



# **Transmission of Helmithiasis in a Community and Treatment Option**

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## **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## **ABSTRACT**

Infections caused by parasitic helminths affect more than a billion people worldwide, causing anemia and with significant social and economic impact. To alleviate this burden, affected population resorts to a massive administration of antiparasitics without worrying about improvements in the factors that aid in spreading helminthosis in the community.

In this study we are proposing as objectives, that of going in search of the we used questionnaires, oral interviews and direct observations to determine risk factors and treatment options for the disease in two communities of Kolwezi in Democratic Republic of Congo. by on the one hand a household questionnaire and observation of the investigator and others by a census of antihelminths in the pharmacies of the city of Kolwezi.

We received 7,014 responses from households and 283 from pharmacies. It was observed from our analysis that most of the plots were clean and dry although sometimes covered with trees and with grass. On average, four households, six children over the age of fifteen and four children under the

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age of five, and two toilets were observed per plot. The quality of toilets, the source of water supply, the misuse of toilet pots for children under five years old as well as variations in weather conditions were the major risk factors for parasitosis in Kolwezi Occasional stool examination revealed mainly dominated by the feeling of vomiting, fatigue and a nocturnal cough. a small portion of the population had access to laboratory tests which, moreover, were able to observe more *Ascaris lumbricoides* eggs. The population resorts to self-medication with Mebendazole® and sometimes herbal teas and palm kernel oils. while on medical prescriptions and on the shelves of pharmacies, Albemedazoles was more present. The elements of transmission having been well identified, the start of an education of the population is a necessity and constitutes the next steps.

**Keywords:** Parasitosis; transmission; community; treatment; Kolwezi.

## 1. INTRODUCTION

Intestinal helminthosis a major public health problem that affects the health of primary school children in low- and middle-income countries where living, water, sanitation, and hygiene conditions are precarious [1]. It is one of the commonly perceived and often observed serious problems in children, leading to high mortality [2]. And faecal-oral transmission is a common way of transmitting soil-transmitted helminth parasites.

Soil-transmitted helminths parasites humans and require soil to grow into their infectious forms [3]. Ecological factors such as soil temperature, soil pH and rainfall patterns are, however, important determinants for the successful transmission of soil helminths, as they play a major role in their abundance and survival in soil [4].

The purpose of the study is to study the ecological factors influencing the transmission of soil-transmitted helminthiasis in the study area, which is more the communes of Manika and Dilala of the city of Kolwezi located: Latitude: - 10.7, Longitude: 25.6667 , 10° 42' 0" South, 25° 40' 0" East, for an area of 21,300 hectares, an altitude of 1,264 m and a humid subtropical climate with hot summers and dry winters (Köppen classification: Cwa) [5,6], over the year, the average temperature in Kolwezi is 22.4°C and the average rainfall is 512.7mm, in the province of Lualaba in the Democratic Republic of Congo.

## 2. METHODOLOGY

**Study sites:** The study was conducted in the two communes of the city of Kolwezi in the province of Lualaba. These communes are in proximity with no boundaries between the population and

many residents of these communes cross frequently as part of their daily activities.

**Questionnaire and survey procedure:** The survey questionnaire included questions related to the environment and composition of households and the type of toilets, water source and their locations. Participants were also asked to describe how parasitic infections had affected their families and communities. It was designed to last 10-15 minutes and included a mix of closed and open questions. Several iterations of the questionnaire were pre-tested in Lubumbashi to assess its duration and clarity.

Participants were informed that their participation was voluntary and that they were free to stop the survey at any time or to skip questions they did not wish to answer. The research was conducted within the framework of the study of the course of parasitology for the students of third graduate of the faculty of medicine of the university of Kolwezi.

The investigation team divided into two groups to conduct the investigation. One group conducted the interview in French with those who spoke the language well. For those who could not communicate in French, a second group conducted the interview through a translator fluent in Swahili, the main language spoken locally. Responses were collected on laptops using a google form questionnaire.

