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ASSESSMENT AND MAPPING OF INTESTINAL PARASITIC INFECTIONS AND ITS ASSOCIATED RISK FACTORS FROM DIFFERENTHEALTH CENTERS IN RWANDA

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ABSTRACT

Intestinal parasitic infections (IPIs) rarely cause death but because of the size of the problem, the global number of related deaths is critical.Intestinal parasitic infections are among the most common infections in the world, being responsible for considerable morbidity and mortality.The objective of this study involved the assessment and mapping of intestinal parasitic infections from different Health Centers in Rwanda.In this study, Different health centers from different districts in Rwandawere targeted. For each suspected patient was given a labeled stool container to collect stool sample. The stool samples were carried in parasitological laboratory for parasitological examination. Macroscopic examination was performed and direct smears prepared with normal saline and/or iodine for parasites analysis under microscope (objectives 10 × and 40×). Risk factors associated to intestinal parasites were assessed using structured questionnaires given to patients. Obtained cross sectional results of intestinal parasites prevalence and associated risk factors from different health centers in Rwanda were used, analyzed by SSPSS version 16, Microsoft Excel and Arc Map and records were incorporated into a geographical system for mapping.The overall prevalence of intestinal parasitic infections from different health centers in Rwanda according to 3139 patients who answered well the questionnaire was 56.99%. Entamoeba histolytica was found to be more prevalent followed by Ascaris lumbricoides with the prevalence of 35.1% and 30.69% respectively. Associated risk factors were normally poor utilization of water,poor food hygiene and poor body hygiene and with the prevalence of 56.97%; 53.88% and 52.26% respectively. With regard to the obtained results, improvement of body hygiene, household and environmental sanitation, provision of safe water and treatment of infected individuals could reduce the prevalence of intestinal parasitic infections.

KEYWORDS: *Protozoans, Helminths, Intestinal Parasitic Infections*

INTRODUCTION

A parasite is an organism that lives on or in a host organism and gets its food from or at the expense of its host. There are three main classes of parasites that can cause disease in humans: protozoa, helminths, and ectoparasites [1]. Over half of the world's population is infected with eukaryotic pathogens. Parasitic infections, caused by intestinal helminths and protozoan parasites, are among the most prevalent infections in humans in developing countries. In developed countries, protozoan parasites more commonly cause gastrointestinal infections compared to helminths. Intestinal parasites cause a significant morbidity and mortality in endemic countries. The World Health Organization (WHO) ranks six parasitic diseases among the top 20 microbial causes of death in the world. Every year, there are over 5 million new cases of

malaria, schistosomiasis, amoebiasis, hookworm, African trypanosomiasis and intestinal parasites reported in developing countries. It is estimated that one third of Ethiopians are infected with *Ascaris lumbricoides,* one quarter is infected with *Trichuris trichiura* and one in eight lives with hookworm. As a result, Ethiopia has the second highest burden of ascariasis, the third highest burden of hookworm, and the fourth highest burden of trichuriasis in Sub-Saharan Africa.In Africa, more specifically Sub-Saharan Africa, parasitic infections are the major public health problem and most of the victims are children [2]. Currently, the protozoan parasite (*Entamoeba histolytica* and *Giardiaintestinalis*) and the soil transmitted helminthes (*Ascaris lumbricoides,Trichuris trichiura*, and Hookworm) are the leading intestinal parasites which cause significant morbidity and mortality in the Africa[3].Intestinal parasitic infection has been estimated to be responsible for 25–75% of all childhood illnesses and episodes of intestinal parasitic to about 14% of outpatient visits and 16% of hospital admissions and accounted for an average of 35 days of illness per year in children aged less than five years [4].

In Rwanda six species of intestinal helminthes with an overall prevalence of 65.8% have been identified among schoolchildren 10-16 years old from 136 primary schools in 2008. The predominant parasites were *Ascarislumbricoides* observed in 38.6% of children, followed by *Ancylostoma duodenale* in 31.6% of the children. Another study performed in 2010 among children less than five years of age revealed that 20% and 60.1% of them were infected by *Giardiaduodenalis*. Intestinal parasitic infections are still a major public health problem, in Rwanda especially in Northern parts due to many different risk factors that appeared in that area like the use of stagnant water and untreated water and there are insufficient and closed latrines in the village surrounding these health centers [5].

