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KNOWLEDGE AND MANAGEMENT OF HELMINTHS INFECTIONS IN COMMUNITY HEALTH CENTRES BASED IN SOWETO, SOUTH AFRICA

PORTIA TONIE

WITS UNIVERSITY

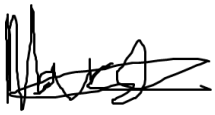
A dissertation submitted to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, in the fulfilment of the requirements for the degree of Master of Science in Medicine.

Johannesburg, South Africa

2025

DECLARATION

I, Portia Tonie, declare that this dissertation report is my own work unaided work. It is being submitted for the degree of Master of Science in Medicine at the University of the Witwatersrand, Johannesburg, South Africa. It has not been submitted before for any degree or examination at any other University.



Portia Tonie

Signed at **Honeydew, Johannesburg** on the **22nd** day of **March** 2024.

DEDICATION

This dissertation is dedicated to my caring and loving parents, Tshilidzi Esther Tonie, and Mashudu Edwin Tonie.

To my supportive Life Partner, Khuthadzo Andrew Magada.

To my dearest brother, Vhutali Robert Mbushi.

To my son, Uapfa Ndivho Tonie.

This achievement would not have been possible without all of you. Thank you.

PRESENTATIONS AND PUBLICATIONS

CONGRESS PRESENTATIONS

- Portia Tonie, Shelley Schmollgruber, Robyn van Zyl – Knowledge and management of Helminths infections in Community Health Centres based in Soweto, South Africa. University of the Witwatersrand Research Day (Oral Presentation) – 05 September 2023
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PUBLICATIONS

The following papers are in preparation to be submitted in 2024/5:

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- Portia Tonie, Shelley Schmollgruber, Robyn van Zyl – An evaluation of the knowledge of Helminthiasis in Soweto community. South African Medical Journal. In preparation.

ABSTRACT

The rising incidences of helminth infections is of global concern. South Africa has a relative gap in research on intestinal helminth even though it remains to be a global health problem. Control of intestinal helminth infections is based on periodic drug treatments to school children or communities. Helminth infections mostly affect deprived communities, and this remains a challenge with the increased rate of re-infection after treatment. To reduce the transmission rate, interventions aiming to improve water, sanitation and hygiene are necessary, as well as vaccine developments. This was a mixed method survey conducted in two phases to study the knowledge, attitude, and practises of Soweto community and healthcare providers (HCP) towards helminthiasis and its management. A standardised questionnaire was used as one of the instruments to obtain information on socio-demographic profile, daily sanitation practices, treatment, management, and history of intestinal worm infection. In depth interviews and focus groups were also conducted amongst HCPs. In total, 409 participants were enrolled in the study, comprising of 362 General Public participants and 47 HCP participants. Over 70% of the participating HCPs in the study sites were not aware of the South African guidelines for the treatment of helminth infections. A total of 67.8% of the HCP participants had heard about intestinal helminths, with 32.2% declaring no knowledge. Only 19.6% of these participants correctly explained what intestinal helminths are, and of these 3.3% thought that helminths were caused by a bacterial infection. Furthermore, 26.5% had no knowledge of intestinal helminths. A total 73.3% of the community participants indicated that they always wash their hands before eating. Over 70% indicated that they have not been treated for intestinal helminths. This study indicates that there is a critical need to further educate the HCPs to empower the public with the necessary knowledge and skills to ultimately protect them from acquiring helminth infections.

Keywords: Helminths, Knowledge, Management, South Africa, Health Care professionals, community

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LIST OF ABBREVIATIONS

EPG	-	Eggs per gram
FGN	-	Focus group number
HCPs	-	Healthcare Providers
KK	-	Kato-Katz
MDA	-	Mass Drug Administration
PCR	-	Polymerase Chain Reaction
PHC	-	Primary Health Care
PN	-	Participant Number
RedCap	-	Research Electronic Data Capture
SES	-	Low-socio-economic status
SSA	-	Sub-Saharan Africa
STH	-	Soil-Transmitted Helminthiasis
WHO	-	World Health Organization

1 CHAPTER ONE: BACKGROUND AND AIM OF STUDY

1.1 BACKGROUND OF THE STUDY

Helminths infections have always been a public burden worldwide, affecting the poorest and most deprived communities such as those in sub-Saharan Africa, China, South America and Asia (WHO, 2023). They are one of the most prevalent global infections with an estimation of 1,5 billion infected people, with the highest reported cases coming from Sub-Saharan Africa (WHO, 2023). Helminthic infections remain undiagnosed in many patients, this can result in a lot of complications (Amin and Wadhwa, 2023). A study conducted to assess the distribution of the global burden of soil transmitted helminth infections (STHIs) has shown that STHIs remain a global burden in 2021 and this is particularly seen in middle parts of Africa and America, in the age population of 5-19 (Chen et al., 2024).

The higher prevalence of transmission has been attributed to poor sanitation, lack of proper hygiene, access to clean water, open-field defecation, lack of adequate health services, and limited awareness (Meleko et al., 2023). Soil transmitted helminth infections (STHIs) are very common in rural areas and in communities of a low socio-economic status or low- income (Lustigman et al., 2012). People of a high socio-economic status are more likely to be educated and knowledgeable about helminths infections. They are also likely to earn a high-level income that enables them to adopt proper sanitation practices compared to those of a low socio-economic status (Malavade, 2015). Socioeconomic conditions is more determinant, however knowledge has also shown to contribute in some previous studies. One study conducted in Ghana reported that participants mentioned that ringworms are a sign of helminth infestation, whereas it is a fungal infection. This shows that many people still have a misconception about helminth infections (Apenteng et al., 2024).

A study conducted in Ghana indicated that education also had a significant association with knowledge and attitude with participants who had tertiary education proportionally having the highest percentage of excellent knowledge and very good attitude (Orish et al., 2023). However, Palmeirin et al. (2018) findings in a study conducted in rural Côte dIvoire, failed to

detect the association between education and knowledge of intestinal helminth infections and these were justified by the differences in geographical, social, and cultural conditions suggesting that knowledge did not necessarily decrease the rate of infection as they found that children with a high general knowledge score had similar infection prevalence as those with less knowledge. Preventative chemotherapy has long been considered the standard form of controlling intestinal helminths (Keiser and Utzinger, 2019) and together with regular supply of clean water and sanitation are important strategies that have been employed by the World Health Organisation (WHO) (WHO, 2023). However, having these measures in place does not guarantee adequate usage or sustained implementation. Instead, improving health- and hygiene-related education might influence behavioural changes, leading to a reduction in the exposure to intestinal helminths (Palmeirim et al., 2018).

In South Africa, there has been an important law change which reclassified helminths infections as a category 2 notifiable condition, this should help to provide statistics to better track and manage helminth infections (NICD,2018). Most helminth control programs and research focus more on treatment and less on environmental considerations and health education that can ensure sustainability. For this reason, equipping community members with the basic knowledge and background of helminth infections might reduce the occurrence of infection in communities and in return diminish the burden on healthcare providers (HCPs) in public clinics and hospitals. Research is crucial in this field to improve the knowledge of Soweto community and HCPs. The outcomes of the research may be used to innovate new tools for intervention and education.

1.2 PROBLEM STATEMENT

Helminths infections are common in rural areas and communities of low-socio-economic status (Lustigman et al., 2012). Although the infections are rarely fatal, they may impair growth, physical fitness, cognition, and reduce school performance (Huat et al., 2012). The major group at high risk are children of preschool age, school age, and women of childbearing age (Mukutmoni et al., 2023); along with people living in rural communities, low socioeconomic or low-income communities. Research has shown that inhabitants of low and

some middle-income areas are less likely to be educated and knowledgeable about intestinal helminth infections. Soweto is a high populated and middle-income area, and it will be beneficial for both the community and HCP be knowledgeable about intestinal helminthiasis.

1.3 RESEARCH QUESTION

The study attempted to answer the following research question:

To what extent do the general population of Soweto and healthcare providers have an adequate level of knowledge on intestinal helminths *infections, such as possible causes and ways to prevent and manage infections?*

1.4 AIM OF THE STUDY

To determine the knowledge and management of intestinal helminthic infections in four community health centres in Soweto, South Africa.

1.5 OBJECTIVES

- To determine the knowledge of Intestinal helminthic management among healthcare providers and community members in community health centres in Soweto.
- To establish whether the healthcare providers follow the South African Department of Health therapeutic guidelines and what measures they take in the management of intestinal helminthiasis.
- To determine the common health practices among caregivers in the Soweto community.
- To determine whether community members use alternative therapies to those recommended by the South African Department of Health.

1.6 STRUCTURE OF THE DISSERTATION

To achieve the aim and objectives of this study, the dissertation has been set out as follows:

- Chapter one provides a brief background to the study leading into the aim of the study and the objectives used to achieve this aim.
- Chapter two is the introduction to helminths in South Africa and the relevance of the various species of helminths and their prevention and treatment.
- Chapter three, include the details of the research design, setting, patient groups and the various methods, analysis and statistics used.
- Chapter four outlines the findings of this study presented in two parts namely quantitative and qualitative finding. Descriptive and inferential statistics were used to analyse the data. Thematic analysis was used for the qualitative data.
- Chapter five is a discussion of the quantitative and qualitative data collated considering the South African Department of Health Guidelines and the interpretation of results and integration of data.
- Chapter six concludes the study indicating some limitations encountered in the study; along with recommendations arising from the study for future investigation.

1.7 SIGNIFICANCE OF THE STUDY

The study sought to obtain an understanding of Soweto community member's knowledge regarding intestinal helminthiasis. It intended to describe experiences and perceptions of HCPs towards helminthiasis and its management at the clinics in Soweto. The results of this study could contribute to the innovation of new tools to educate communities and HCPs, which can have a positive impact in clinical practice, community well-being and children. It could improve the services offered at the clinics and drive them towards a more educational approach.

2 CHAPTER TWO: LITERATURE REVIEW

2.1 INTRODUCTION

The word "helminth" comes from the Greek word meaning “worm”. Helminths appear to be a significant contributor to global health problems (Tekalign et al., 2019), where they affect more than a quarter of the world’s population and can cause substantial disease and disability (Jourdan et al., 2018). Intestinal helminthiasis is widespread amongst children living in tropical and subtropical areas, although they are rarely fatal, they may impair growth, physical fitness, and cognitive performance in those affected. Intestinal parasites are transmitted through food, water, and hands i.e. via faecal-oral human to human transmission. Warm climates and adequate moisture, lack of personal or environmental hygiene, sanitation, education, and poor health or nutritional status are known to increase the risk of intestinal worm infections. Due to children’s playing habits, lack of natural immunity and low level of awareness, children are at greater risk to contract and spread these infections (Alelign, Degarege and Erko, 2015)

2.2 GLOBAL DISEASE BURDEN

STH have always been a burden worldwide, especially in developing countries such as China, India, and Africa (WHO, 2023). In 2021, 1.65 billion people were reported to require some form of treatment and care. At the end of 2022 the South-East Asia region had the largest number of people infected (857 million, followed by the Africa region with 584 million cases. The remaining regions accounted for 212 million people requiring intervention (Figure 2.2.1). The positive trend observed between 2020 and 2021 was potentially due to the interruptions caused by the COVID-19 pandemic, which led to closure of schools across many countries. This affected school-based deworming campaigns for the distribution of albendazole and mebendazole (WHO, 2023). Major disruptions were also observed in healthcare facilities that severely impacting health products supply chains such as medication for helminths infections.

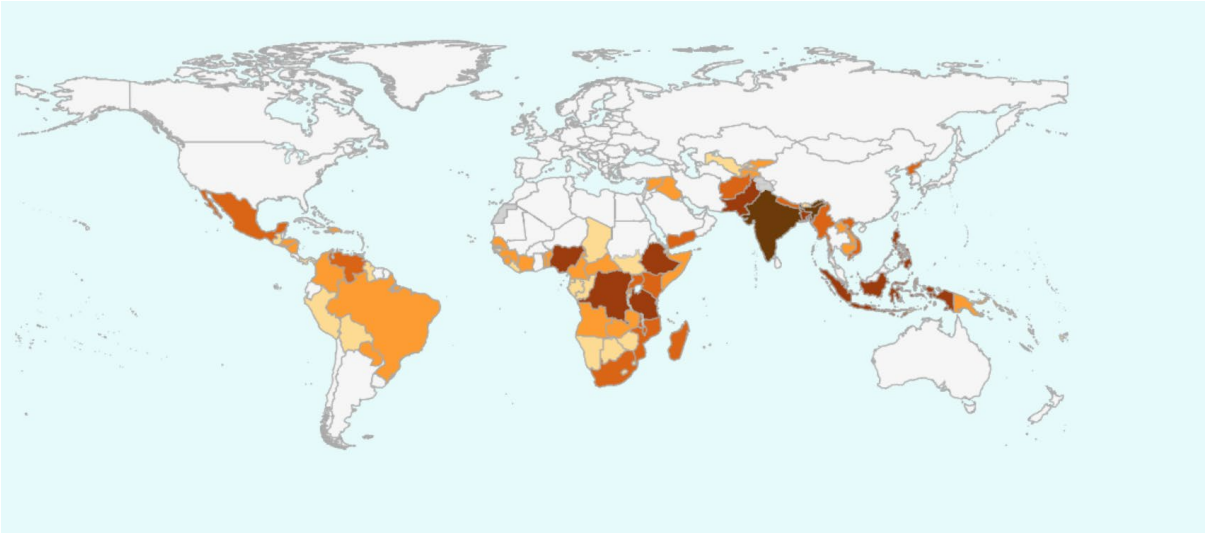

Figure 2.2.1: 2022 Global distribution of soil-transmitted helminths (WHO, 2022). Where soil-transmitted helminths are a group of intestinal helminths that include *Ascaris lumbricoides* (giant roundworm), *Trichuris trichiura* (whipworm), and *Ancylostoma* spp. (*A. duodenale, A. ceylanicum*) and *Necator americanus* (hookworms).

Helminths infections are common in rural areas and communities of low-socio-economic status (Lustigman et al., 2012). People of high socio-economic status are more likely to be educated and knowledgeable about helminth infections. They are also likely to earn a high-level income that enables them to adopt proper sanitation practices compared to those of low socio-economic status (Malavade, 2015). Although it is most common in low-income and middle-income regions, helminth infections can also affect people in high-income regions in vulnerable populations including immunosuppression, certain malignancies,human T-cell lymphotropic virus type 1 infection, and alcoholism (Palmeirim et al., 2018).