**Study design:** This is a cross-sectional study among the inhabitants of the city of Kolwezi on the transmission of parasitic diseases. A total of 7014 households and 283 pharmacies were visited and the results received were analyzed using Epi info 7.3 and Office Excel 2013 and are presented in the form of tables, and histograms.

### 3. RESULTS AND DISCUSSION

**Table 1. Characteristics of the study area**

Study sites	Characteristics	Frequency (Number)	Frequency (Percentage)
<b>Communities with households</b>	Manika	4155	59.2
	Dilala	2859	40.8
	<b>Total frequency</b>	<b>7014</b>	<b>100.0</b>
<b>Characteristics of households</b>	Humid environment	1211	7.5
	Land covered by plants	2389	14.8
	Land not covered by plants/trees	2171	13.4
	Dry land	4311	26.6
	Shady	3379	20.9
	Presence of surface flowing water	1089	6.7
	Presence of herbs	1643	10.1
	<b>Total frequency</b>	<b>16193</b>	<b>100.0</b>
<b>Average number in plot of land</b>	Households	4	
	Adults (Age≥15 Years)	6	
	Children (age ≤5 years)	4	
	Toilets	2	

**Types and quality of toilets:** 7014 households from Kolwezi were visited: 59.2% or 4155 households were from the commune of Manika and 40.8% or 2859 were from Dilala. These households had plots characterized by a clean yard (48.1%), dry (61.4%), humid (17.26%) covered by trees in 34.0% of cases, with the presence of grass 23.42% and a flow of water not controlled in 15.52% cases. The plots had on

average: 4 households with 6 children over 15 and 4 under 5 and two toilets.

**Environmental conditions near toilets and locations of water sources:** 45.8% of toilets were of the Turkish type; 38.5% were seated and 15.7% were makeshift toilets. The roof was present on 58.16% of the toilets, 62.11% of them had a door and 57.57% were of fired brick construction.

**Table 2. Types and quality of toilets**

Quality of toilets	Variables	No.	%
Kind of toilets	Turkish	3213	45.8
	Seat	2701	38.5
	Unclassified (Make-shift)	1100	15.7
	<b>All toilets</b>	<b>7014</b>	<b>100.0</b>
Roof	Without roof	1132	16.1
	With roof	4080	58.2
	Unclassified	1802	25.7
	<b>All toilets</b>	<b>7014</b>	<b>100.0</b>
Door	Without door	971	13.84
	With Door	4357	62.12
	Unclassified	1686	24.04
	<b>All toilets</b>	<b>7014</b>	<b>100.0</b>
Types of construction	Adobe brick	470	6.7
	Baked bricks	4038	57.6
	Unclassified	2506	35.7
	<b>All toilets</b>	<b>7014</b>	<b>100.0</b>

**Table 3. Environmental conditions near toilets and locations of water sources**

<b>Characteristics</b>	<b>Variables</b>	<b>Frequency (No.)</b>	<b>Frequency (%)</b>
Environment near toilets	Humid	1903	17.4
	Shady	3413	31.2
	Presence of toilet potties infants	2607	23.8
	Presence of herbs	1802	16.4
	Presence of plants (e.g., banana, sugar cane)	1221	11.2
	<b>Total frequency</b>	<b>10946</b>	<b>100.0</b>
Environment near water sources	Public	2874	36.7
	Drilling	3219	41.1
	Open well	385	4.9
	Closed well	861	11.0
	River	116	1.5
	Lake	27	0.4
	Kishimpo	346	4.4
	<b>Total frequency</b>	<b>10946</b>	<b>100.0</b>
Environment near location of water sources	Near the toilet	775	11.0
	Near trees (e.g., banana and sugar cane)	953	13.6
	Far from toilets and trees	5286	75.4
	<b>Total frequency</b>	<b>7014</b>	<b>100.0</b>

The environment of the toilets is shown in Table 3. Frequency of those shaded was 48.65%, humid (27.13%), presence of grass (25.69%) and trees (17.40%), and presence of un-emptied toilet pots for children under 15 (37.16%). The water source was either private by drilling (45.89%), public (40.97%), manually dug closed wells (12.27%), manually dug open wells (5.48%), lakes (0.38%), rivers (1.65%) or Kishimpo (4.93%). Frequency of water sources placed far from toilets and trees was 75.36%, near toilets (11.04%) and near a tree (13.58%).