MATERIALS AND METHODS

The study was to deal with the assessment and mapping of intestinal parasitic infections and associated risk factors from different health centers in Rwanda that predispose people for intestinal parasitic infections. It is a meta-analysis study that carried outfrom January 2016 to November 2017on some health centers in Rwanda. The present study was carried out inRwanda, located in central Africa, to the east of the Democratic Republic of the Congo, at the co-ordinates 2°00′S 30°0′E, at 26,338 square kilometers. The study was carried out on 3839 patients who attended different health centers in Rwanda, answered well the questionnaire and having diarrhoea with or without mucous or blood, fever, abdominal distinction, nausea, vomiting, anal itch, abdominal pain and anemia symptoms in the period of the study from January 2016 to November 2017.This research project has been conducted based on different research projects conducted with different authors from INES Ruhengeri during 2016-2017. During all those studies, each individual was given a stool container to collect the sample. The stool samples were carried to parasitological laboratory and this was done in each health center parasitological laboratory for parasitological examination.The content of the questionnaire included full identification of the patient and risk factors that are associated to intestinal parasitic infections (water utilization and source, food hygiene body hygiene, toilet utilization and animals in the family). The questionnaire was originally developed in English and then translated into local language (Kinyarwanda). For children who were not able to answer to the questions on the questionnaire their parents or caretakers took the responsibility of filling the questionnaires.The questionnaire assessed hygienic habits in suspect patients with intestinal parasites such as socio-economic status which provides information on social status (icyicirocy'ubudehe), level of education, occupation, water consumed, food hygiene, body hygiene, toilet utilization and animals in the family**(**live with or handle animal in your family, kind of animal do you frequently handle). Questionnaires were given to patients after delivering stool samples. All collected stool samples were characterized macroscopically based on their consistency (formed, lose or watery), presence and absence of larval stages of parasitic

infections and other macroscopic features seen by the researcher in the presence of experienced laboratory technician. Intestinal parasitic infections results were recorded and risk factors assessed. The sample were tested macroscopically for checking if there is no other contamination and see clearly the color and their consistence.A direct wet mount was prepared, stool samples mixed with normal saline and iodine and mounted on microscopic. Slides were then examined under light microscopy. Direct microscopic examination for ova, cysts and parasitic infections was carried out under the supervision of experienced medical laboratory technician and diagnosis was made on the basis of morphology and size microscope at 10X and 40X magnifications.

RESULTS AND DISCUSSION

The figure 1 shows the different intestinal parasite generally found in Rwanda.*Entamoeba histolytica* had high prevalence with 35.1%, followed by *Ascaris Lumbricoides* with 30.69%. The lack of awareness about personal cleanliness, food hygiene; toilet utilization and illiteracy among rural population in Rwandawas linked with this high prevalence of *Ascaris lumbricoides.* this comparison shows the same results [6].The recorded high prevalence of intestinal parasitic infections might be due to low knowledge about intestinal parasitic infections, climatic, environmental conditions of the area along with poor water supply and sanitation facilities, which could be favorable for their transmission [7].

The figure 2 shows the different intestinal parasites found in Musanze district.In Musanze district *Entamoeba histolytica* had high prevalence of 31.49%, followed by *Ascaris lumbricoides* with 28.66%. As a big number of Musanze citizen are farmers, could be infected by the soil as *Ascaris lumbricoides*is among the soil-transmitted helminths. Many mountain found in this area do not facilitate piping water to citizens of Musanze district.Rural to urban migration rapidly increases the number of food eating places in towns and their environs. Some of these eating estabishments have poor sanitation and are overcrowded, facilitating disease transmission as amoebiasis, especially through food-handling [8].

The figure 3 shows the different intestinal parasites found in Rutsiro district.In Rutsiro district *Entamoeba histolytica* had high prevalence of 44.86%, followed by *Asacrislumbricoides* with 44.69%. For other parasites, their prevalence is less than 3%.According to Integrated Household Living Conditions Survey 3 (EICV 3)more than 90% of the population of Rutsiro are farmers andfemales comprise 52.4% of the population of Rutsiro district. The majorityisyoung with 84.7% of the population aged under 40 years old; more than a half (56%) of the population are aged 19 years or younger, as provided by the EICV3 survey in 2010–2011. As those are risk factors of Intestinal Parasitic Infections must increase the prevalence in this district.Same results showed that among the infected patients, *Entamoeba histolytica* was the mostdominant intestinal followed by *Trichomonas intestinalis*, *Giardia lambria, Ascaris lumbricoides* and *Entamoeba coli,* this was due to the fact of most people in the study area hadn't enough information about intestinal parasites, most of them use stagnant to clean sweet potatoes, they also have a habit of not using boiled water , open latrines played an important role in the spread of intestinal parasite and the same result were also reported in a study preformed in one universities of Rwanda, Kigali Institute of Education (KIE) and the same results was also obtained in this study [9].