Other studies investigating the knowledge of helminth infections reported a potential misconception in community members; where there was confusion between helminth infections with the ringworm, which is a fungal infection (Palmeirim et al., 2018; Apenteng et al., 2024). It has also been reported that most of the participants preferred to seek medical assistance in public/ government hospitals with the belief that the public sectors perform thorough tests to ensure proper diagnosis and treatment. Other participants preferred using over the counter medications due to some disadvantages encountered in public hospitals and

clinics namely: travelling long distances, long queues, lack of examination equipment, shortage of medications, and HCPs showing lack of interest in carrying out diagnostic tests such as stool samples (Palmeirim et al., 2018). A study undertaken in KwaZulu-Natal, South Africa indicated a significant misconception on signs, symptoms, transmission, and prevention of schistosomiasis, where the latter was confused with sexual transmitted infections (Sacolo-Gwebu, Kabuyaya and Chimbari, 2019).

South Africa appears to have a moderate burden of helminth infections (Müller et al., 2017). A Study conducted in Qheberha indicated that only 7.2% of children were infected with at least one intestinal helminth species (Nqweniso et al., 2023). At the end of 2018 there were government policy changes where helminths infections were reclassified as a notifiable disease under category 2 notifiable medical conditions, which requires written or electronic notification within 7 days of diagnosis. The cases had to be notified following laboratory confirmation by the HCP receiving the results. Currently the number of annual infections remain unknown (Molvik et al., 2017). In addition, the knowledge, attitude, and perception of helminth infections within the Gauteng and Soweto area are also unknown. Most reported cases of helminths infections come from the Western Cape followed by Kwazulu-Natal, then Mpumalanga. Another study that was conducted in South Africa which aimed to estimate the prevalence and trends of public sector laboratory-confirmed schistosomiasis cases between 2011 and 2018, indicated that the geographic distribution of human schistosomiasis is limited to areas such as northern and eastern sections of South Africa, parts of the North West and Gauteng provinces, most of Limpopo, Mpumalanga and KwaZulu-Natal provinces, and parts of the Eastern Cape Province. The predominant species found in South Africa is *Schistosoma haematobium*, which causes urogenital schistosomiasis, however, there has been cases of *Schistosoma mansoni* that cause intestinal schistosomiasis observed in certain areas (De Boni et al., 2021).

A study conducted in Kwazulu-Natal describing risk factors associated with HIV and intestinal helminths infections indicated *Ascaris lumbricoides* to be the most predominant amongst adults residing in areas with poor sanitary conditions. A high prevalence of intestinal helminths infections has been reported in Kwazulu-Natal due to its subtropical weather (Mpaka-Mbatha, 2023). One other study focused on the impact of intestinal helminths on

ruminant, investigating the knowledge and attitudes towards gastrointestinal parasites including helminths in the Eastern Cape province. It was concluded that even farmers need to be educated on the infection and transmission dynamics of intestinal parasite infections to develop appropriate measures against intestinal infection (Jansen et al.,2022).

2.3 CLASSIFICATION OF HELMINTHS

There are three main groups of helminths, namely, trematodes, cestodes, and nematodes (Figure 2.2.2) (Mahapatra et al., 2022). The STH nematode group includes *Ascaris lumbricoides* and *Strongyloides sterocoralis* (roundworms), *Trichuris trichiura* (whipworm), *Ancylosta duodenale* and *Necator americanus* (hookworms) (Jourdan et al., 2018), with the trematode group consisting of *Schistosoma mansoni*, *Schistosoma haematobium* and *S. japonicum* (Wright et al., 2018). The main species that infect humans are *Ascaris lumbricoides, Trichuris trichiura, Necator americanus* and *Ancylostoma duodenale*. Globally, it is estimated that more than 500 million individuals are infected with hookworms, 460 million with whipworms, and more than 800 million with roundworms (Riaz et al., 2020).

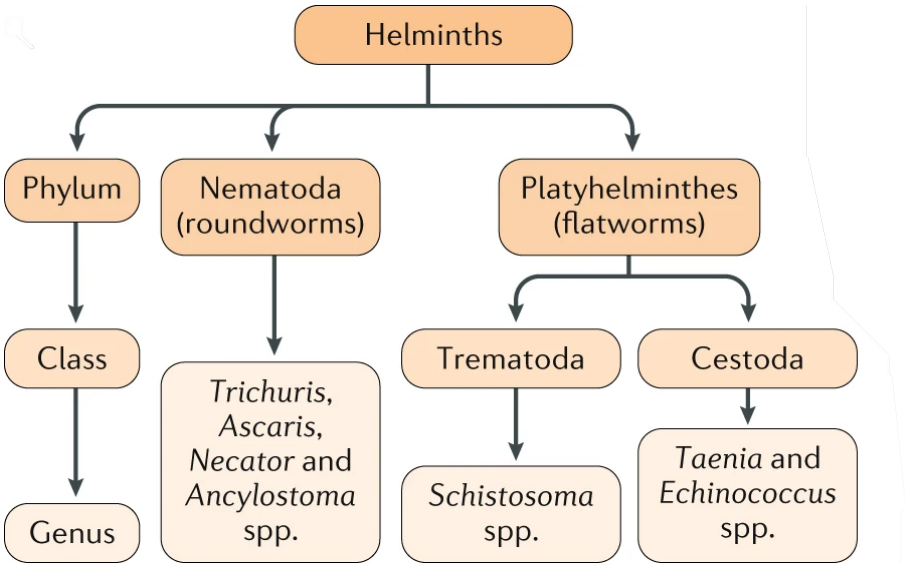

Figure 2.2.2: Helminthes taxonomic categories infecting humans. Where the STHs include *Ascaris lumbricoides* (giant roundworm), *Trichuris trichiura* (whipworm), and *Ancylostoma* spp. (*A. duodenale, A. ceylanicum*) and *Necator americanus* (hookworms) (Else et al.,2020)

2.3.1 WHIPWORM

Trichuris trichiura (whipworm*)* causes trichuriasis mainly affecting humans in East Asia, China, sub-Saharan Africa, and some parts of America (WHO, 2023). Findings based on data collected from studies conducted between 2010 until mid-2023 revealed a global prevalence of *Trichuris* infection at 7.1%, indicating that about 513 million individuals worldwide are affected by *Trichuris* (Behniafar et al, 2024). They are commonly known as "whipworm" due to their whip-like structure that is usually pink in colour and attaches to their host via the slimmer anterior end. They vary in length from 3 to 5 cm (Figure 2.2.3), with the female worm being larger than the male and the female able to lay 2,000 to 10,000 eggs per day (Hailu, Tafesse and Hailu, 2020).

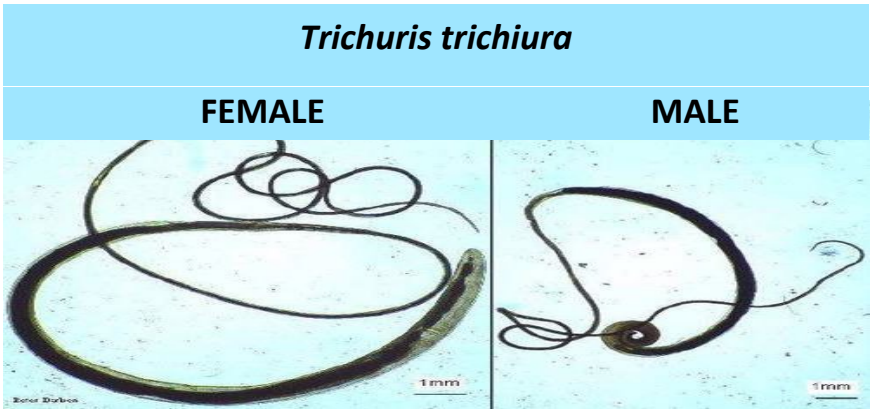

Figure 2.2.3: Structure of female and male whipworms (Karki, 2020).

2.3.2 HOOKWORMS

It is estimated that approximately 740 million individuals are infected with hookworms (Mpaka-Mbatha et al., 2023) Both species of hookworms have particular transmission paths, where the *Necator americanus* is transmitted only via penetration through the skin and *Ancylostoma deodenale* is transmitted percutaneously, orally, and transplacental (Hailu, Tafesse and Hailu, 2020). Morbidity associated with chronic infection includes intestinal blood loss, anaemia, and protein malnutrition (Ghodeif and Jain, 2023). The naming of the hookworm is based on the anterior portion of the worm facing forward demonstrated as a hook (Figure 2.4).

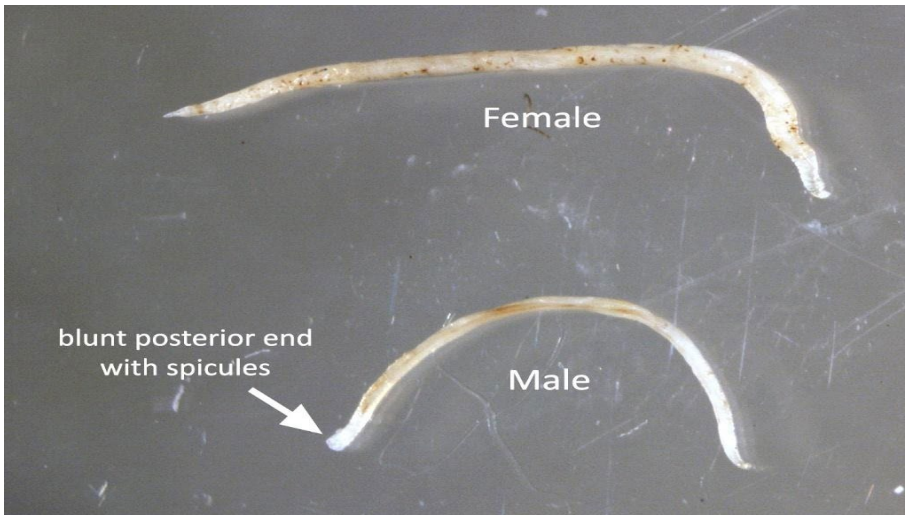

Figure 2.4: Structure of female and male hookworms (Adams et al., 2023).

2.3.3 ROUNDWORM

The roundworm, *Ascaris lumbricoides* that causes ascariasis in humans, has the highest prevalence rate amongst the various neglected tropical diseases, infecting approximately 1.2 billion individuals globally (WHO, 2023). It has been estimated that approximately 500 million people, mainly in tropical and subtropical regions, suffer from roundworm infections. It causes significant public health issues, especially among school-aged children (Hailu, Tafesse and Hailu, 2020). Roundworms mainly target children in developing countries and may cause severe iron deficiency anaemia and malnutrition, this may result in physical and mental retardation. The blood-feeding nematodes, *N. americanus* and *A. duodenale* have caused substantial loss of financial and disability-adjusted life years annually (Hailu, Tafesse and Hailu, 2020).

2.3.4 TAPEWORM

Taenia saginata, T. solium, and *T. asiatica* cause taeniasis and they infect both humans and animals worldwide living in the small intestines after being ingested by eating raw or undercooked beef or pork (Hailu, Tafesse and Hailu, 2020). Symptoms are usually non-existent and thus taeniasis is under-reported. People infected by taeniasis — with or without symptoms — will shed tapeworm eggs in their faeces and might accidentally contaminate their environment. Their length can range between 2 to 12m (Figure 2.5)



Figure 2.5: Tapeworm location of infection and length (Hailu, Tafesse and Hailu, 2020).

2.4 ETIOLOGY AND LIFE CYCLE OF HELMINTHS

The risk of acquiring helminth infections is determined by a coexistence of multiple factors, including environmental, behavioural, social, and biological factors, both at an individual and community level. Different markers of social advantage such as, home ownership, occupation, education, TV/radio ownership, demographic factors (ethnicity, place of residence either urban/rural, mother's age, and gender), and the factors associated with lifestyle and housing (use of soap, place of cooking, domestic animals, method of waste disposal, water source, type of toilet, and roof type are potential risk factors that can be explored (Riaz et al., 2020).

Transmission of intestinal helminths is usually through contact with infected faeces or ingestion of undercooked or uncooked meat, drinking infected water, contaminated soil, direct contact with an infected person, zoonotic transmission, and skin absorption (Figure 2.6) (Hailu et al., 2020). There is no direct person-to-person transmission, or infection from fresh faeces, because eggs passed in faeces need approximately 3 weeks to mature in the soil before they become infective (WHO, 2023).

The route of infection for *Ascaris lumbricoides* is through the faecal-oral route (Jourdan et al., 2018) (Figure 2.6A) where an egg travels through different stages, hatching, penetration of intestinal mucosa, and migration to the pulmonary circulation (Jourdan et al., 2018). Thereafter, it traverses the tracheobronchial tree to the larynx and into the small intestine to moult into an adult worm. The adult female worm can produce a thousand of eggs per day (Table 2.1) which can remain in the gastrointestinal tract (GIT) or pass into the stool to infect

a new host. The production of these eggs can only occur 2-3 months post infection and can live for a few years in warm and moist soil (Jourdan et al., 2018).

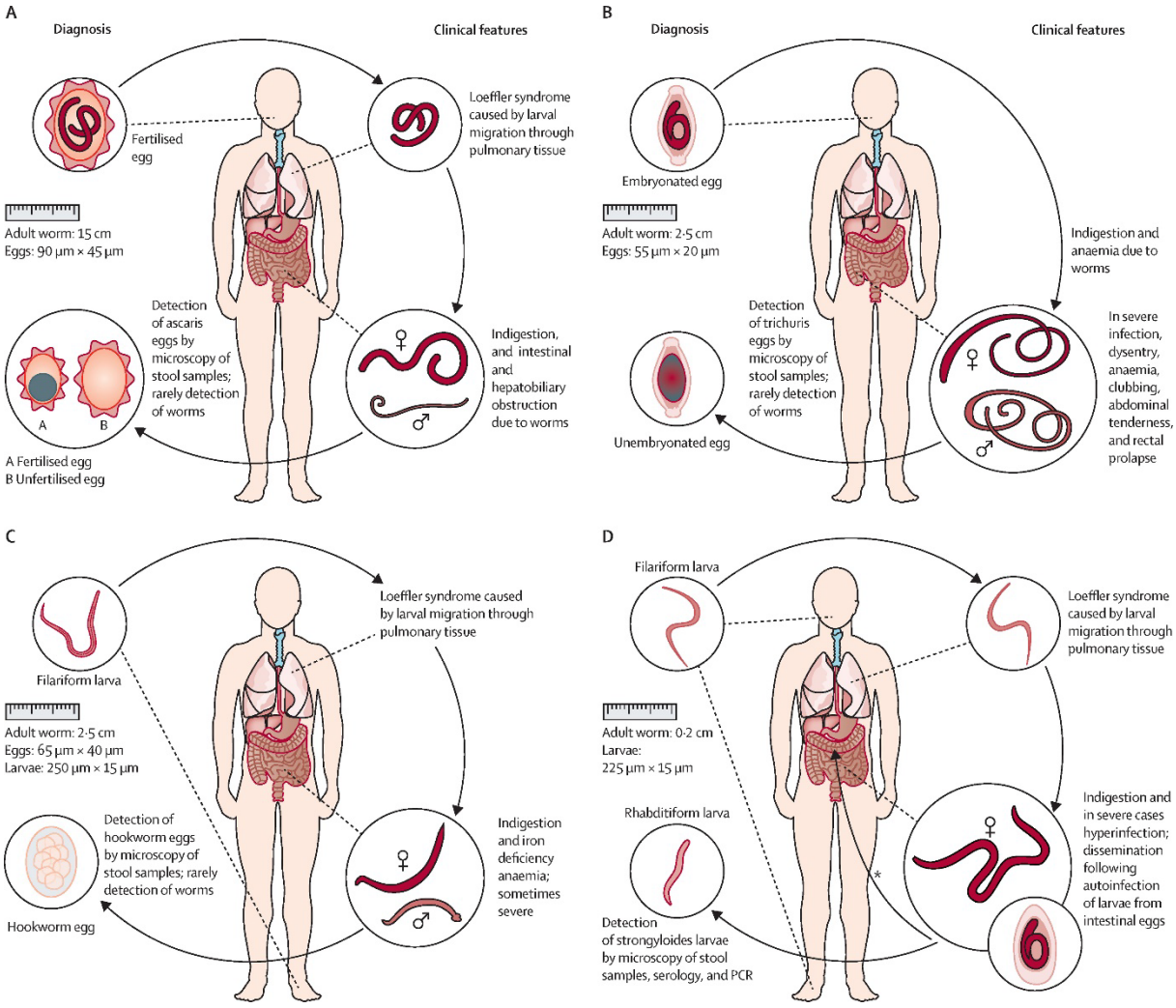

Figure 2.6: Transmission of *Ascaris lumbricoides* (A), *Trichuris trichiura* (B), hookworm (*Ancylostoma duodenale* and *Necator americanus*; C), and *Strongyloides sterocoralis* (D) (Jourdan et al., 2018).