It is a known fact that the development of soil-transmitted helminthiasis in the soil depends on several factors that create favorable environmental conditions for the survival of nematode eggs [5]. Studies carried out in other tropical and subtropical areas have investigated the influence environmental factors on the occurrence and intensity of soil-transmitted helminth infections [7,8], where it was reported that these factors significantly favor the survival and development of soil helminth stages.

Rainfall not only provides essential moisture for the development of ova to infective larval stages, but also aids in the dispersal of ova and the migration of larvae throughout the environment [9].

It has been shown that there are more soil-transmitted helminths during wet than dry seasons. This is like other reports in Croatia [10],

Cameroon [11]. and in Nigeria [8], where infection rates were significantly higher during the rainy season than during the dry season. The effect of rain on the dispersal of the larvae is important, a drop can transport the larvae up to 90 cm from contaminated manure. However, the optimum recovery of larvae is only about 5 cm (2 to 3 inches) from the edge of the fecal patch, with numbers decreasing to about 25 cm. Several authors report a migration of the larvae in the soil up to 15 cm deep and up to 40 cm from the center of the faecal mass. Soil type can have a major effect on the ability of larvae to migrate [12].

Although the collection of data was made during the intermediate period between the rainy season and the dry season, it is known that the ova of *Ascaris lumbricoides* record the highest occurrence during the dry months because of the greater resistance of the eggs of *Ascaris lumbricoides* to extreme environmental conditions and can remain viable in the soil for several months due to aestivation which explains their survival in strange and harsh weather conditions, such as extremely hot and dry weather [13].

Also, an inverse relationship between soil conductivity and occurrence of soil-transmitted helminths was found by Letah et al. [14] in Cameroon and Bandung, Indonesia by Muntalif et al. [15]. Thus, the availability and abundance of soil-transmitted helminths are independent of

the conductivity of their environment, and no correlation was found between the parameter and the prevalence of helminth larvae and ova.

The presence of trees and grasses in the plots provides the soil with abundant quantities of organic matter; one would have thought that it would increase the survivability and viability of helminths in the soil. Indeed, studies conducted in Egypt indicated that there was an increase in the abundance of STH with increasing total organic matter (TOM) [16,17]. However, *Strongyloides stercoralis* showed a negative correlation with total soil organic matter. Khieu et al. [18] reported that a high amount of total organic carbon, which is a major constituent of total organic matter, does not seem to favor the survival of *Strongyloides* larvae in the environment.

Fig. 1 shows that the temperature forecasts for the city of Kolwezi vary between the fork of 16°C and 24°C.

The World Health Organization has reported that hookworm and other soil helminths can tolerate a pH range of 4.6 to 9.4 and would still be able to hatch and grow to stages infectious [19,20]. *A. duodenale* and *S. stercoralis* larvae showed a

significant negative correlation with observed soil temperature range. The ovules of *Ascaris* and *A. duodenale* also showed a significant positive correlation with soil conductivity. This shows that the presence of salt ions in the soil favored egg survival and viability, as reported by Amadi and Uttah [12].

In the environment, survival is favored at moderate temperatures (0 to 20°C). Humidity affects the survival of *Tænia* spp. eggs more than temperature. eggs are commonly found on vegetables (0.9-30%) and in soil and water samples (0-43%), their presence posing a risk to the consumer [21]. Invertebrates can function as transport hosts, transferring infection to an intermediate host, but the importance of this route of transmission is still questionable. contamination of food, soil and water can increase the risk of infection for humans and other intermediate hosts [22,23], as can spread via invertebrates and wind [24, 25]. the presence of eggs in soil and water samples [26,27].

From Fig. 2, we see that 65.86% of households use potties for the toilet of children under 5 years old, 73.42% acknowledge having suffered from parasitosis and only 48.37% have had to pass laboratory tests for diagnosis.