The figure 4 shows the different intestinal parasites found in Gakenke district.In Gakenke district *Entamoeba histolytica* had high prevalence of 39.24%, followed by *Entamoeba coli* with 31.85%. These two parasites are responsible for amoebiasis. As cysts caused the disease are ingested through food or water or direct contact with fecal matter, and can resist several months relatively inactive form in the soil or environment where the feces are deposited, these facts could increase the prevalence. As in this area there is high number of inadequate and lack of latrines. Same results found in

Rwanda also in 2013, that took place in Rukara Health center where the overall prevalence was assessed to be 56.1% among 193 cases tested where the high prevalence was found to be for *Entamoebahistolytica* followed by *Entamoeba coli* with a high number of infected persons observed in females than in males [10].

The figure 5 shows the different intestinal parasites found in Nyabihu district. In Nyabihu district *E.histolytica* had high prevalence of 59.01%, followed by *Trichuris trichiura* with 46.38%.The whipworm is especially prevalent in areas of high rainfall, high humidity and dense shade. 83% are farmers and animal keepers, they spend much time in the farms, where there isn't atleast pipe water. This increase poor food and body hygiene which increase the prevalence of parasitic infections in Nyabihu district.Same results showed that the prevalence of intestinal parasites diagnosed in the United States among African refugees, Variables included results of microscopy of a single stool specimen, age, sex, ethnicity and departure origin, were 1,254 refugees, 56% had intestinal parasites. 14% had helminths; In addition, 52% had protozoans as high prevalence. The most common pathogens were *Giardia lamblia* (14%) and *Trichuris trichiura* (9%) [11].

The figure 6 shows the different intestinal parasites found in Rulindo district. In Rulindo district *Ascaris lumbricoides* had high prevalence of 41.90%, followed by *Entamoeba histolytica* with 20.42%. The reason of this high prevalence is the same as those of Musanze district. The highest prevalence of ascariasis occurs in tropical countries where warm, wet climates provide environmental conditions that favor year round transmission of infection which shows same results. This contrasts to the situation in dry areas where transmission is seasonal, occurring predominantly during the rainy months. The prevalence is also greatest in areas where suboptimal sanitation practices lead to increased contamination of soil and water more than 1.5 billion people or 24% of the world's population are infected with soil-transmitted helminth infections worldwide [12].

The figure 7 shows the different intestinal parasites found in Burera district. In Burera district *E.histolytica* had high prevalence of 52%, followed by *Ascaris lumbricoides* with 27% and *Giardia lamblia* with 14%. The reason of high prevalence is because there isn't sufficient pipe water and in this area there is lakes. People use lake water as is near. This is in agreements with the previous epidemiological studies in Nahavand County, western Iran. The study demonstrated high prevalence of IPIs among different population and had shown that *Entamoeba histolytica* and *Ascaris lumbricoides* are the predominant IPIs [13]. Amoebiasis is the third leading cause of death from parasitic diseases worldwide, with its greatest impact on the people of developing countries [14].Practice of hygiene by washing vegetables and other food before cooking, use proper water and washing hands while preparing meals or eating are good measures of preventing amoebiasis infection [15].

The figure 8 shows the different intestinal parasites found in Rubavu district.In Rubavu district *Asacrislumbricoides* had high prevalence of 55.09%, followed by *Trichuris trichiura* with 14.81%. The reason of high prevalence is the same as Burera, there isn't sufficient pipe water they prefer Lake Kivu. People use lake water as is near. This result is comparable with another study from Guatemala, 60% of the population in a rural village was infected with *A. lumbricoides* and 41% with *Trichuris trichiura*[16]. Higher prevalence was found in the studies from the eastern part of Turkey, where the socio-economic and environmental conditions were lower.

The figure 9 shows the different intestinal parasites found in Bugeseradistrict. In Bugesera district *Entamoeba histolytica* had high prevalence of 60.77%, followed by *Entamoeba coli* with 54.78%. This area seen to like desert, there is

insufficient pipe water, as it need in people day life. This is the reason of high prevalence. This is comparable to epidemiology done regarding the morbidity and mortality scale of Intestinal Parasitic Infections caused by protozoans, the distribution is as scabrous. Indeed, *Entamoeba histolytica*, the causative agent of amoebiasis, is estimated to infect 40–50 million people and to kills up to 100 000 people each year in the world in high prevalence[17].There is a general lack of interest in the control of important intestinal protozoan diseases such as amoebiasis and giardiasis. However, intestinal helminths and protozoan parasites are major public health problems in developing countries [18].