Table 2.1: Helminths characteristics ((Jourdan et al., 2018).

Species	Length (mm)	Daily egg output per female worm	Location in host	Lifespan (years)
Ancylostoma duodenale	8–13	25,000–30,000	Upper small intestine	5–7
Ascaris lumbricoides	150–400	200,000	Small intestine	1
Necator americanus	7–13	9,000–10,000	Upper small intestine	5–7
Trichuris trichiura	30–50	3,000–5,000	Caecum and colon	1·5–2·0

Trichuris trichiura's route of transmission is also via the faecal-oral cycle (Jourdan et al., 2018). (Figure 2.6B). Their larvae unlike those of *Ascaris lumbricoides*, do not migrate through the lungs they instead travel straight to the colon by attaching to the intestinal villi, where they develop into adult helminths, and are excreted through the stools. *Ancylosta duodenale* and *Necator* live freely in the soil and can directly penetrate though the skin. The larvae travel to the pulmonary system and then develop further into mature helminths in the small Intestines (Figure 2.6C). The larvae inside the egg can survive for months (*A. duodenale*) or years *(N. americanus*) (Figure 2.6C).The female helminths have the ability to produce thousands of eggs at a time and release these eggs the anus or into the stool where they can hatch in the soil after a couple of days. Additionally, *A. duodenale* can be orally ingested, potentially resulting in nausea, vomiting, pharyngeal irritation, cough and dyspnoea (Wakana Syndrome).

In comparison, *Strongyloides stercoralis* has a complex life cycle that is likely to take multiple routes, including a life cycle outside the human host (Figure 2.6D) (Jourdan et al., 2018). The schistosome's route of transmission is through the skin from fresh water, larvae migrate to the lungs, then to the left heart into circulation. The larvae mature in the liver and then migrate to the mesenteric vessels of the bowel or bladder where females lay eggs that either develop within the host or are excreted with faeces or urine (Lisak et al., 2016).

2.5 IMMUNOLOGY

Helminths generally have a complex life cycle involving several developmental stages. An infected host gets exposed to these different stages with each stage having its own unique collection of antigens. The immune response to a helminth infection is primarily dependant on the type of helminth and location (Wong, Anuar and Tye, 2023). Helminth infections mainly trigger a T-Helper 2 (Th2) type response that is characterised by secretions of cytokines, such as interleukins-4, -5, and -13, as well as antibody production such as immunoglobulins IgG1, IgG4, and IgE. It also involves the cell-mediated Th1/Th2 and Th17 responses that includes leukocytes, such as mast cells, basophils, eosinophils, M2 macrophages, and type-2 innate lymphoid cells (Figure 2.7) (Wong, Anuar and Tye, 2023; Broxterman et al., unpublished).

Table 2.2: Classification of helminths (Mpaka-Mbatha, Naidoo; Isl, 2022; WHO, 2023; Hailegebriel, Nibret and Munshea, 2020; Amin and Wadhwa, 2023.

Common name	Scientific name	Country of prevalence	Global Prevalence (million)	Prevalence In Sub-Saharan Africa (%)	Structure	Route of infection	Organ of Infection	Symptoms	Transmission
Trematodes									
Flukes	*Schistosoma mansoni*	Africa, the Middle East, Caribbean, Brazil	230	90	The adult worms are 1-2 cm long and has a cylindrical shape	Penetration of the skin	Mesenteric veins	Diarrhoea, abdominal pain, hepato-splenomegaly blood in stool,	During contact with contaminated water containing parasite eggs
	Schistosoma haematobium	Africa, the Middle East, Corsica (France)				Penetration of the skin	Mesenteric veins	Cystitis, urethritis, haematuria calcifications in the bladder	During contact with contaminated water containing parasite eggs
Nematodes									
Whip-worm	*Trichuris trichiura*	East Asia, China, sub-Saharan Africa	795	11.6	Whip-like structure that is usually pink in colour and attaches to their host via the slimmer anterior end.	Faecal-oral route.	Intestinal mucosa	Petechial lesions, mucosal haemorrhage, oozing, colonic inflammation, and Anaemia	Through ingestion of infective eggs
Round-worms	*Ascaris lumbricoides*	Worldwide	500	13.6	Long Cylindrical worms. Female relatively larger than the male.	Faecal-oral route.	Lungs	Abdominal discomfort, pain, cough	Through ingestion of infective eggs

Table 2.2 continued: Classification of helminths (Mpaka-Mbatha, Naidoo; Isl, 2022; WHO, 2023; Hailegebriel, Nibret and Munshea, 2020; Amin and Wadhwa, 2023.

Common name	Scientific name	Country of prevalence	Global Prevalence (million)	Prevalence In Sub-Saharan Africa (%)	Structure	Route of infection	Organ of Infection	Symptoms	Transmission
Pin-worms	*Enterobius vermicularis*	Worldwide	200	26.3	The white worms are slender with a pointed tail. Female worms are longer than males.	Faecal-oral route.	Intestines	Itching and prickling sensation in the perianal area	Through direct transfer of infective eggs by contamination
Hook-worms	*Necator americanus* and *Ancylostoma duodenale*	Worldwide	740	13.6	Parasitic female worms longer than males, S-shaped body shape of *Necator americanus* compares to C-shaped *Ancylostoma duodenale*	Penetration of the skin	Lungs	Itching and localised rash.	Penetration of the skin
Cestodes									
Tape-worms	*Taenia saginata*	Worldwide	2.56-8.30	30	Flat shaped adult worm resembling a long ribbon. Complete body length: 4-12 meters	Faecal-oral route.	Intestines	Abdominal pain, nausea, diarrhoea, or constipation	Through ingestion of contaminated food or water and raw or under-cooked beef
	Taenia solium	Worldwide		30	The complete body length can reach 2-8 meters	Faecal-oral route.	Intestines	Severe headache, blindness, convulsions, and epileptic seizures	Cysticercosis through ingestion of contaminated plants (strawberries)

This response reduces parasite burden by offering protection of host tissues by mitigating tissue damage associated with the trafficking of these parasites and by facilitating helminth expulsion from the body (Chen et al., 2022). This process involves producing helminthic effector molecules like resistin-like molecule-β, epithelial cell turnover, smooth muscle contraction, heightened mucous and fluid secretion, encapsulation, and barrier formation. Previous animal studies have shown that antibodies also play a vital role in the projection against helminth to a certain degree, and this depends on the type of helminth involved (Wong et al., 2023). In humans there has been a strong link identified between helminth infections and regulatory T-cells activity, especially in asymptomatic patients (White, McManus and Maizels, 2020).

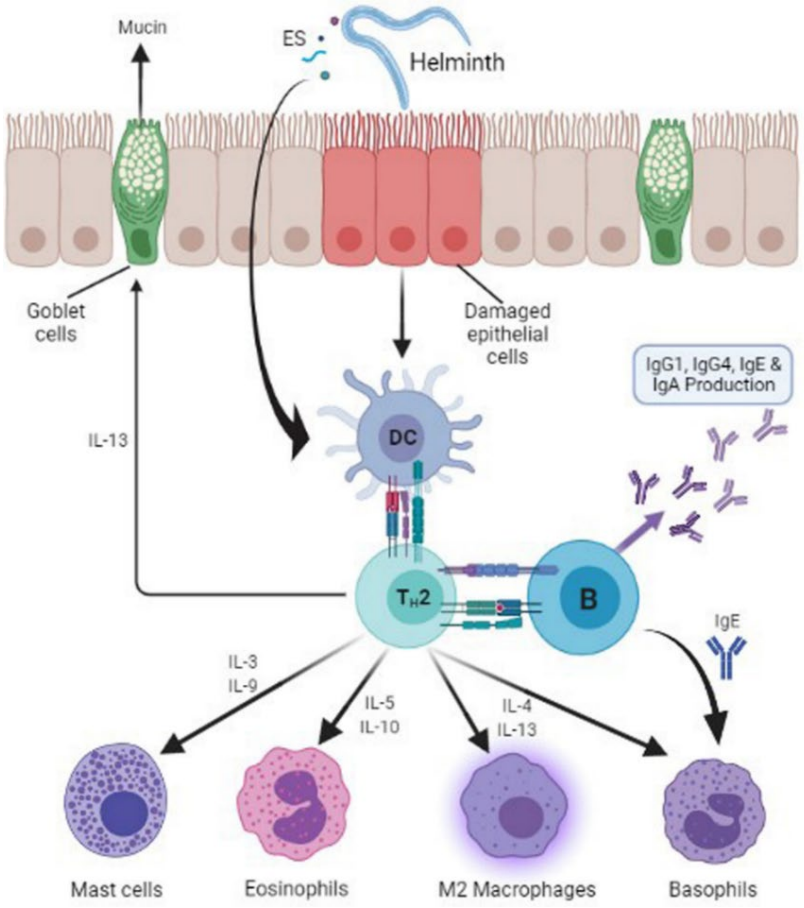

Figure 2.7: Overview of the immune system response against helminths (Wong et al., 2023).

2.6 PATHOPHYSIOLOGY AND CLINICAL PRESENTATION

The clinical manifestation of intestinal helminth infections is usually dependent on the worm burden. The acute phase is usually seen in children, who do not have natural immunity with diarrhoea and gastrointestinal symptoms, as well as the Loeffler's syndrome. Other patients may remain asymptomatic in light infection. However, in heavy infection, patients may be fatigued due to iron deficiency anaemia, abdominal pain, distension, and diarrhoea (Armed, 2023). Generally, helminth infections of moderate intensity tend to cause clinical manifestations in the GIT, and those which are of high intensity are very common in children (Bethony et al., 2006).

One of the most prevalent helminths is *A. lumbricoides* and can affect people of any age group potentially causing growth retardation, respiratory and digestive issues, and decreased physical fitness in massive infestation (Mukutmoni et al., 2023). Adult *Ascaris* can lead to small bowel obstruction, volvulus, or intussusception, especially in children, or can invade orifices leading to appendicitis, cholecystitis, pancreatitis, and gastric ascariasis (Jourdan et al., 2018). Anaemia can also result due to bleeding in the GIT or through inflammation. *Ascaris* induces a predominantly T-helper-2 cell (Th2) immune response, increased eosinophilia and IgE titres are very common in acute infection. Host protection and parasite evasion features are regulated by cytokines particularly interleukin-10 (Jourdan et al., 2018).

Ascaris lumbricoides infection can be asymptomatic or produce mild symptoms. The symptoms depend on the phase of the parasites' life cycle and intensity of the infection. The larvae migration through pulmonary tissue can cause self-limiting inflammation which can result in eosinophilic pneumonia (Loefflers syndrome) (Jourdan et al., 2018). Asthenia, lack of appetite, abdominal discomfort, diarrhoea or other altered bowel habits, and weight loss are very commonly associated with intestinal ascariasis, followed by anaemia, occult fresh faecal blood with mucosal haemorrhage, and many GIT symptoms. *Trichuris trichiura* is also commonly asymptomatic, does not cause Loeffler's syndrome, symptomatic patients often present with asthenia, abdominal pain, and diarrhoea. In severe cases, symptoms include anaemia, digital clubbing, abdominal tenderness, and rectal prolapse.

Anaemia can be severe as the parasite's feeds on the blood of the host tissue leading to proteinaemia and loss of iron (Mukutmoni et al., 2023).

Table 2.3: Clinical features of helminths infections (Jourdan et al., 2018).

Helminth infection	Clinical features		General features
	Larval migration	Adult gastrointestinal parasitism	
Ascariasis	Verminous pneumonia	Lactose intolerance	Impaired growth
		Vitamin A malabsorption	Impaired physical fitness
		Intestinal obstruction	Impaired cognition
		Hepatopancreatic ascariasis	Reductions in school attendance and performance
Trichuriasis	None	Colitis	Abdominal Pain
		Trichuris dysentery syndrome	Diarrhoea
		Rectal prolapse	Rectal prolapse
Hookworm	Ground itch	Intestinal blood loss	Cough
	Cough	Iron-deficiency anaemia	Dyspnoea
	Wakana disease	Protein malnutrition	Haemoptysis

Ancylostoma duodenale and *N. americanus* are also commonly asymptomatic, and their larvae can potentially cause type-1 hypersensitivity reaction (Jourdan et al., 2018). Infected persons often present with itchiness and vesicular lesions. They are less common than ascariasis, however they can potentially cause Wakana Syndrome which comprises of cough, dyspnoea, nausea, vomiting, and pharyngeal irritation. Once the helminths are established in the small intestines, they can cause abdominal tenderness and diarrhoea. They are the major cause of anaemia globally, particularly in children and pregnant women (Jourdan et al., 2018).

S*trongyloides stercoralis* infections are commonly asymptomatic in otherwise healthy individuals. The larvae might cause type-1 hypersensitivity reaction and the adult helminths cause local inflammation in the intestinal mucosa. It commonly presents with eosinophilic pneumonia, cough, dyspnoea, wheezing, and haemoptysis. *Strongyloides* hyper-infection syndrome typically presents as intestinal or pulmonary failure and has a mortality rate of 100% if left untreated (Jourdan et al., 2018).