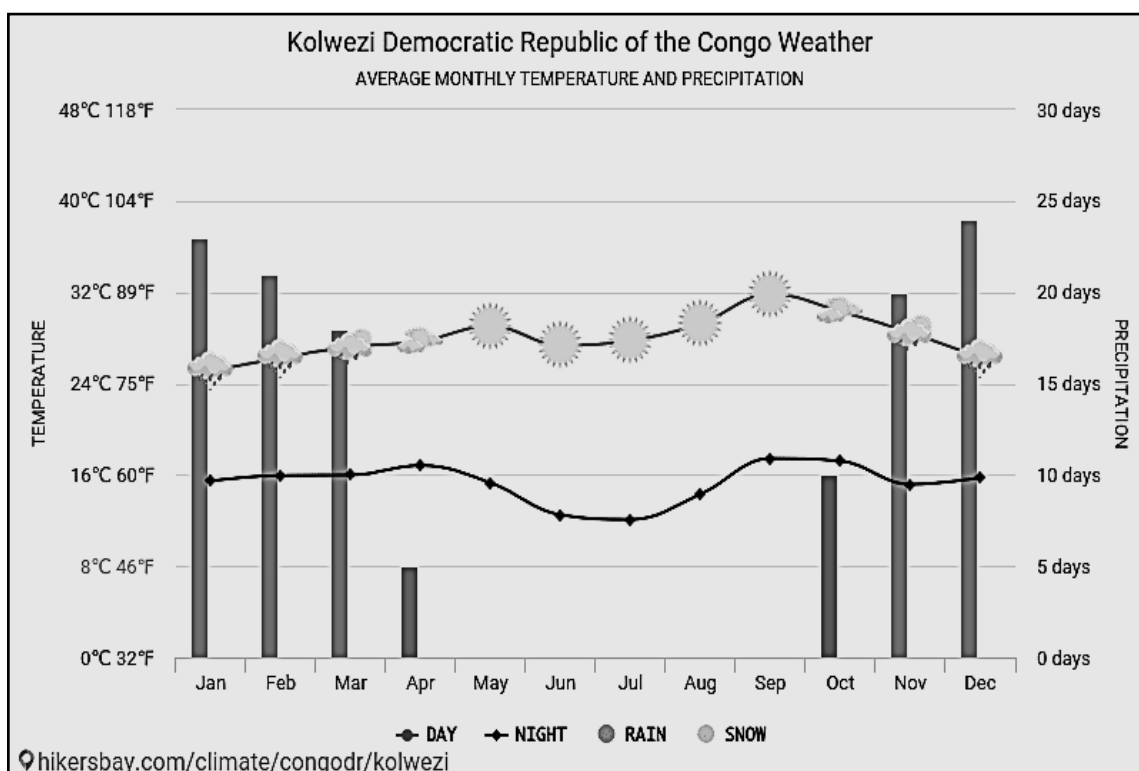
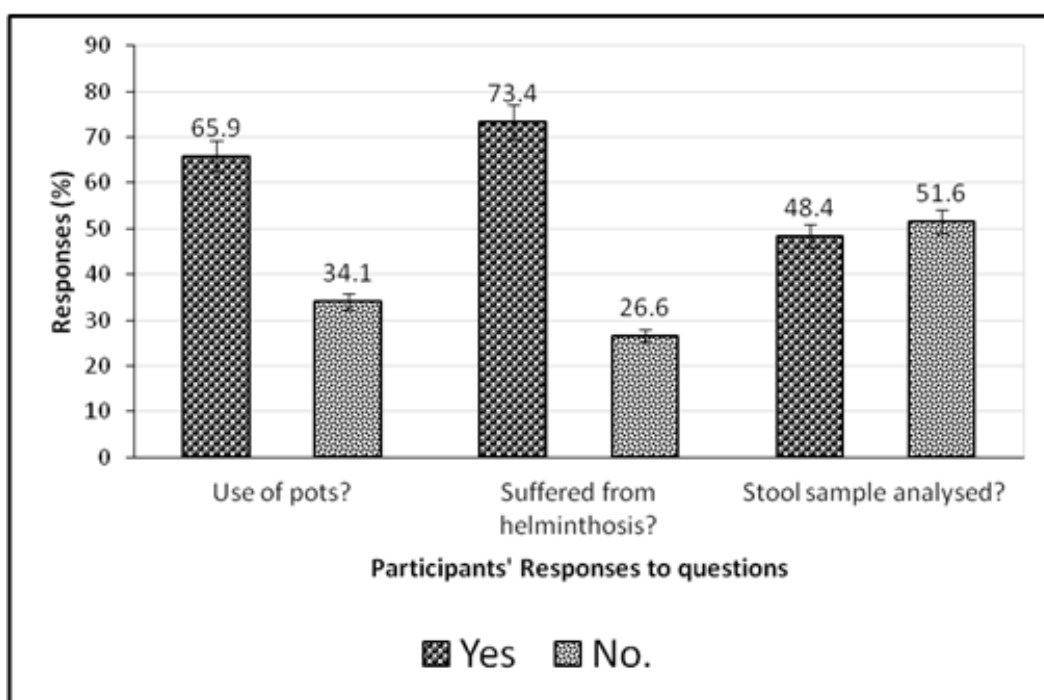