The figure 10 shows the different intestinal parasites found in Gisagara district. In Gisagara district *Entamoeba histolytica* had high prevalence of 72.58%, followed by *Entamoeba coli* with 39.17%.The reason of high prevalence is because ignorance as the high number of illiteracy as well as lack of pipe water. Trophozoites are responsible for producing lesions in amoebiasis. Invasion of blood vessels leads to secondary extra intestinal lesions. This is comparable to study done said: Individuals travelling to endemic areas are also at risk of developing amoebiasis due to *Entamoeba histolytica*.Amebic liver abscess is rare (occurring in less than 5% of cases), but is the most common extra intestinal manifestation of *Entamoeba histolytica* infection [19].

Infection rates are also high in temperate areas with poor sanitation .Most cases of amoebiasis in the Unites States occur in immigrants from endemic areas, in HIV infected patients and people living in states that border Mexico [20].

Table 1 shows the relationship between intestinal parasitic infections and associated risks factors among patients attending different health centers in Rwanda.According to the results regarding to food hygiene our results agreed with those from Ethiopia [7] which showed that the fact of not cleaning kitchen materials with pipe water and detergent, not cleaning always the kitchen and not washing fresh fruits before eating had a statistical significant association ($P < 0.05$) with the prevalence of intestinal parasitic infections. All of three factors recorded a strong relationship with intestinal parasitic infections and current results agreed with results from Burkina Faso [18]. Same results with studies from Ethiopia [2],[21];Kenya [22]; had a clear agreement to our results that showed that body hygiene in its some components (not washing hands with pipe water and detergent, not washing hands after toilet, not cutting finger nails after growing and swimming in fresh water, lakes, stream) showed a statistical significant and strong association with the prevalence of intestinal parasitic infections ($P < 0.05$).

The figure 11 shows the Map of Intestinal Parasitic Infections from different districts health Centers in Rwanda. Burera had prevalence of 56.02%, Gakenke had 39.24%, Musanze had 60.01%, Gisagara had 72.58%, Bugesera had 60.77% Nyabihu had 59.01%, Rubavu had 48.00%, Rutsiro had 44.39%, Rulindo had high prevalence 80.29% of intestinal parasitic infections among other districts in Rwanda.For instance, in a study to determine the Prevalence of intestinal parasite infections and associated risk factors among students of Kigali Institute of education in Rwanda, more than 50.5% of the stools were found to be infected with an intestinal parasite *Entamoeba. histolytica* was the highest with 54.5%, *Trichomonas intestinalis* and *Ascaris lumbricoide*s were 20.0%, Giardia lamblia 3.6% and *Ancylostomaduodenale* 1.8%[5].

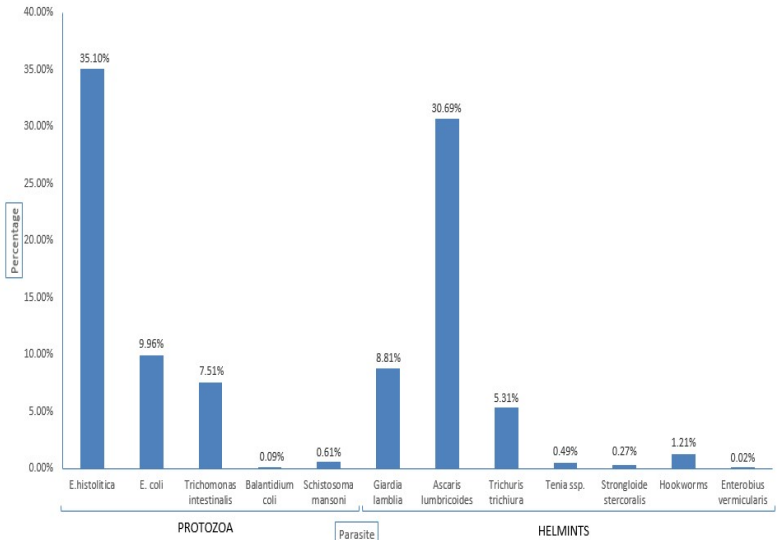

Figure 1: Prevalence of Intestinal Parasites in Rwanda.