Taenia can present either as cysticercosis when the tissue is infected with larval cysts or intestinal taeniasis. Cysticercosis is usually asymptomatic but can cause seizures and other neurological signs following eating the eggs excreted in human faeces. Whilst intestinal taeniasis occurs when the adult tapeworms infect the intestine causing mild gastrointestinal symptoms once undercooked pork infected with larval tapeworm is eaten (WHO, 2022).

2.7 DIAGNOSIS

Accurate diagnosis and successful treatment rely on confirmed infection and verification of the helminth species, since the clinical signs of helminth infections tend to be unspecific, and most of the patients are asymptomatic (van Zyl, 2019). Helminths seldom cause mortality; therefore, their impact is measured in disability adjusted life-years; where disability adjusted life-years equals the sum of years of life lost and years lived with disability (Global Burden of Disease Collaborative Network, 2020). Disability adjusted life-years allow for the estimation of the total number of years lost due to specific causes and risk factors at the country, regional, and global levels. Data from previous years show that disability adjusted life-years associated with helminths infections have declined especially in upper-middle income regions as the disease burden becomes more concentrated in low-income regions (Jourdan et al., 2018).

For many decades, microscopy has been the main method used to detect, identify, and enumerate parasitic helminths (Papaiakivou et.al., 2019). The detection of the infection by microscopy is quite cost effective and simple to carry out, however, it may lack reasonable sensitivity due to several factors including low infection intensity below the limit of detection, improper transportation or storage of sample leading to parasite disintegration, and intermittent excretion of parasite ova (Khurana, Singh and Mewara, 2021).

The gold standard method of diagnosis as recommended by the WHO is the Kato-Katz method that is inexpensive and easy to prepare. However, its sensitivity deceases in low prevalence and low intensity settings. The Kato-Katz technique consists of examining sieved stool via microscopy and counting the number of eggs on the slide. The egg count is then multiplied by 24 to give eggs per gram of faeces. The eggs per gram of faeces threshold can be classified

based on intensity (Dunn et al., 2020). The Kato-Katz method is relatively effective in detecting infection of moderate to heavy intensities and has a very low sensitivity to light infections.

The detection of eggs can be difficult for hookworms using this method because the hookworm shells hatch in the soil soon after excretion and are less resistant than those of *A. lumbricoides* and *T. trichiur*a, which only hatch after passage through the stomach (Bosch et al, 2021). It is recommended to analyse multiple Kato-Katz thick smears from a single and multiple stool samples collected over consecutive days to avoid the clustering of eggs within different parts of the stool sample, as this is another factor that could influence its sensitivity. Furthermore, it is also recommended to homogenise the stool sample by stirring it prior to the preparation of the Kato-Katz smear, this will control intra-specimen variation and allows for even distribution the eggs (Bosch et al., 2021). To overcome the low sensitivity of this method WHO recommends a microscopic analysis with 30 to 60 minutes after slide preparation. It has been shown that any delay in slide preparation and reading of slides and the use of the glycerol used in the Kato Katz technique destroys the hookworm eggs overtime. In contrast, *T. trichiura* and *A. lumbricoides* eggs are visible for several months (Bosch et al., 2021). Other microscopic techniques such as McMaster method and FLOTAC have similar limitations as the Kato-Katz.

The modified McMaster method is a standard quantitative method used to determine the quantity of roundworm eggs per gram of faeces with the use of a special counting chamber known as the McMaster slide. This is a flotation test that separates parasite eggs from debris based on density; the eggs float in the saturated salt solution to the surface of the counting chamber (Barda et al., 2014; WHO, 2021).

Advances in molecular biology and genomics provides opportunities for better diagnosis. Antibody assays might aid in the diagnosis of first-time infections; however, they are not yet standardised. A variety of new diagnostic tests have been introduced, these included microscopic based (FECPAK^{G2} and (mini-)FLOTAC) and DNA-based methods (quantitative polymerase chain reaction) (WHO, 2021). Both FECPAK^{G2} and (mini-) FLOTAC have a clearer microscopic view, FECPAK^{G2} also provides an opportunity for an automated egg counting, and it can differentiate hookworm species as well as those that are not human parasites (WHO, 2021). Polymerase chain reaction assays (qPCR) and (mini-)FLOTAC have a higher clinical

sensitivity (WHO, 2021). Polymerase chain reaction assays are increasingly being used as diagnostics and research pertaining to helminth infections, especially in the United States (Bradbury et al.,2023). The requirement for a more sensitive diagnostic tool, as well as the interest in distinguishing whether an infection is with a STH species that is predominately found in humans or animals has led to increasing research into the use of the qPCR as a STH diagnostic. PCR is well suited to detect DNA targets present in stool even in low-prevalence settings. Detecting low levels of infection becomes important when the breakpoint of transmission is approached and when monitoring for reoccurrence once control or elimination is achieved (Papaiakivou et.al., 2019). Previous studies have compared PCR and Kato-Katz results and have found PCR to be more sensitive. However, one of the main reasons that Kato-Katz remain the gold standard technique is the lack of better cost-effective, simple alternatives.

These tests, however, require well-equipped laboratories with trained skilled technicians. The high number of samples that are processed are associated with a higher cost, particularly when the samples are processed in a laboratory that is far from the collection site (WHO, 2021)

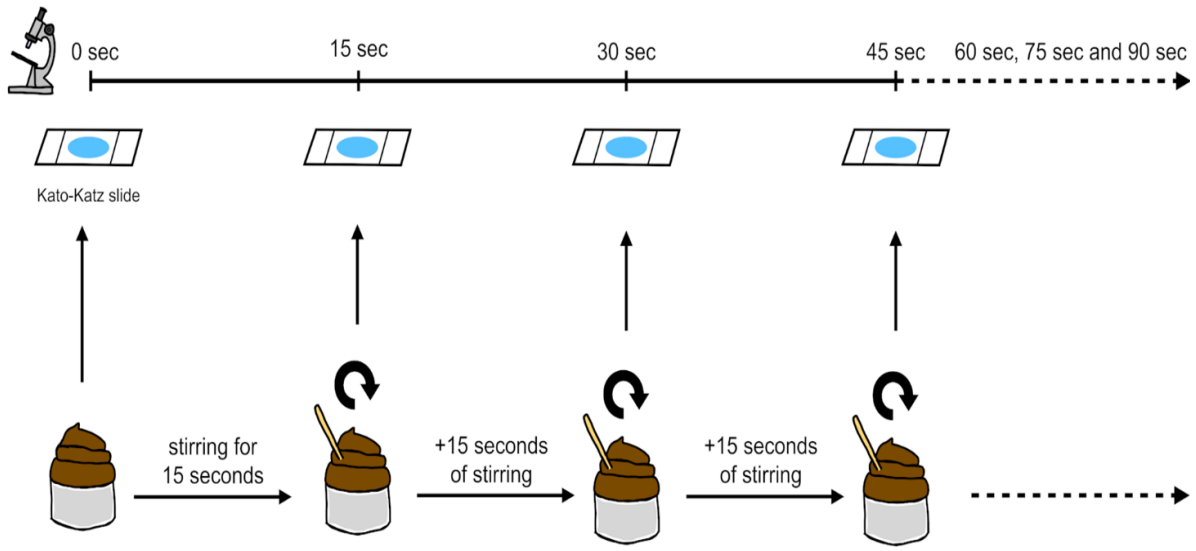

Figure 2.8: Timepoints for the preparation and analysis of Kato-Katz slides after stirring stool samples. An assessment of the effect of time, storage temperature and stirring of stool samples on fecal egg counts, stool sample underwent 15 seconds of stirring with a wooden spatula (Papaiakivou et.al., 2019

2.8 CLINICAL AND NON-CLINICAL INTERVENTIONS

There are highly effective and selective antihelminth drugs available which generally have a wide margin of safety (Table 2.4.) The different classes of antihelminth dugs include benzimidazoles, probenzimidazoles, salicylanilides, substituted phenols, imidazothiazoles, tetrahydro pyrimidines, organophosphates, macrocyclic lactones, thioxanthone group and the amino-acetonitrile derivatives (cyclic octadepsipeptides, and spiroindoles). Benzimidazoles that are used to treat nematodes and trematodes have limited activity against cystodes. These benzimidazoles include mebendazole, flubendazole, fenbendazole, oxfendazole, oxibendazole, albendazole, albendazole sulfoxide, thiabendazole, thiophanate, febantel, netobimin, and triclabendazole (MSD Online, 2022). Praziquantel, the pyrazino-isoquinolein derivative from the thioxantonic anthelmintic compounds has been shown to be highly effective against platyworms including schistosomes and the cestodes, tapeworms (Drugbank Online, 2024).

Control of intestinal worm infections is based on periodic drug treatments and depends heavily on their availability. The mass treatment with deworming medication kills adult worms and should be regularly administered to avoid reinfection. Helminth infections mostly affect deprived communities, and this remains a challenge with the increased rate of re-infection after treatment. Although chemotherapeutic control of intestinal helminth infections is currently believed to be satisfactory, there is a growing concern of drug resistance (Wong et al., 2023). An integration is required to reach most people suffering from these infections, these should include the control measures into healthcare system. This integration requires HCPs who can recognise the symptoms, diagnose the condition, and prescribe the appropriate medication as well as upskill the community with nonpharmacological health practices.

Previous studies have shown that the integration of schistosomiasis control measures into routine Primary Health Care services significantly reduced the prevalence and intensity of schistosomiasis infection. However, many of the schistosomiasis endemic countries in Sub-Saharan Africa have failed to integrate schistosomiasis intervention measures into the PHC services due to non-availability of drugs, diagnostic tools, and poor knowledge by the Primary Health Care staff (Mazigo et al., 2021). Although a list of preventative measures have been put

into place to alleviate the burden of helminth infections worldwide, the incidence of parasitic infections continues to adversely impact the poorest nations. The control of parasitic diseases requires HCPs to accurately identify the causative agents and requires them to have sufficient knowledge of parasite transmission, and importantly, treatment. Parasitic diseases appear to be under diagnosed and misdiagnosed, therefore, there is an increased need in HCPs to be expertly qualified in laboratory identification and clinical diagnosis (Palmeiri et al., 2011).

It is imperative that both public and private HCPs are provided with regular training to aid them in the diagnosis and treatment of emerging and remerging infectious diseases (Dayananda, et al., 2021). Training of HCPs, including physicians, physician assistants and nurses, can be accomplished through participation in continuing medical education courses, attending workshops, and reading current literature from professional journals and internet resources.

The South African Guidelines of Standard Treatments recommends the use of Albendazole at 200mg for children age between 12 to 24 months and 400mg for children older than 2 years and adults as a single dose. Mebendazole is recommended at 100mg 12 hourly for 3 days for children between 1-2 years, 500mg as a single dose for children over the age of 2 years and adults (Table 2.4). Pyrantel Pamoate can also be given at a single dose of 10-11mg/kg body weight orally, with the maximum dose of 1kg per day. The drugs are given at different forms to cater for the different age groups (Trasia, 2021). The choice of antihelminth drugs is very important as it needs to be selectively toxic to the parasite either by inhibiting metabolic processes that are vital to the parasite but not the host or by inherent pharmacokinetic properties of the compound that cause the parasite to be exposed to higher concentrations of the anthelmintic than are the host cells. While the exact mode of action of many antihelminth drugs is not fully understood. The sites of action and biochemical mechanisms of many parasites are known. For the parasites to maintain a proper energy state, feeding site, and reproductive processes they need to ingest food into their digestive tract. The pharmacological basis of antihelminth treatment usually interferes with these processes leading to starvation, paralysis, and expulsion or digestion of the parasite (MSD Online, 2022).

To reduce the transmission rate, interventions aiming to improve water, sanitation and hygiene are necessary, as well as the introduction of a safe STH vaccine development and administration (Nery et al., 2019). The sustainable development goals (SDG) report was reviewed, and it highlights the crisis that are amongst people and how to manage them. SDG 3 emphasizes on ensuring individual health and promoting well-being. SDG 6 focuses on the importance of sanitation and hygiene services. Many people are in need of these services and there is a rising demand of water as the population keeps growing. To ensure sustainable and equitable distribution of water. Implementation strategies have to be put in place to improve water resource management. The report shows that in 2020 there were 2 billion people that still did not have access to safe water, including 1.2 billion people lacking basic services. Universal access to drinking water, sanitation, and hygiene is critical to global health and essential in controlling infectious diseases (United Nations statistics Division, 2022).

The research supports South Africa's national malaria elimination strategic plan which focuses on the environmental management and sanitation improvements with the aim of reducing exposure to vectors and improving public health. These efforts are part of a broader strategy to achieve zero local transmission by 2028 (South African Government, 2024). At a continental scale, the project aligns with the African Union's Agenda 2063 and the Africa Health Strategy (2016–2030), which emphasize a prosperous and integrated Africa driven by inclusive and sustainable development (African Union Commission, 2015) which will promotes universal health coverage and disease elimination (African Union Commission, 2016). The above is in line with the African Leaders Malaria Alliance (ALMA) commitments which further reinforces the continents broader health and development goals (African Leaders Malaria Alliance, 2025). The above is supported by the WHO Global Technical Strategy which also aims to reduce malaria incidences with an emphasis on environmental management and vector control (WHO, 2015).

Close to a million people die each year from diseases that are directly attributable to unsafe water, inadequate sanitation, and poor hygiene practices. An improvement in these services can lower the burden of diseases like intestinal helminthiasis. The people at risk are pre-school, and school aged children, as well as women of childbearing potential including pregnant and breastfeeding women. The WHO recommends improved sanitation especially

to pre-school and school aged children living in endemic areas without previous diagnosis (Emovon et al., 2019). When the prevalence of STHI is above 20% treatment should be given once a year and when it is above 50% it will be twice a year to reduce worm burden that in turn reduced morbidity (WHO, 2023). It has been noted that in Soweto healthcare facilities are mainly consulted for infectious disease (Wong et al, 2018), therefore health-seeking behaviours in a community like Soweto is more likely to be influenced by access to health facility and disease severity.

In 2011, over 300 million pre-school aged, and school aged children were treated with antihelminthics medication in endemic areas corresponding to 30% of the children at risk. In 2015 the department of basic health education rolled out deworming programme to prevent STHI. Learners in grade R-7 that attended public schools were targeted (Basic department of health, 2015).

Table 2.4: Pharmacological profile of anthelminthic agents (van Zyl, 2019; WHO, 2023; SAMF, 2024).