Fig. 1. Monthly temperature and rainfall forecasts in Kolwezi in 2023



**Fig. 2. Helminthosis in households: use of toilet pots and laboratory tests for STHs**

The overturning of toilet pots for children under five, the age group carrying parasites, provides the soil with eggs and larvae. Indeed, the soil remains the main reservoir of the infectious stages of soil-transmitted helminthiasis and serves as an important medium for determining the level of susceptibility of a population to soil-transmitted helminthiasis. The results of the study showed that soil-transmitted helminth infections in endemic areas are not only due to unsanitary and poor living conditions, but also to ecological factors favoring the dispersal and development of the stages. infectious soil helminths [28].

Symptoms include deterioration of the intestines, toxic effects, blood loss, diarrhea, malnutrition, and anemia. Some helminths eat away at the intestinal wall causing bleeding while secreting an anticoagulant. The damage caused by inflammation and the wounds they open generate tumors and growths. Additionally, helminths can block the ducts or cause intestinal obstruction and perforation of the digestive tract causing peritonitis [29].

Helminthiasis can lead to serious collateral effects limiting the physical and mental development of children, especially when

repeated infections occur between 5 and 15 years of age. An estimated 182 million preschool children are infected, about 33% of those living in developing countries [30]. These children show lower height and weight due to undernourishment compared to well-nourished children living in a healthy environment. At the same time, malnutrition leads to poor academic performance and a lower intelligence quotient [31]. Other effects, such as epileptic seizures, violent headaches, dizziness, local paralysis, vomiting, and optical and physical disturbances, have been reported [32].

Helminths are parasitic worms transmitted to humans via their eggs (infectious life stage, Fig. 4). They are the most resistant biological structures to inactivation in the field of environmental engineering [33]. Most helminths are transmitted by direct contact with contaminated soil, crops, or sewage (e.g., *Ascaris lumbricoides*, *Trichuris trichiura*, and hookworms), but some require the presence of intermediate hosts (e.g., garden snails). water in the case of schistosomiasis) [34]. The main species that infect humans are roundworm (*Ascaris lumbricoides*), whipworm (*Trichuris trichiura*) and hookworms (*Necator americanus* and *Ancylostoma duodenale*) [35].