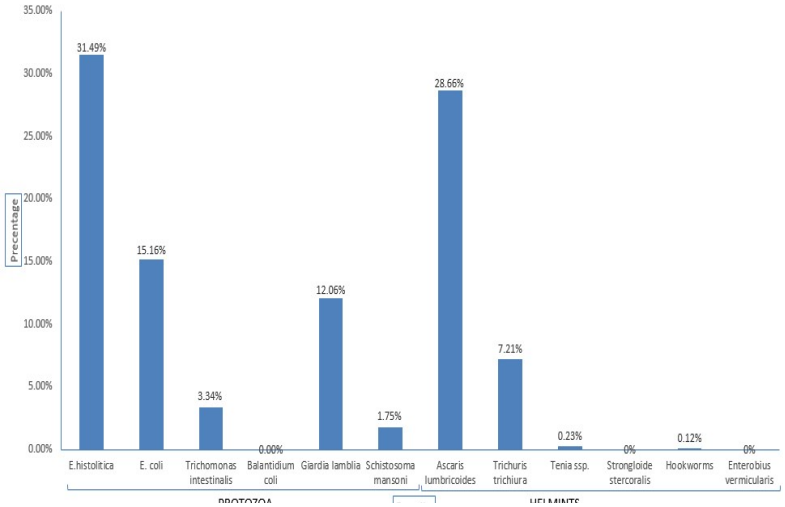

Figure 2: Prevalence of Intestinal Parasites in Musanze District.

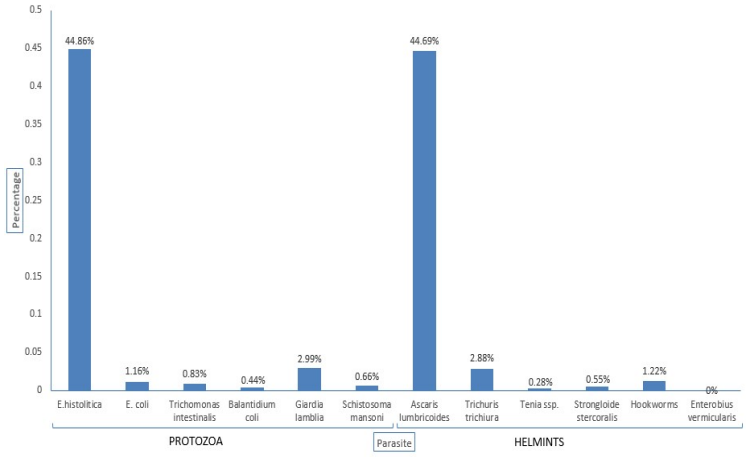

Figure :3 Prevalence of Intestinal Parasites in Rutsiro District.

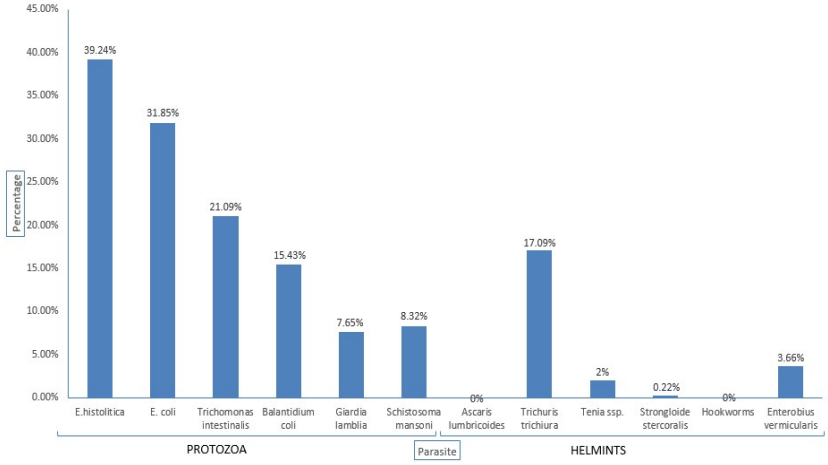

Figure 4: Prevalence of Intestinal Parasites in Gakenke District.