Antihelminth Agents	Dosing	Mechanism of Action	Adverse Reactions	Contraindication
Albendazole	Taenia: • Children: 1-2 years: 200 mg single dose • Adults and children > 2 years: 400 mg single dose Neurocysticercosis: 15 mg/kg/day in 3 doses for 14 days Hydatid disease: 10-15 mg/kg/day; usually 400 mg twice daily for 3-6 months	Microtubule-function disturbing drug that prevents sugar uptake, resulting in degeneration of the parasite by diminishing its energy production.	Epigastric pain, headache, dizziness, diarrhoea, nausea and vomiting, sleep disturbances, mood changes, visual disturbances	Porphyria Children: Not fully evaluated in children under 1 year old Pregnancy: Not recommended as it is teratogenic and embryo toxic Lactation: Minimally excreted into breast milk, use if benefits outweigh risks
Mebendazole	Taenia: • Children > 1 years and adults: 100 mg twice daily for 6 days, repeat after 3-4 weeks if needed • Adults: Higher success rate with 200 mg twice daily for 4 days or 300 mg twice daily for 3 days	Same as Albendazole	Uncommon with recommended doses: Gastrointestinal discomfort, abdominal pain, nausea, diarrhoea. High doses : Bone marrow depression and hepatotoxicity, allergic reaction, alopecia	Porphyria Children: Not fully evaluated in children under 1 year old Pregnancy: Not recommended as it is teratogenic and embryo toxic Lactation: Breastfeeding should not be withheld Caution: In Crohn's disease, ulcerative colitis, GIT ulcers Caution: In Crohn's disease, ulcerative colitis, GIT ulcers
Piperazine	over 2 years: 50-75mg/kg , should be repeated after 2 weeks for enterobiasis Renal dose : 20-50 mg/kg, doses to be decrease due to accumulation of piperazine in the liver due to the drug being partially metabolized	Selectively blocks the neuromuscular cholinergic receptors of parasites causing paralysis	Nausea, vomiting, colic, diarrhoea, allergic reactions, muscular incoordination. Spastic paralysis of the worms with possible intestinal obstruction if there is a high number of parasites.	Renal Impairment, epilepsy, live disease

Table 2.4 continued: Pharmacological profile of Anthelminthic Agents (van Zyl, 2019; WHO, 2023; SAMF, 2024).

Antihelminth Agents	Dosing	Mechanism of Action	Adverse Reactions	Contraindication
Niclosamide	Adult dose Beef, pork, fish tapeworm: oral, 2g as a single dose. Dwarf tapeworm: 2g on the first day, followed by 1g daily for 6 days. Paediatric doses: Over 6 years, as for adults; 2-6 years, half adult dose, under 2 years, one-quarter the adult dose.	Uncouples oxidative phosphorylation in the parasite's mitochondria, resulting in death of the scolex and adjoining segments. The segment chain then loses its grip and is eliminated from the GIT during a bowel movement.	Uncommon: gastrointestinal disturbances, light-headedness, pruritus ani	Children: No adequate studies done in children under 2 years Pregnancy: Poorly absorbed, recommended to delay therapy until after delivery or until second or third trimester Lactation: Safe for use during breastfeeding as minimal is absorbed in the GIT
Praziquantel	Schistosomiasis: 40 mg/kg as a single dose or in two divided doses Pork, beef, and fish tapeworm: 5-10 mg/kg as a single dose Dwarf tapeworm: 25mg/kg as a single dose Children over 2 years take the same dose as adults	Disruption of calcium ion homeostasis in the parasite. It also antagonises the voltage-gated calcium channels resulting in an uncontrollable calcium iron influx causing muscle contraction and paralysis.	Common: Gastrointestinal disturbances, headache, drowsiness, dizziness Uncommon: Urticaria, eosinophilia, arthralgia	Porphyria Children: No adverse reactions noted in children over 2 years Pregnancy: Treatment offered during pregnancy Lactation: Not recommended, can be excreted in breast milk Breastfeeding to be discontinues for 72 hours from first day of therapy

2.9 ANTIHELMINTH DRUG RESISTANCE AND VACCINE DEVELOPMENT

Helminth infections are primarily managed by antihelmintic drugs (Table 2.4). However, with these been used for decades there is a concern related to the development of antihelminth drug resistance (Drurey, Coakley and Maizels, 2020). Antihelminth resistance is considered to be the loss of sensitivity of an antihelminth drug in a population that was once susceptible to the same drug (Fissiha and Kinde, 2022).

Antihelmintic resistance can develop in several ways namely: Side Resistance, Cross resistance, Multiple resistance (Fissiha and Kinde, 2022). Side Resistance is the resistance to a selection by one other anthelmintics which has a similar mechanism of action, this includes resistance amongst benzimidazoles anthelmintics. Cross resistance: The parasites strain can tolerate doses of drugs with different mechanisms. An example would include parasite resistant to benzimidazoles anthelmintics also showing resistance to levamisole (Rebuma, Regassa and Tariku, 2023). Multiple Resistance: Occurs when parasites become resistance to more than one anthelmintics that are not chemically related. These exhibit resistance to different antihelminth classes (Rebuma, Regassa and Tariku, 2023).

The development of resistance varies geographically based on different factors such as weather conditions, species of parasite, mode of therapy, and use of variable drugs. It is slightly lower in temperate regions. Resistance is being reported globally including South Pacific, Australia, Latin America, North America, Africa, Eastern Union, and Southeast Asia (Malik et al., 2022).

In addition to human infections, infections of farmed animals cause a significant economic loss worldwide. Farmers have started to notice drug resistance in various live stocks due to the widespread use of antihelminth drugs. This raise concerns as drug resistance might start becoming a problem for humans. It therefore warrants the need for vaccine development more specifically those that comprise of different antigens (Drurey, Coakley and Maizels, 2020). It is a huge concern that there are still no approved vaccines against human infections. Some studies have indicated that these measures are not easy to implement and might take

time to produce results leading to inconsistencies in the desired outcome (Wong et al., 2020). Vaccine development for helminth infections could be a very challenging process because the organisms are generally large, multicellular which might require a constant immune attack from different angles. Furthermore, they have multiple lifecycle stages which allows them to travel between different tissues within the same host. Antigens themselves are not sufficient to stimulate the desired immune response, molecules such as adjuvants such as aluminium salt which has been approved for use in human can assist to enhance T helper cells immune response (Wong et al., 2020). Adjuvants are substances added to the vaccines to enhance and prolong immune response results (Retnakumar et al., 2023).

Recombinant vaccines have been evaluated in different helminth organisms because it seems to be rather difficult or impossible to obtain helminth material that is large enough (Claerebout and Geldhof, 2020). A few recombinant vaccines have been shown to be proactive, the challenge in further development is to be able to develop these in a manner that will accommodate large scale commercial production and being able to test efficacy on large scale clinical trials (Claerebout and Geldhof, 2020).

A critical stage of the life cycle of helminths, involves transit through the lungs, which plays a vital role in the early clearance of the parasite, and thus the larvae stage 3 would be a perfect target for therapeutic and vaccine strategies to promote host resistance. Vaccine development seems to be a challenge as helminths are large multicellular organisms which require immune attacks from various points, this coupled with the multiple life cycles impedes the development of vaccines against helminths (Wong et al., 2023)

2.10 THE GAP IN COMMUNITY-BASED KNOWLEDGE, ATTITUDE, AND PRACTICE STUDIES

In addition to pharmacological interventions, education and community involvement are essential components to the long-term success of any programme. As such, the community-based control programmes should first seek the understanding of community knowledge and attitude towards helminth infections before implementing the programme-based activities.

Previous studies show that most helminth infections educational programmes target school children because they are easy to reach, however community members, parents and guardians are a more critical group due to their functional role as caregivers and also as possible reservoirs from which children can be reinfected. Caregivers are highly influential within their families and at the community level, however without enough knowledge, they tend to mislead others or engage in risky practices that predispose their young children to helminth (Sacolo-Gwebu, Kabuyaya and Chimbari, 2019).

Community-based knowledge attitude, and practices studies are limited in Soweto township. This may negatively impact the effectiveness of measures that are currently put in place to eliminate the infections. Caregivers are critical in the control of schistosomiasis and STHIs among preschool aged children in KwaZulu-Natal (Sacolo-Gwebu, Kabuyaya and Chimbari, 2019). One of the (2019) studies that reviewed KAP on helminth infections in Sub-Saharan Africa indicated the importance of including caregivers in the planning and implementation of the helminth infection control programmes to enhance efficiency (Sacolo-Gwebu, Kabuyaya and Chimbari, 2019). Similarly, the community health centres are the primary health systems that the community use and it is very important to the healthcare providers to accurately diagnose and treat helminths infections. Before moving forward with the implementation of the programme in Soweto, South Africa, the level of knowledge and management of intestinal helminthic infections amongst community members and healthcare providers in community health centres in Soweto needs to be determined.

3 CHAPTER THREE: RESEARCH DESIGN AND METHODS

3.1 STUDY DESIGN

The design used in this study was an explanatory sequential design, which was conducted in two phases, quantitative and qualitative phases (Creswell et al., 2022). This was used to provide a better understanding of the research problem as opposed to using either approaches alone. The qualitative data provided an overview of the participants knowledge and perception about helminthiasis; the data was collected using a semi-structured questionnaire. The qualitative approach provided an open-ended environment for participants to provide their view; this was conducted in a form of in-depth discussions with the HCPs.

3.2 STUDY SETTING

The study was conducted in Soweto, an urban township located in Johannesburg, Gauteng Province (Figure 3.1) with an estimated population of 1.3 million people in 355,331 households (2011 census). Soweto is one of the biggest townships in South Africa, comprising mainly of black African citizens. Majority of the household in Soweto are of a low educational level and socio-economic status, and they depend on the government healthcare systems when in need of medical attention. The target population for this study is comprised of community members of Soweto attending one of the three Clinics, particularly parents or caregivers as well as HCPs working at the clinics. Soweto has several socio-economic factors that could predispose the community to helminth infections namely, limited healthcare access, poverty, malnutrition, access to clean water, poor sanitation, limited health education, informal settlement and overcrowding.

Soweto has a substantial number of healthcare facilities, these include 23 Primary Health Care clinics and 2 public hospitals – Chris Hani Baragwanath Academic Hospital and Bheki Mlangeni Hospital situated in an area called Jabulani (Johnstone et al., 2021). Residence of Soweto also have access to private facilities such as Doctors' offices and Private hospitals. Patients with no

urgent issues are referred to primary healthcare clinics and those that have more complicated and urgent conditions are transferred to one of the Hospitals. This study was meant to be carried out in four Clinics / Community Health Centres. However, data was only collected from only 3 Clinics because the fourth one was under renovations during the data collection period and for this reason the clinic was not used. The Clinics names have not been mentioned to maintain anonymity, only codes were used to classify them namely, Clinic M, Clinic O, and Clinic C. The Clinic locations were between 6 to 10 Kilometres away from each other to cover the different sub-communities around the clinics.

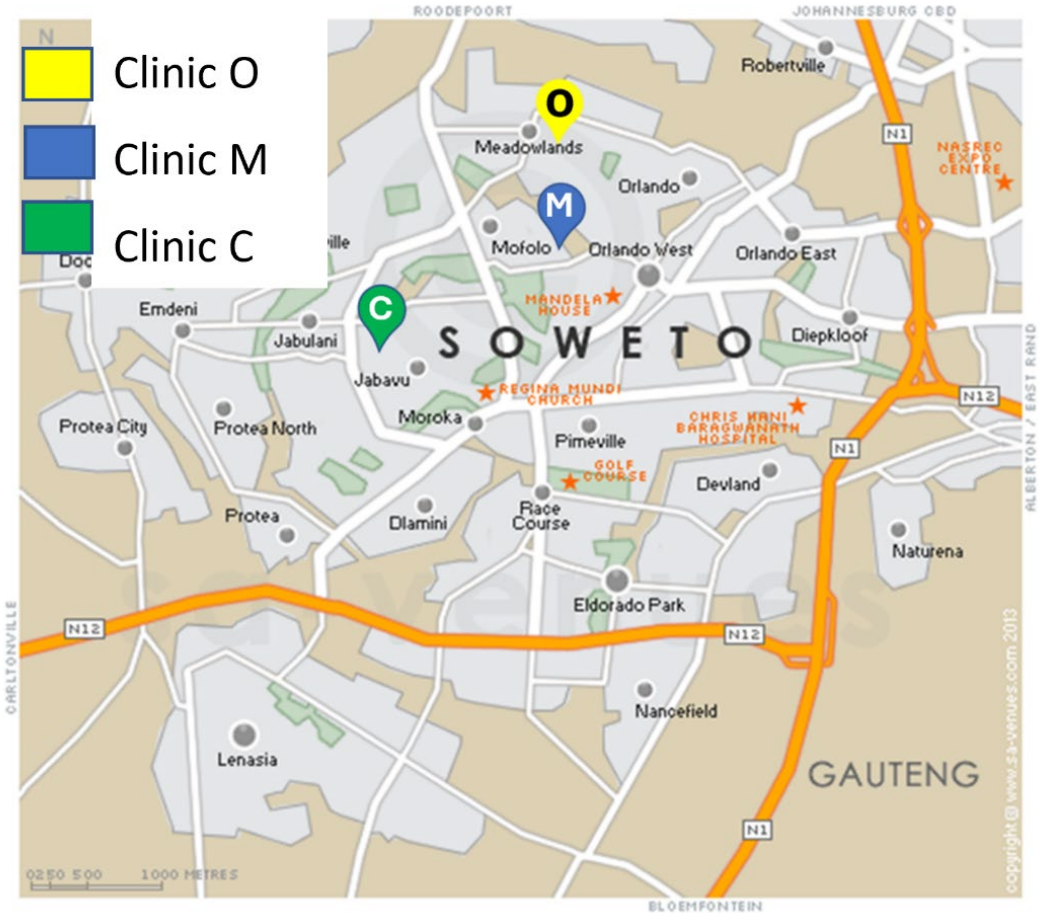

Figure 3.1: Soweto Map showing the deferent clinics (SA Venues, 2023).

3.3 CLINIC INFORMATION AND PROCEDURES

Separate interviews were held with the administrative staff, Assistant Pharmacist, Facility Manager, Operations Managers, and Community Health Worker Supervisors to understand the processes that are followed at the clinics.

3.3.1 CLINIC M

The procedure involved at Clinic M requires the patient to register their name at the reception to be allocated a file, either their existing file if it was not their first visit to the clinic, or those visiting for the first time to be allocated a new file. The patient then needed to wait in the waiting area where they got allocated to a nurse or a doctor. There was one doctor that took chronic conditions files and those with other conditions were allocated to any nurse or doctor available. In the morning every staff ordered medication of common conditions that they see daily from the pharmacy. If there was a condition that required medication that was not on the pre-ordered medication from the pharmacy, then a script was written for the patient to collect the medication directly from the pharmacy. The Pharmacist was required to only dispense the medication and did not provide any medical advice or education. The Community Health Workers were each allocated to 250 households, where they were only allocated to houses in Meadowlands zones 1, 2, 4, 5 and 6, as there were not enough Community Health Workers to cover zones 3,7, and 8.

3.3.2 CLINIC O

The post-natal unit followed the same process as Clinic M, where medication was ordered from the Pharmacy and dispensed by the Primary Health Care nurses. Children from the age of 6 were treated in the Acute Care Unit, however they could still get their immunisation at the anti-/post-natal unit they were 12 years old. The anti-/post-natal unit did not contain any Doctors, only three Professional Nurses and 1 enrolled Nursing Assistant.