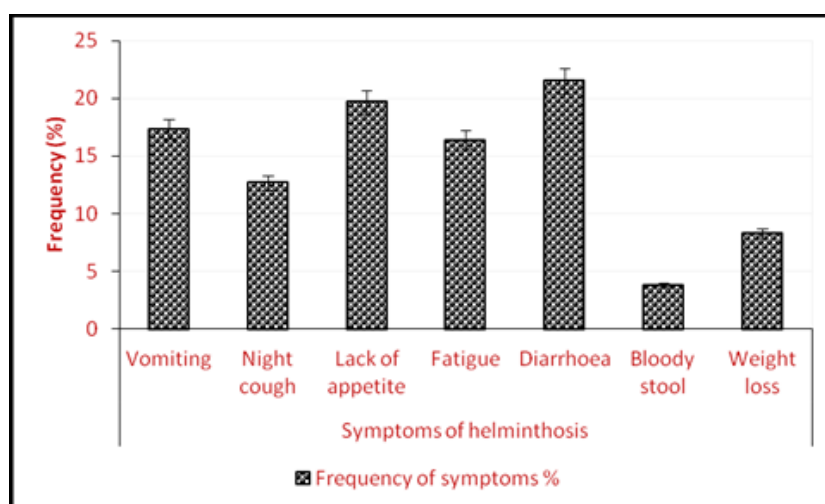


Fig. 3. Frequencies of symptoms of helminthosis experienced in the community

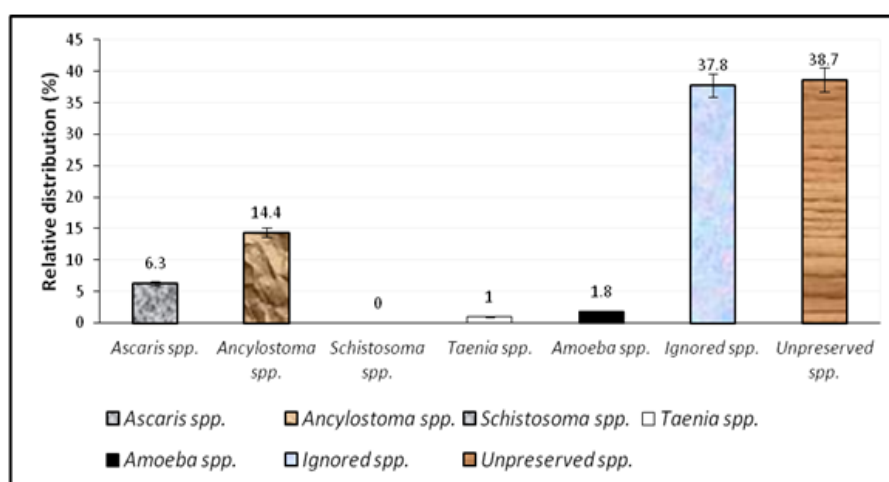


Fig. 4. Relative distributions of parasites in the community

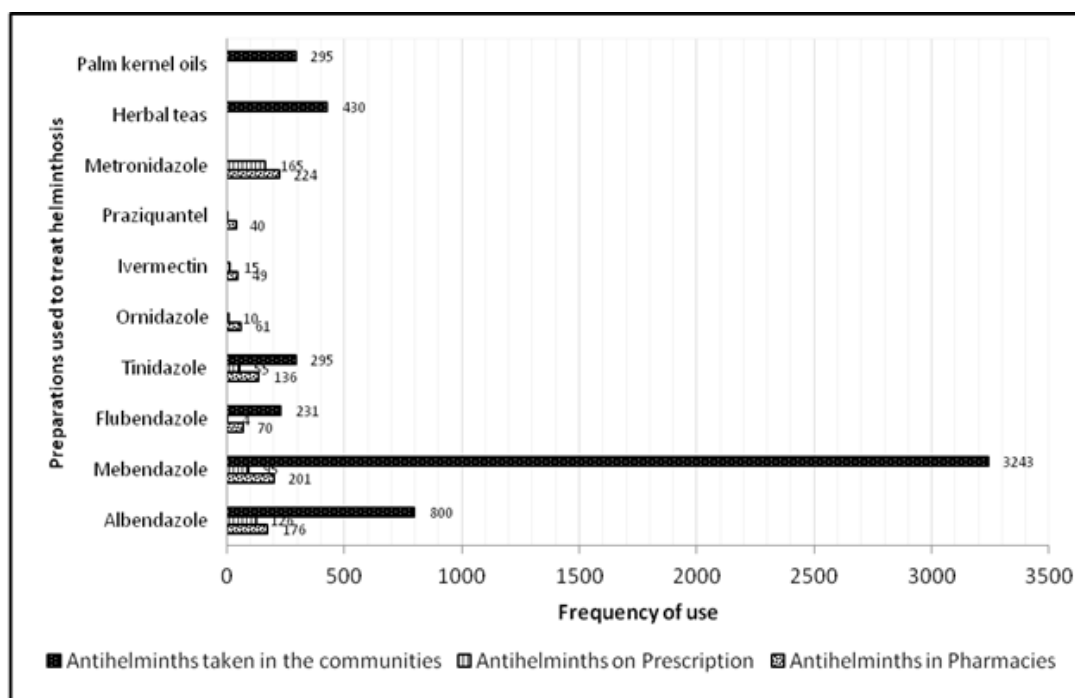
Concerns about their presence are related to their extremely low infectious dose, their high survival rate in the environment for prolonged periods (up to several years, compared to weeks for other pathogens) and their high resistance to conventional disinfection processes [36]. Helminth eggs pose a particular health threat when sanitary conditions are poor, polluted water is used for irrigation, or when excrement or untreated sludge is disposed of uncontrollably. They cause a group of diseases called “helminthiasis” which are given specific names depending on the genus concerned (for example, ascariasis for the genus *Ascaris*) [37].