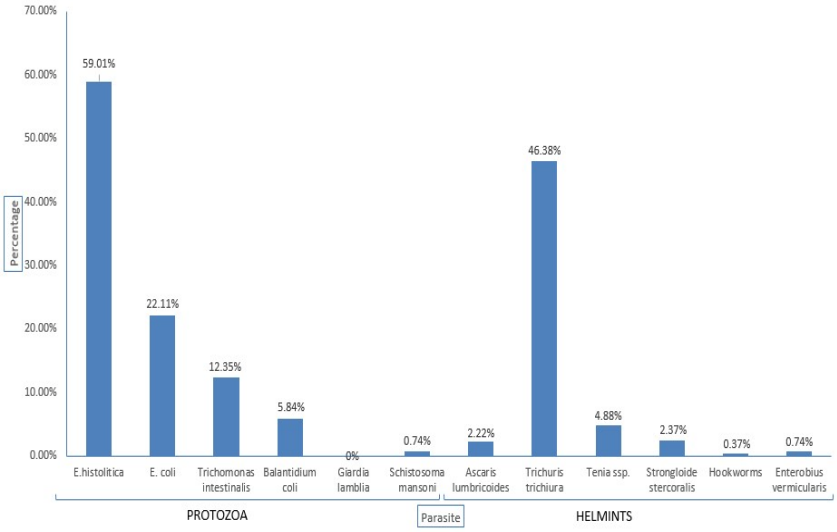

Figure 5: Prevalence of Intestinal Parasites in Nyabihu District.

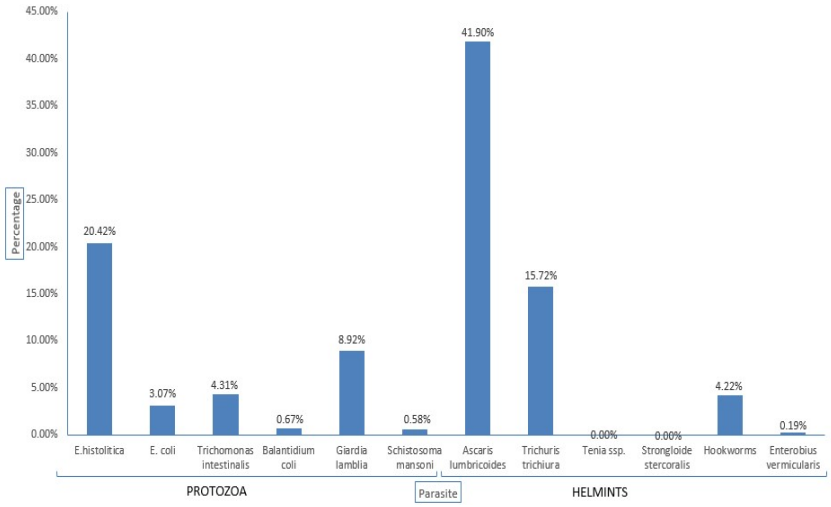

Figure 6: Prevalence of Intestinal Parasites in Rulindo District.

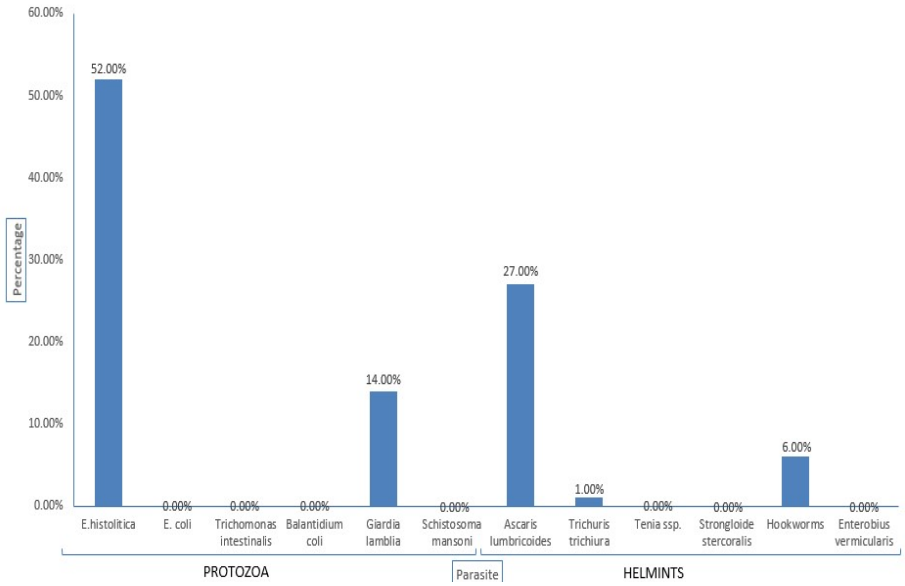

Figure 7: Prevalence of Intestinal Parasites in Burera District.