3.3.3 CLINIC C

Clinic C's Anti/Post-Natal Unit consisted of a total of 7 Nurses, where three nurses only dealt with vitals, dressings, and injections, while the remining four diagnosed and treated the patients. There were no Doctors in this unit unless requested. In contrast the Acute Unit had

one Doctor along with 2 Enrolled Nursing Assistants, 2 Enrolled Nurses, who were sometimes assisted by 2 Student Doctors. The Acute Care Unit catered for children from 6 years and above. In the case of a positive helminth infection diagnosis the Nurses wrote a script to be taken to the Pharmacy for medication collection. The Pharmacy did not provide any health education regarding the helminth infection, but they did however inform the patient of the side effects of the medication. Children between 5 and 12 years were required to be present with their caregiver/s and those from 12 years could collect the medication on their own. There were 40 Community Outreach Team members at Clinic C, but they did not discuss helminths infections when they visited the community, they only provide anthelmintic tablets should there be a child that was due for their cycle at the clinic. The Outreach Team had no training regarding helminth infections.

3.4 RESEARCH PHASES

3.4.1 PHASE 1: QUESTIONNAIRE SURVEY (QUANTITATIVE)

The first objective for this study was to determine the knowledge, attitude, and perception of Soweto community and healthcare providers to helminthiasis and its management, this was achieved using a semi-structured questionnaire. The participants recruited were from the different areas in Soweto and use the clinics as a primary healthcare facility, as well as the HCPs (Doctors, Nurses, Pharmacists, community healthcare workers) that work in the clinics. The study was limited to the mother and child departments and the questionnaires were handed to Mothers of new-born babies, those bringing children for immunization, as well as pregnant women.

3.4.1.1 Population

The estimated average number of potential community participants was 23 968 derived from the number of residences in the Chiawelo, Meadowlands, and Zola communities as reported in the 2011 census.

3.4.1.2 Sampling

- The community members of Soweto were chosen upon availability of clinic attendance and willingness to participate.
- Health Care Professionals were chosen based on availability and willingness to participate.
- Community health centres were chosen due to the availability of HCPs (Doctors, Nurses, and Pharmacists) and to determine whether the consenting HCPs are aware that helminth infections are a notifiable disease and to determine if the HCPs were familiar with the South African treatment guidelines.

The sampling method was that of convenience of staff and community members who are present at the clinics when the researcher visits the study sites. According to census 2011, the Chiawelo, Meadowlands, and Zola community has 13,103, 13,970, and 44,777 residents, respectively (Frith, 2011). The study aimed for an approximate of 385 participants, 100 HCPs and 285 GPs. The sample size was obtained using the Raosoft calculator (http://www.raosoft.com/samplesize.html) with <20,000 population at a 95% confident interval and 5% margin of error. A total of 409 participants were enrolled in this study, 362 General Public and 47 HCPs.

The inclusion criteria for potential general public participants included the following, with no exclusion criteria:

- Subjects that are 18 years or older.
- Parents or caregivers.
- Permanent residents of Soweto.

The inclusion criteria for potential HCP participants included the following, with no exclusion criteria:

- HCP at one of the four Clinics

3.4.1.3 Pilot testing

The purpose of the pilot study was to identify any challenges that may occur during the study and possibly make changes to the research instrument. There were no changes made to the instrument, as the participants were able to complete the questionnaires without difficulties. To determine the rate at which community members and the HCPs will understand and be able to complete the questionnaires, a pilot study was done, and the data collection tool was used on five (n=5) community members and three (n=3) HCPs. The average time that the participants took to complete the questionnaire was 15 minutes for the community and 10minutes for the HCP. The results of the pilot were not included in the main study.

3.4.2 PHASE 2: FOCUS GROUP DISCUSSIONS (QUALITATIVE)

The second objective of the study was to establish whether the HCPs follow the South African Department of Health therapeutic guidelines and what measures they take in the management of helminthiasis. To assess this, in-depth interviews were conducted with HCP across the three clinics. The population in this phase included a portion of HCPs who participated in the quantitative study. The HCP were working in the three clinics in the mother and child section.

3.4.2.1 Population

The population in this phase included a portion of HCPs working in the three clinics in the mother and child section and who participated in the quantitative study.

3.4.2.2 Sampling

The sampling process that was adopted in this phase was that of convenient sampling, as this allowed the researcher to select the HCP from wards which were more prone to having helminth cases i.e., the mother and child section. The invited participants were to provide detailed information about their feelings, perceptions, and experiences. In this study four focus groups were conducted consisting of an average of 5 to 10 participants per group. There was a total of 30 participants that participated in discussions. The discussions consisted of seven discussion questions, which took approximately 40 minutes (APPENDIX 8.C).

3.5 DATA COLLECTION

3.5.1 DATA COLLECTION INSTRUMENTS

3.5.1.1 Questionnaires

Data was collected using a semi-structured self-administered questionnaire. The content of the questionnaire was checked by a group of content experts that included Doctors, Nurses, radiologists, and Pharmacologists. The questionnaires included open- and close-ended questions and was administered in English, which is the standard language of communication in South Africa. For general public, participants that did not understand English, the questions were translated in the language that they understand. The researcher was multilingual and could speak and understand nine of the South African languages namely, English, Venda, Zulu, Sotho, Tswana, Pedi, Tsonga, Xhosa, and Swati. The researcher asked the general public participants which language they were comfortable to communicate with to be able to translate the questions and not to guide them to answers. The study was conducted from May to November 2022.

Questionnaires were either administered on Research Electronic Data Capture (RedCap) software (https://projectredcap.org/software/) or by pen and paper depending on the participant's preference. The questionnaire used in this study was adapted from research conducted by Nasr et al. (2013) in a study entitled "*Towards an effective control programme of soil-transmitted helminth infections among Orang Asli in rural Malaysia. Part 2: Knowledge, attitude, and practices."*

The questionnaires for the HCP contained 3 sections, with a total of 19 questions (APPENDIX 8.A), and for the GP it had 7 sections and 48 questions (APPENDIX 8.B).

For the general public, the following seven sections were included:

- Section 1: included demographic information for the participants (9 questions).
- Section 2: sourced information about water, environment, and sanitation conditions (4 questions).

- Section 3: asked the participants about their personal practices including washing of fruits and vegetable before eating, usage of soap when washing hands (7 questions).
- Section 4: sourced questions about treatment and treatment seeking behaviour (03 questions).
- Section 5: sought for more information about children and their worm management (10 questions). The Researcher aimed to establish the burden of helminthiasis by asking the parents or caregiver questions related to their children's previous infections, treatment, personal practice, and prophylaxis. One of the objectives was to determine whether community members use alternative therapies to those recommended by the South African Department of Health.
- Section 6: focused on the treatment with herbal medication, to understand the type of therapies that the GPs are taking and who prescribes them (04 questions).
- Section 7: In this section the participants were asked if they would like more information about Helminthiasis and in what form they would prefer the information to be delivered (01 question).

For the HCPs, the following seven sections were included (APPENDIX 8.A):

- Section 1: included demographic information for the HCP participants (4 questions respectively).
- Section 2: of the HCP questionnaire was assessing their knowledge about helminths (12 questions). The researcher aimed to establish their knowledge pertaining to common helminths, clinical symptoms, methods of diagnosis, preventative measures, treatment, and their knowledge on the South African guidelines for treatment of helminthiasis (03 questions).
- Section 3: In this section the participants were asked if they would like more information about Helminthiasis and in what form they would prefer the information to be delivered (03 questions).

The participants recruitment process for the community was a direct face to face invitation to participate as they wait to be assisted in the waiting area. They were made aware that participation in the study is voluntary. These discussions took place either in groups or

individual information sessions to identify eligible participants. For the HCP, the recruitment process was through the clinic's head or managers, the researcher worked with the clinic's managers and gained permission to recruit participants, they have assisted to gather the HCP together for an information session to identify interested participants. For the focus groups, posters were places in clinics to provide details for HCP who were interested.

The questionnaire was administered during the clinic visits for the community and during lunch breaks for the HCP. The participant were given ample time to complete the questionnaire either before or after their clinic visits for the community. The researcher was available to provide support to those that may struggle to complete the questionnaire.

3.5.1.2 Focus group discussions

The primary method of data collection in this phase was through a semi-structured interviews with the HCP. An interview guide was used to facilitate the discussions (APPENDIX 8.C). Whilst the focus groups provided detailed information about feelings, thoughts, understandings, perceptions, and impressions of people in their own words. All HCPs were invited to have the discussions over tea; the invitations were posted a few days prior to the discussions. Posters were put up around the clinic to create more awareness of the discussions (APPENDIX 8.L). The discussions were conducted by the researcher with the help of two other co-facilitators. The facilitator was an experienced researcher in qualitative research with PhD. The role of the researcher was to direct the discussions and limit the conversations within the research topic. The co-facilitators assisted with notetaking and recording the sessions following approval from all the HCP participants in the group.

The focus group discussions took place in the tea rooms and bigger consultation rooms. The researcher ensured that there were minimal distractions during the interviews by ensuring that there was a note on the door stating that there was a discussion in progress, for Clinic M the clinic manager kindly addressed the patients and notified them about the discussion taking place in the respective rooms. The researcher welcomed the HCP participants in a friendly manner and started with some introductions (off record) to establish rapport and to break the ice. The researcher encouraged clarity and probing to obtain detailed information.

Furthermore, the participants were made aware that there were no right or wrong answers to allow them to comfortably share their views and opinions.

The information discussed was recorded and transcribed verbatim into a word document as shown in APPENDIX 8.M, APPENDIX 8.N, APPENDIX 8.O . Prior to conducting the interviews, the participants were handed an information sheet to read through (APPENDIX 8.E) and were required to sign a consent form to give permission for recording the discussion (APPENDIX 8.F). The Researcher crossed checked for consistency of the transcripts against the audio files to ensure the accuracy of the transcribed files, the files were also received by the researcher's supervisors. The focus groups contained both females and male participants of different professions.

3.6 DATA ANALYSIS

3.6.1 QUANTITATIVE DATA ANALYSIS

The data was exported to Microsoft Excel, cleaned, and analysed using Stata version 17.0. The data was summarised using descriptive statistics such as percentages and frequency values.

Data from all paper questionnaires was administered in RedCap (https://projectredcap.org/software/) to allow for easy processing, with several subsequent steps involved in analysing the data. Redcap generated the data into tables that could either be exported to an Excel file or any statistical software files. The data was exported to Microsoft Excel to clean prior to importing it into Stata version 17.0 programme for analysis. A simple descriptive analysis was done to produce baseline data on knowledge and prevalence of helminthiasis and a general overview of the study population. This was followed by analysing p values to assess if lack of knowledge and specific hygienic habits were associated with a higher prevalence of infection, evaluated calculating estimated relative risks or Odds Ratios. A P-test was used to assess associations between variables, statistical significance was used at $p<0.05$.

The below steps outline the data cleaning process undertaken:

- Importing the clean excel document into a statistical programme, Stata version 17.0.

- Further cleaning took place in the Stata software prior to analysis.
- The data set was in strings, meaning that it was a set of characters which needed to be coded for the programme to recognize the information and easily analyse.
- Each variable for both groups was encoded.
- Variables were regenerated and assigned new labels.

3.6.2 QUALITATIVE DATA ANALYSIS

The qualitative data was analyses using thematic analysis which is a method used for analysing qualitative data that involves searching for similar or recurring data in a particular data set. This process contains several stages which aimed to summarise, organise, and give shape to a large volume of data to provide meaning (Braun and Clarke, 2006).

Stage 1: Immersing oneself in the data

This stage commences following data collection. It involves transcribing interviews and reading it repeatedly to be familiar with the data. During this stage, the researcher listened to the recording and transcribed the information verbatim and read the transcript multiple times to analyse the content of the data and actively looked for meanings and patterns and made notes of any finding that could assist with code generation.

Stage 2: Generating initial codes

Once the data was familiar, the data was organised and grouped into meaningful units. The first step was to clean the excel file by reading every open-ended response to gain in-dept insight. The researcher created coded in Excel, which were formed using patterns and grouping similar data to provide a common phrase to narrow the responses and place them into certain categories. The next step was to fix errors to maintain uniformity of the document, there were a couple of typing errors in the raw report which were fixed in the cleaning process.

Stage 3: Searching for themes

Ones the coding and grouping was completed, the themes were searched for by identifying how different text may fit together to form a theme. The objectives of the study were constantly reviewed while forming themes to stay aligned. Some of the codes did not fit any themes and these were grouped together and place under a category named “other”. The

Researcher developed a sense of understanding of the knowledge and management of helminthiasis and the emerging themes and subthemes became apparent.

Stage 4: Reviewing themes

Once the potential themes were identified, they then refined the data. This allowed for a deeper examination of the data and to re-sort the data, as some potential themes were not relevant to the research question and other themes could be combined and others could be separated to form different themes. The entire data set were re-read to capture any data that could have been missed during the coding stage.

Stage 5: Defining and naming themes

In this stage the themes were refined and organised coherently. A detailed analysis of each individual theme was outlined in relation to the research question.

Stage 6: Producing the report

The last stage commenced after themes have been identified and was concluded by writing a report. The report represented the analysis and demonstrated trustworthiness. The themes were clearly demonstrated.

3.7 VALIDITY, RELIABILITY, TRUSTWORTHINESS

3.7.1 VALIDITY

The content validity of the questionnaire was checked by a group of experts that included Doctors, Nurses, Radiologists, and Pharmacologists.

3.7.2 RELIABILITY

In this study, reliability was maintained by the accurate and consistent use of the same instrument for the collection of data throughout the study. The people that assisted with data collection were properly trained to minimise errors. The researcher transcribed the interviews and captured the questionnaires into Redcap. A pilot study was also conducted to ensure that the phrases and terms used are clear and well understood by the participants. For participants

that did not understand English, the questions were translated in the language that they understand. The researcher is multilingual and can speak and understand nine of the South African languages.

3.7.3 MEASURE OF TRUSTWORTHINESS

Trustworthiness forms part of the qualitative research validity and includes the following concepts (Shenton, 2004):

3.7.4 CREDIBILITY

Credibility was guaranteed by recording the discussions for the focus group to obtain accurate data. It was further ensured by accurately transcribing the recordings. During the study, the researcher continuously met with the supervisors to review and provide input during the different phases of the study.

3.7.5 TRANSFERABILITY

Sufficient descriptive data was provided to allow readers to evaluate whether the data is applicable to other contexts. In this study a convenient sampling was used to include nurses that work with children, as helminthiasis is most found in children.

3.7.6 DEPENDABILITY

In this study, the researcher ensured that processes are being recorded in detail to ensure other researchers to repeat the study in future to achieve similar findings.