mebendazole are donated to national ministries of health through WHO in all endemic countries for the treatment of all school-aged children. Generic ivermectin for *S. stercoralis* control has

been available at an affordable price since 2021 [38].

Mebendazole is the most consumed antiparasitic in the community, the most present in pharmacies. Albendazole is the most prescribed and second in terms of consumption in the community and by its presence in pharmacies. the population sometimes uses herbal teas and palm oils as a means of treatment against parasites.

For treatment, WHO recommends Albendazole (400 mg) and mebendazole (500 mg), antiparasitic that are effective, inexpensive, and easy to administer by non-medical personnel (e.g., teachers). They have undergone extensive safety testing and have been used in millions of people with few minor side effects [39].



**Fig. 5. Preparations used for the treatment of helminthosis in the study community**

Albendazole is an anthelmintic antiparasitic. It is a Benzimidazole carbamate. It acts on nematodes, cestodes and certain protozoa. It acts on the cytoskeleton of helminths by inhibiting the polymerization of tubulins and their incorporation into microtubules, thus blocking the uptake of glucose by the parasites, and causing their death. It also has activity on *Giardia intestinalis* (or *duodenalis*). It exerts an irreversible action targeted on the ventral disc of the trophozoite by effect on the polymerization of tubulin and giardin, resulting in disorganization of the cytoskeleton and micro ribbons. The ability to adhere to enterocytes is diminished, resulting in inhibition of parasite growth and multiplication [40].

#### 4. CONCLUSION

Environmental factors that affect temperature, soil moisture, and atmospheric humidity influence the survival rate and development of hookworm larvae, thereby affecting transmission. In this study, increased vegetation (NDVI) and elevation were associated with increased risk of infection as well as increased intensity of infection.

Access to a handwashing facility with soap and water in the household was also associated with lower risk of infection as well as lower infection intensity.

The transmission of parasitic diseases is a fact in Kolwezi, it is carried by the level of housing and sanitation of plots, access to water, the load of children under five in households. important not to neglect the role of flies which function as an important mechanical vector of infectious parasitic forms, which proliferate due to the non-discharge of children's toilet pots having been used as excrement. The fruits and vegetables produced in the area function as vehicles for the parasites, constituting a risk factor associated with transmission due to the marketing of these agricultural products in other areas. This transmission is also favored by geographical, climatic, and meteorological conditions.

It is therefore essential to educate the population to modify habits that could be considered risk factors, while improving adequate environmental sanitation, emphasizing socio-cultural and educational aspects, as well as hygienic practices. public health. These interventions must combine technical and socio-economic actions that guarantee public health, including environmental sanitation in general, and the elimination of other factors that affect the dispersal and transmission of intestinal parasites, such as faecal contamination of soil and water.



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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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