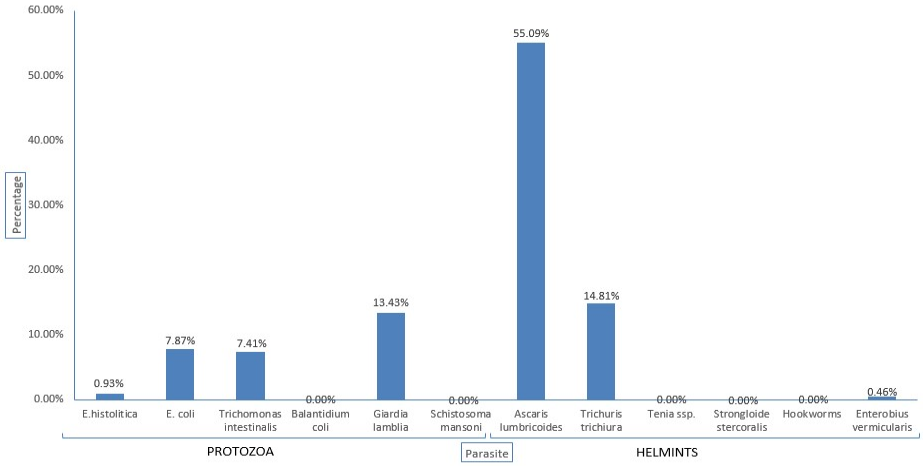

Figure 8: Prevalence of Intestinal Parasites in Rubavu District.

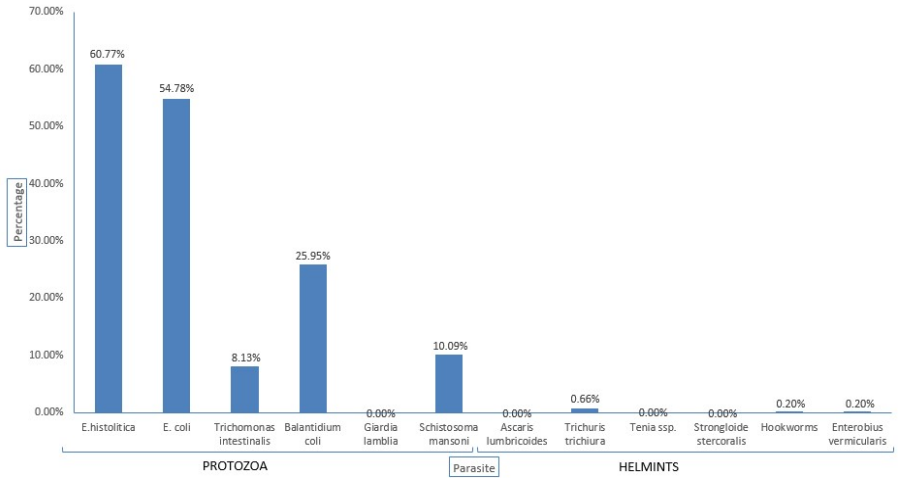

Figure 9: Prevalence of Intestinal Parasites in Bugesera District.

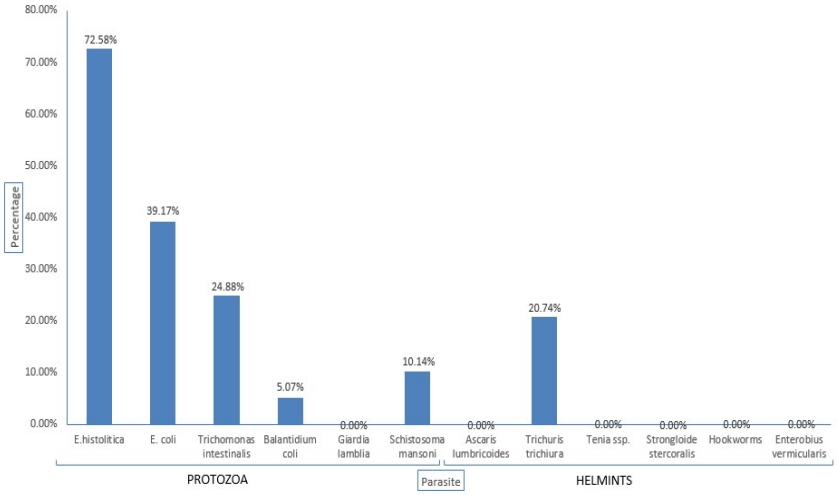

Figure 10: Prevalence of Intestinal Parasites in Gisagara District.