3.7.7 CONFIRMABILITY

Confirmability was guaranteed by having two co-facilitators during the focus group interviews. This allowed them to record information that reflected the participants verbal and non-verbal reactions rather than the researcher's perspective.

3.8 ETHICAL CONSIDERATIONS

3.8.1 PERMISSION TO CONDUCT RESEARCH

Approval for this study was granted by the University of the Witwatersrand Human Research Ethics Committee (ref.no M210907) (APPENDIX 8.P). Upon receiving approval from ethics, permission was also requested from the head of the respective community health centres (APPENDIX 8.G, APPENDIX 8.H, APPENDIX 8.I, APPENDIX 8.J) and Gauteng Department of Health (GP_202111_041) (APPENDIX 8.K). The permission to conduct research in the respective clinics was verbally obtained from the clinic's operational Managers and professional nurses in charge.

3.8.1.1 Informed consent

After the researcher was granted permission to conduct the study, participants received written and verbal information about the study. Informed consent was obtained from the GPs and HCPs to complete an anonymous questionnaire. Participants were provided with an information sheet that explained all details of the study (APPENDIX 8.E), if there was agreement to participate, they were required to complete and sign a consent form (APPENDIX 8.F). There was no financial compensation given to the participants to encourage participation.

The researcher informed all that participation was voluntary and that they could stop any point in the study. During Phase 2, all participants completed a consent form to participate and to be recorded (APPENDIX 8.D). All participants were fit to make informed decision.

3.8.2 CONFIDENTIALITY

Confidentiality of participants was maintained throughout the study by ensuring that no form of identification was provided in the questionnaires and during the interviews. During the recording, the participants did not provide their names and when the data was being transcribed, they were assigned numbers and codes. There was no identifying information in the final report.

3.8.3 JUSTICE

The participant's selection was based on the inclusion and exclusion criteria, and those that declined to participate were treated fairly and with respect (Section 0).

3.8.4 MANAGEMENT OF DATA AND SECURITY

The data collected in the study remained in a safe and secure place. All information including, recordings, completed questionnaires, consent forms, and notes were stored in the Pharmacology Division. All electronic copies were securely saved on a computer. Only the researcher and supervisors had access to the data. The data was kept in storage for a minimum of 5 years.

4 CHAPTER FOUR: RESULTS

4.1 INTRODUCTION

This section outlines the findings of this study presented in two parts namely quantitative and qualitative finding. Descriptive and inferential statistics were used to analyse the data. Thematic analysis was used for the qualitative data. By the end of the data collection period of four months for the quantitative part 1 of the study, a total of 362 questionnaires were completed for the public and a total of 47 for the HCP respondents.

4.2 PART 1: QUANTITATIVE FINDINGS

4.2.1 GENERAL PUBLIC RESPONDENTS

4.2.1.1 Section A: Demographic data of general public respondents

This section focuses on demographic data of the GP respondents (Table 4.1) from Questions GP.A1-10 (APPENDIX 8.B). The section comprised of nine items namely: ethnic group, age, gender, address, highest level of education, occupation, average family income, number of residents in the same household, and number of rooms in the house. In the HCP group, this section comprised of four items namely: ward working in, job description, years of service, and gender.

Just over a third of the respondents did not indicate their tribe (37.29%), followed by the Zulu tribe (25.97%). The largest group (47.51%) was in the age category of less than 30 years. Females accounted for (94.75%). Clinic C had the most respondents (37.75%). Majority of the respondents were unemployed (55.52%). Information about their living conditions indicated that most were staying in houses with less than 5 rooms (59.12%), and between 5-10 people living in the same household (62.71%). With regards to the education level of the public respondents, those with secondary education dominated with a total of 203 participants (56.08%) (Figure 4.1).

Table 4.1: The demographic characteristics of the public respondents (n=362) from Questions GP.A1-A5,A7-A10 (APPENDIX 8.B).

Variables	Fre-quency	Percen-tages	Variables	Fre-quency	Percent-ages
Ethnic/ cultural groups					
Did not specify (African)	**135**	**37.29**	Xhosa	14	3.87
Zulu	**94**	**25.97**	Pedi	8	2.21
Tsonga	34	9.39	Other	6	1.68
Tswana	25	6.90	Coloured	3	0.83
Sotho	21	5.80	Ndebele	3	0.83
Venda	18	4.97	Swati	1	0.28
Age					
Less than 30	**172**	**47.51**	Between 41 and 50	29	8.01
Between 30 and 40	145	40.06	Greater than 50	16	4.42
Gender					
Female	**343**	**94.75**	Male	19	5.25
Address					
Clinic C	137	37.85	Soweto, Gauteng	12	3.31
Clinic M	118	32.60	(blank)	1	0.28
Clinic O	94	25.97			
Employment Status					
Unemployed	**201**	**55.52**	Not comfortable to share	30	8.29
Employed	131	36.19			
Average family Monthly Income					
Less than R1000	72	19.89	Income not provided	53	14.64
Less than R5000	**103**	**28.45**	More than R10 000	42	11.60
Between R5000 and R10,000	92	25.41			
Rooms in the house					
less than 5 rooms	214	**59.12**	Information not provided	9	2.49
More than 5 rooms	139	38.40			
People in the household					
Less than 5 people	121	33.43	More than 10 people	3	0.83
between 5 and 10 people	227	**62.71**	Information not provided	11	3.04

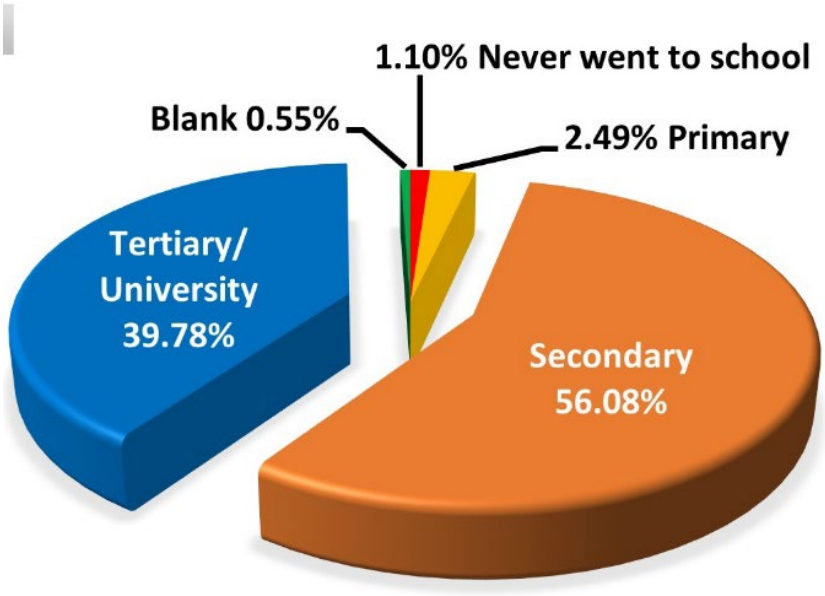

Figure 4.1: Level of education of the public respondents ranging from never going to school (n=4), primary school (n=9), secondary school (203) compared to those who attended a tertiary institute or university (n=144); where there were only 2 responses left blank (Questions GP.A6, APPENDIX 8.B).

4.2.1.2 Section B: Source of water environment and sanitation

This section assessed the respondent's sanitation practices and contained 4 items from Questions GP.B1-B4 (APPENDIX 8.B) in Table 4.2. Pipe water was highlighted to be the most used (93.37%) facilitating most of the respondents to indicate the use of flush toilets in their own homes (97.24%) such that waste disposal was via sewer pipes was selected (94.75%) more than septic tanks. A total of 336 (92.82%) respondents indicated that household garbage disposal is through the municipal services compared to having to dispose the garbage on the dump, in the river or an open field (Table 4.2).

Table 4.2: Sanitation practices responses (n=362) from Questions GP.B1-B4 (APPENDIX 8.B).

Variables	Fre-quency	Percen-tages	Variables	Fre-quency	Percent-ages
Source of water for drinking					
Pipe Water	**338**	**93.37**	Other	3	0.83
Well	14	3.87	Rain	1	0.28
River	5	1.38	(blank)	1	0.28
Type of Toilet					
Have a flush toilet in my own home	**352**	**97.24**	Pit Toilet- Communal	1	0.28
No Flush Toilet in the house	3	0.83	Pit Toilet on own property	2	0.55
No Toilet in the house	2	0.55	(blank)	1	0.28
Other	1	0.28			
Waste disposal					
Sewer pipes	**343**	**94.75**	Septic tanks	2	0.55
Other places	11	3.04	(blank)	4	1.10
Others	2	0.55			
Household garbage disposal					
Municipality removal and disposal	**336**	**92.82**	Disposal at city dump	3	0.83
Disposal in an open field	10	2.76	Dispose of in a river	2	0.55
Other	7	1.93	(blank)	4	1.10

4.2.1.3 Section C: Personal Practice

This section assessed the respondent's personal practices and contained 7 items from Questions GP.C1-C7 (APPENDIX 8.B). The comparison of general public participants behaviour, measuring their hygiene and sanitation practices with regards to intestinal helminths showed that 76.24% of the participants indicated that they always wash their hands before eating, followed by 20.17% that wash their hands sometimes (Table 4.3). A close majority (45.86%; n=166) of the general public participants indicated that they use soap when washing their hands. Overall, more than 70% of the participants wash their fruits and vegetables before eating or cooking them respectively.

Table 4.3: Personal practice responses regarding washing practices (n=362) from Questions GP.C1-C5 (APPENDIX 8.B).

Variables	Frequency	Percentages	Variables	Frequency	Percentages
Do you wash your hands before eating?					
Always	276	**76.24**	Never	1	0.28
Sometimes	73	20.17	(blank)	5	1.38
Rarely	7	1.93			
Do you use body soap when washing your hands?					
Always	166	**45.86**	Never	28	7.73
Rarely	17	4.70	(blank)	4	1.10
Sometimes	147	40.61			
Do you use antiseptic soap when washing your hands?					
Always	110	**30.39**	Never	73	20.17
Sometimes	141	38.95	(blank)	5	1.38
Rarely	33	9.12			
Do you wash fruits?					
Always	274	**75.69**	Never	10	2.76
Sometimes	68	18.78	(blank)	4	1.10
Rarely	6	1.66			
Do you wash vegetables before eating?					
Always	312	**86.19**	Never	3	0.83
Sometimes	41	11.33	(blank)	4	1.10
Rarely	2	0.55			

When the respondents were asked if they consumed pork and if they were able to recognize worm infected meat (Questions GP.C6 and C7; APPENDIX 8.B), the majority of the respondents (n=241, 66.57%) indicated that they do consume pork meat and most of the respondents (n=268, 74.03%) indicated that they do not know how to recognize worm infected meat (Figure 4.2).

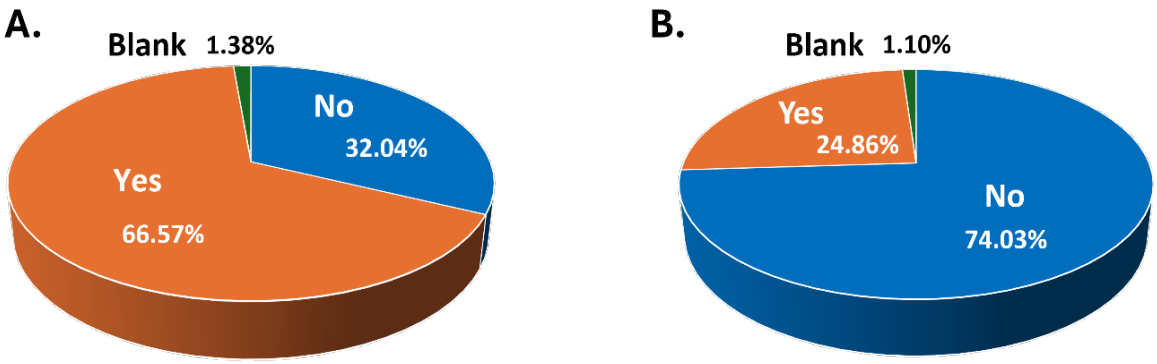

Figure 4.2: Responses regarding pork meat consumption (A.) and responses regarding recognition of worm infected meat (B.) from Questions GP.C6 and C7 (APPENDIX 8.B).

4.2.1.4 Knowledge about helminth infections

This section describes the responses given by the general public participants in relation to knowledge and source of information regarding intestinal helminths from Questions GP.D1-10 (APPENDIX 8.B). A total of 66.85% (n= 242) of the participants had heard about intestinal helminths before, with 31.77% (n=115) indicating no knowledge and 1.38% (n=5) did not indicate whether they have any knowledge regarding intestinal helminths or not (Table 4.4).

Table 4.4: Responses regarding knowledge and source of information (n= 362) from Questions GP.D1 and D2 (APPENDIX 8.B).

Variables	Frequency	Percentages	Variables	Frequency	Percentages
No (had not heard about intestinal worms before)	**115**	**31.77**	No Response	5	1.38
Yes (had heard about intestinal worms before)	**242**	**66.85**			
Clinic	103	28.45	Hospital	3	0.83
Family	31	8.56	I don't know	9	0.83
Previous experience with worm infection	28	7.73	Radio	2	2.49
School	17	4.70	At work	1	0.28
Internet	14	3.87	Community	1	0.28
Television	9	2.49	Day care	1	0.28
Friends	4	1.10	Doctor's office	1	0.28
From neighbours	4	1.10	General information	1	0.28
I cannot remember	4	1.10	I am a nurse	1	0.28
Word of mouth	4	1.10	Reading	1	0.28
Social media	3	0.83	Saw them on meat	1	0.28

Only, 31.77% (n=115) of the participants Indicated that they have not heard about intestinal helminth before, while 66.85% (n=242) reported that they had not. Additionally, 1.38%(n=5) did not provide any response to this question (Questions GP.D1 (APPENDIX 8.B). Those that have indicated awareness have listed the different sources of information (Questions GP.D2 (APPENDIX 8.B). (Table 4.4).

In response to the question “What are Intestinal worms?” 50% (n=181) of the participants indicated that they do not know, followed by 12.71% (n=46) who indicated that intestinal worms are found in the stomach and 5.80% (n=21) indicating that they are caused by dirty/unhealthy food, soil, and water (Table 4.5). When asked to provide the names of intestinal worms majority 67.96% (n=246) indicated that they do not know (Table 4.6)

Table 4.5:Responses to question "What are Intestinal worms? " (n= 362) from Questions GP.D3 (APPENDIX 8.B).

