ, Meshnick SR. The effect of timing and frequency of Plasmodium falciparum infection during pregnancy on the risk of low birth weight and maternal anemia. Trans R Soc Trop Med Hyg. 2010 Jun;104(6):416–22.
13. Mahande AM, Mahande MJ. Prevalence of parasitic infections and associations with pregnancy complications and outcomes in northern Tanzania: a registry-based cross-sectional study. BMC Infect Dis. 2016 Dec;16(1):78.
14. Phuanukoonnon S, Michael A, Kirarock WS, Pomat WS. Intestinal parasitic infections and anaemia among pregnant women in the highlands of Papua New Guinea. Papua New Guinea Medical Journal. 2013;56(3):8.
15. Derso A, Nibret E, Munshea A. Prevalence of intestinal parasitic infections and associated risk factors among pregnant women attending antenatal care center at Felege Hiwot Referral Hospital, northwest Ethiopia. BMC Infectious Diseases. 2016 Sep 30;16(1):530.
16. Nyeri County Government CIDP-2018-2022.pdf.
17. Fisher A, Fisher A, editors. Handbook for family planning operations research design. 2nd ed. New York, N.Y: Population Council; 1991. 77 p.
18. Derso A, Nibret E, Munshea A. Prevalence of intestinal parasitic infections and associated risk factors among pregnant women attending antenatal care center at Felege Hiwot Referral Hospital, northwest Ethiopia. BMC Infect Dis. 2016 Dec;16 (1):530.
19. Chaudhary M, Maharjan M. Association of Anaemia with Parasitic Infection in Pregnant Women Attending Antenatal Clinic at Koshi Zonal Hospital. Nepalese Journal of Zoology Vol 2 Issue 1November 2014. :8.
20. Eu A, Rs H, Sd M. Knowledge and risk factors of intestinal parasitic infections among women in Makurdi, Benue State. Asian Pacific Journal of Tropical Medicine. 2010 Dec;3(12):993–6.
21. Kuete T, YEMELI FLS, MVOA EE, NKOA T, SOMO RM, EKOBO AS. Prevalence and risk factors of intestinal helminth and protozoa infections in an urban setting of Cameroon: the case of Douala. Am J Epidemiol Infect Dis. 2015; 3(2):36–44.

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