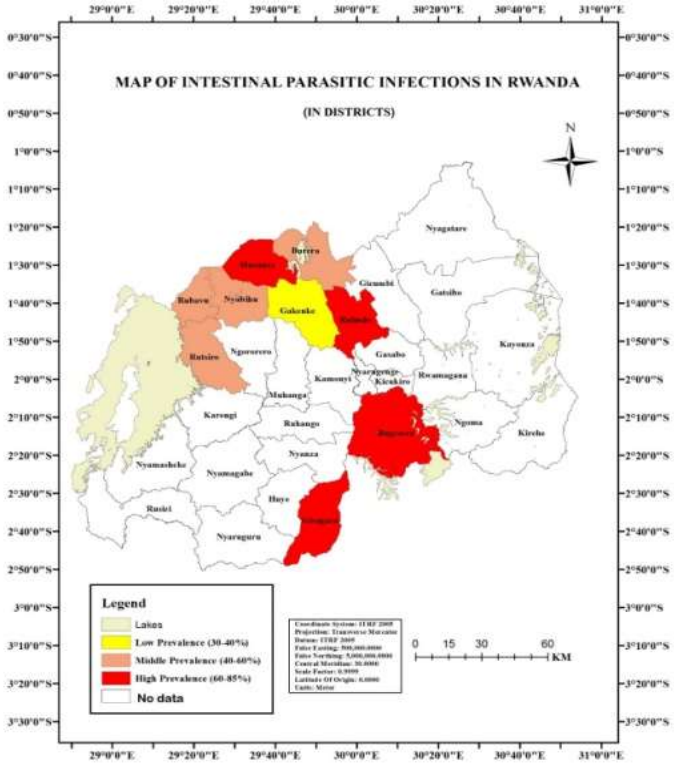

Figure 11: Map of Intestinal Parasitic Infections in Districts from Rwanda.

Table 1: Association of Intestinal Parasites with Risk Factors

N=3139

Parameter		Tested Patients	Positive Cases (%)	Negative Cases	P-Value
Water Utilization					
Pipe water	Yes	1556	498 (32%)	1058	P<0.05
	No	1583	1113 (70%)	470	
Boiled water	Yes	1094	358 (33%)	736	
	No	2045	1323 (65%)	722	
Stagnant water	Yes	1222	783 (64%)	439	
	No	1917	872 (46%)	1045	
Mineral water	Yes	203	106 (52%)	97	
	No	2936	1403 (48%)	1533	
Food Hygiene					
Washing fresh food before cooking	Washing	2196	1030 (47%)	1166	P<0.05
	Not washing	943	371 (39%)	572	
Cleaning kitchen materials with pipe water and detergent	Cleaning	2164	897 (42%)	1267	
	Not cleaning	975	775 (80%)	200	
Kitchen is always cleaned	Cleaned	2149	897 (42%)	1252	
	Not cleaned	990	699 (71%)	291	
Eating always in restaurant	Yes	480	242 (50%)	238	
	No	2659	1174 (44%)	1485	
Washing fresh fruits before eating	Yes	1969	736 (37%)	1233	
	No	1170	797 (68%)	373	
Body Hygiene					
Washing hands with pipe water and detergent	Yes	2068	759 (38%)	1309	P<0.05
	No	1071	670 (63%)	401	
Washing hands after toilet	Yes	1546	682 (44%)	864	
	No	1593	903 (57%)	690	
Cutting finger nails after growing	Yes	1964	834 (43%)	1130	
	No	1175	777 (66%)	398	
Wearing shoes	Yes	2060	810 (39%)	1250	
	No	1079	624 (58%)	455	

CONCLUSIONS

This current study has tried to point out relatively assessment and mapping of intestinal parasitic infections and associated risk factors in Rwanda.The relatively high prevalence rate of intestinal parasites infections in Rwanda are the reflection of poor sanitation of the environment, poor personal hygiene, relatively unhygienic water supply and lack of clean drinking water supply. Those were the main risk factors for intestinal parasites infection in Rwanda.There is a need for community mobilization towards provision and use of safe and adequate water supply, latrine construction to reduce open field defecation. The high overall prevalence of intestinal parasitic infections in this present study need the mass deworming in the community and establishment of good personal hygiene and environmental sanitation; public health education is also necessary on the transmission of intestinal parasitic infections in communities, participatory approaches and combined efforts from the community and health sectors are needed to control the study areas.

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Conflicts of Interest

The authors declare that they have no conflicts of interest.

Ethics Approval

This research has been approved by the ethic committee of different health centers in Rwanda.

Consent to Participate

All participants were given the consent form and have accepted to participate in the study.

Availability of Data and Material

The data used to support the findings of this study are available from the corresponding author upon request.

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