Variable	Frequency	Percentages
Worms caused by dirty/unhealthy food, soil, and water	21	5.80
bacterial infections	12	3.31
Caused by eating pork	2	0.55
I don't know	181	50.00
internal worms	1	0.28%
makes you eat a lot	7	1.93
Not applicable	13	4.70
Other	15	4.14
Parasitic Infections	9	2.49
small worms, come out of the nose	2	0.55
white worms that come out of children	7	1.93
Worms that are found in the stomach	46	12.71
Worms that come out of the anul area ad makes it itchy	19	5.25
Worms that commonly affect children	9	2.49
(blank)	18	4.97
Grand Total	**362**	**100**

Table 4.6: Responses to question "Give type of names of intestinal worms you know? " (n= 362) from Questions GP.D4 (APPENDIX 8.B)

Variables	Frequency	Percentages
Ascaris lumbricoides	1	0.28
body worms, ring worms	1	0.28
hook,pin,trichinella	1	0.28
hook,tape,round worm	1	0.28
Hookworms, Tapeworms, Ascariasis, pinworm infection	1	0.28
I don't know	**246**	**67.96**
long, round,flat	1	0.28
Not applicable	11	3.04
Not applicable	4	1.10
pin	6	1.66
pin worms	4	1.10
pin worms, round worms, tape worms	1	0.28
pin, round	1	0.28
pin,hook,round,tape worms	1	0.28
ring worm, round worm	1	0.28
ring worm, tape worm	2	0.56
ring worms, body worms	1	0.28
ring,small,straight,round	1	0.28
ringworms, tapeworms	1	0.28
Round worms	5	1.40
Tape worm	21	5.08
Round worms, tapeworms	1	0.28
round, flar worms	1	0.28
round, pin,hook	1	0.28
round, tape	2	0.55
round,hook,pin	1	0.28
round,hook,tape,whip	1	0.28
round,tape	1	0.28
Roundworm and Tapeworms	1	0.28
Roundworms, Pinworms, Tapeworms, Hookworms.	1	0.28
Roundworms, Smallworms	1	0.28
Roundworms, Tapeworms	1	0.28
Roundworms, Tapeworms, Hookworms, Pinworms	1	0.28
Roundworms, Tapeworms, Pinworms	1	0.28
Short worms, long white worms	1	0.28
tape worm, parasitic worm	1	0.28
tape worms, hook worms, round worms	1	0.28

tape worms, pin worms	1	0.28
tape, hook, liver fluke (?), threadworm	1	0.28
tape, maggots	1	0.28
tape, ring worm	1	0.28
tape, round, hook worms	1	0.28
tape, round, ringworm	1	0.28
tape,round,hook,whip	1	0.28
Tapeworm, Pinworm.	1	0.28
Tapeworm, Ringworm	1	0.28
Tapeworm, Ringworm	1	0.28
Tapeworm, Ringworm.	1	0.28
Tapeworm, Roundworm, Pinworms	1	0.28
Tapeworm, Roundworm.	1	0.28
Tapeworms, Ringworms.	1	0.28
Tapeworms, Roundworms, Hookworms, Pinworms	1	0.28
whipworm, parasites, hook worm, round worm	1	0.28
white lng	1	0.28
(blank)	16	4.42
Grand Total	**362**	**100**

In response to Question GP.D5 (APPENDIX 8.B), "*do you think helminths are good or bad for people's health?*", most of the respondents thought that helminths were indeed harmful (n=230, 63.54%) This was followed by 28.18% (n=102) of the respondents that indicated that they did not know, 4.97% (n=18) indicating that worms are harmful, and 0.56% (n=2) indicating that they are good for health. The remaining 2.76% (n=10) did not provide any response (Figure 4.3).

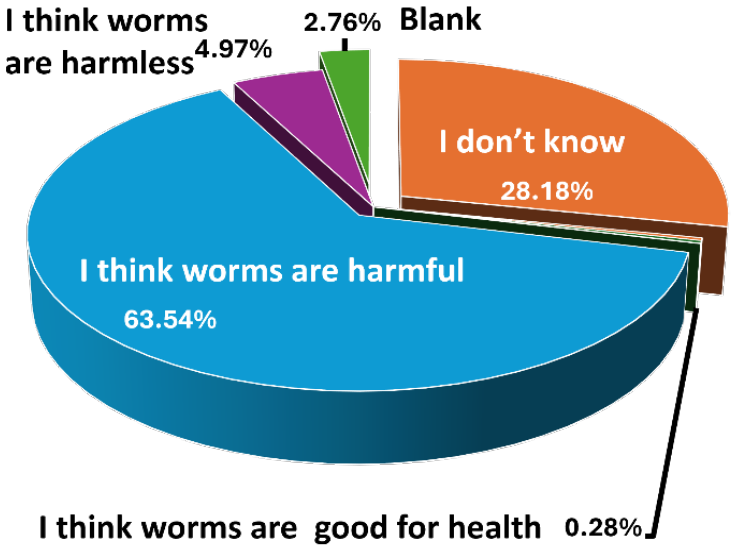

Figure 4.3: The General Public response to "*are helminths good or bad for people's health*" (Question GP.D5 (APPENDIX 8.B)), most of the respondents thought that helminths were indeed harmful (n=230, 63.54%).

When asked about the transmission of helminthiasis in Question GP.D6 (APPENDIX 8.B), a notable portion of respondents 39.78% (n=144) indicated that they do not know how intestinal helminths are transmitted. This was followed by 30.11% (n=109) that indicated that transmission is through "*Eating contaminated, unclean, and under-cooked food or pork. And from eating or playing with soil*"(Table 4.7). There was a small number of respondents (n=12, 3.31%) who indicated that they have not heard about intestinal helminths before hence this question was not applicable to them. (Table 4.7)

Table 4.7: Responses to question about transmission of helminthiasis in Question GP.D6 (APPENDIX 8.B)

Variable	Frequency	Percentages
Bacteria	5	1.38
body change, forever itching	1	0.28
By eating a lot dairy products	11	3.04
By Eating contaminated, unclean, and under-cooked food or pork. And from eating or playing with soil.	109	30.11
causes diarrhoea, infection of different sicknesses in your body	1	0.28
Eating a lot.	4	1.10
From birth	2	0.55
I don't know	144	39.78
Not applicable	12	3.31
Not washing hands, Fruits and Vegetables	18	4.97
Poor Hygiene	12	3.31
Raw, contaminated, or rotten meat.	19	5.25
touching objects with worm eggs on them, touching soil with worm eggs in it	1	0.28
Unclean water and environment	6	1.66
(blank)	17	4.70
Grand Total	**362**	**100**

In the open-ended question that asked, "*how can we prevent intestinal helminths?*" (Question GP.D9 (APPENDIX 8.B)), other than the 38.95% (n=141) who responded that they did not know; the remaining General Public respondents provided several alternatives with most of the respondents listing "Washing hands, fruits and Vegetables, avoid playing in soil, properly cooking meat, and disinfecting unclean areas, and drinking a lot of water" (Table 4.8). In response to the question "Do you think human faeces can be a source of worm infection?", 56.91% (n=206) of the general public indicated that they "do not know" (Question GP.D10 (APPENDIX 8.B)), whilst 8.56% (n=31) responded 'No' and 31.49% (n=114) said 'Yes'.

Table 4.8: Responses regarding helminthiasis prevention (n=362) (Question GP.D.9 (APPENDIX 8.B)).

Variable	Frequency	Percentage
I don't know	**141**	**38.95**
By Washing hands, fruits and Vegetables, avoid playing in soil, properly cooking meat, and disinfecting unclean areas, and drinking a lot of water	108	29.83
Deworming	48	13.26
(blank)	21	5.80
Following a healthy diet practice good hygiene	18	4.97
Not applicable	11	3.40
Go to the clinic, Doctor or Hospital	8	2.21
Lessen meat consumption	3	0.83
By Creating awareness	2	0.55
Drinking water, avoid eating sour milk	1	0.28
Keeping children inside the house	1	0.28

When the general public participant were asked if they had had an intestinal infection, 76.80% (n=278) had not, with 17.96% (n=65) reporting that they had had an infection when they were a child(Table 4.9). This response had a direct influence on those in Section E on treatment and treatment seeking behaviour (Section 4.2.1.5).

Table 4.9: Responses to the question "*Have you had an intestinal parasite/helminth infection*" and "*If yes, when was the last time*"? (n=362) (Question GP.D7 and D8 (APPENDIX 8.B).

Variables	Frequency	Percentage
I don't know	**10**	**2.76**
I do not remember	1	0.28
Not Applicable	8	2.21
When I was a child	1	0.28
No	**278**	**76.80**
I do not remember	2	0.55
Not Applicable	273	75.41
(blank)	3	0.83
Yes	**65**	**17.96**
I do not remember	9	2.49
Less than 3 months ago	2	0.55
More than a year ago	4	1.10
One year ago	4	1.10
When I was a child	46	12.71
(blank)	**9**	**2.49**

4.2.1.5 Section E: Treatment and Treatment seeking behaviour

The majority of the respondents (85.64%; n=310) indicated that they have not been treated for intestinal helminths (Question E.1 (APPENDIX 8.B)), with 11.60% (n=42) having received treatment at the time of data collection (Figure 4.4).

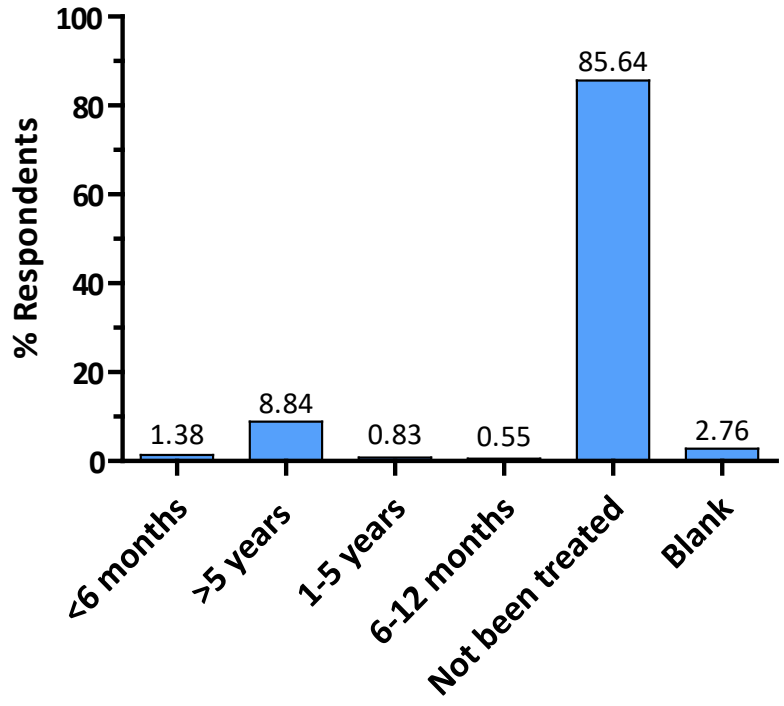

Figure 4.4: Intestinal worm infection treatment responses over the lifetime of the respondent (n=362) (Question E.1 (APPENDIX 8.B).

With a high proportion of the respondents (85.64%) reported to not have been treated for helminths, it was not surprising that 84.25% of the general public participants had selected not applicable in their responses to the question, "*what medication did you take to eradicate the infection*?" (Question E.2 (APPENDIX 8.B)) The majority of respondents (84.25%; n=305) that had had some form of treatment reported taking mebendazole (4.70%; n=17), 0.28% piperazine (n=1) and 0.28% (n=1) other (traditional medication) (Figure 4.5).

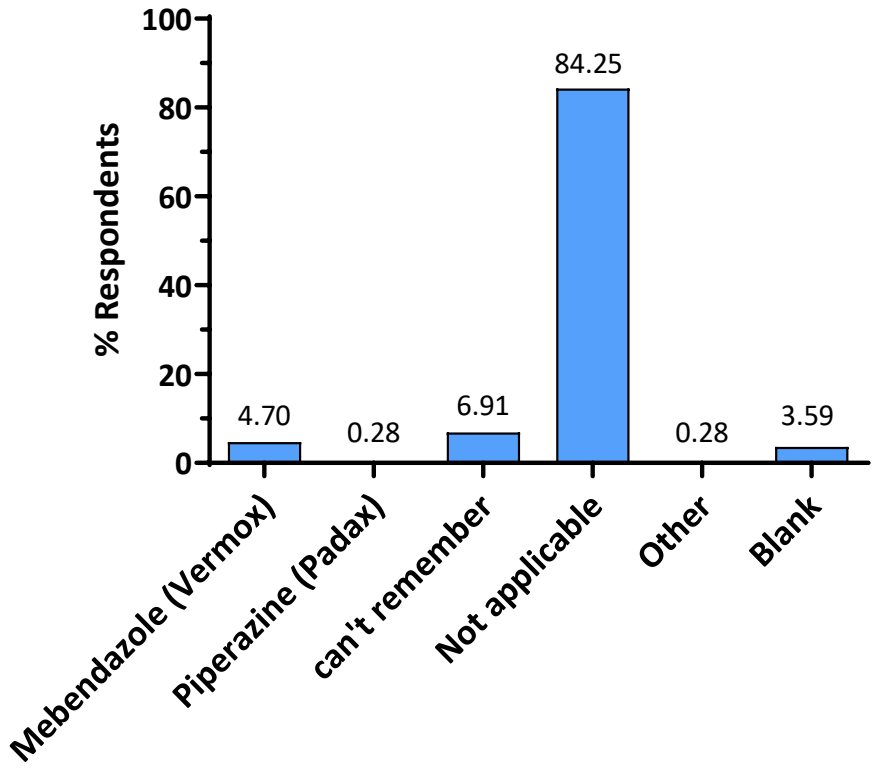

Figure 4.5: Medication reported to have been taken to treat helminth infections by the General Public (n=362) (Question E.2 (APPENDIX 8.B).

When asked "*If you suffer from diarrhoea or abdominal pain, what do you do?*" (Question E.3 (APPENDIX 8.B), only 69.89% (n=253) of the respondents reported to visit the Clinic/Pharmacy/Doctor, whilst 16.02% (n=58) elected to not seek treatment. Some participants selected "Other" 7.73% (n=28) and specified their responses including, self-medicated with a salt-sugar solution, vinegar water or bicarbonate of soda and vinegar, and African tea (Table 4.10).

Table 4.10: General public's treatment seeking behaviour for diarrhoea and abdominal pain (n=362) (Question E.3 (APPENDIX 8.B).

Variables	Frequency	Percentages
Go to Clinic/Doctor	109	**39.78**
Go to Clinic/Pharmacist	144	30.11
Nothing	58	16.02
Other	28	7.73
Blank	21	5.80
Take traditional Medicinal Plants	2	0.55

4.2.1.6 Section F: Helminth management of children

Intestinal helminth infections can affect children in different geographical regions such as sub-Saharan Africa, China, South America and Asia (WHO, 2023) due to a number of factors including socioeconomic, environmental, and lack of adequate health services. As such this section is essential to better understand initial helminthic statistics in Soweto (Question F.1-10 (APPENDIX 8.B)). A total of 260 of the general public respondents (71.82%) indicated that their children had never been diagnosed with intestinal helminths (Table 4.11). Of those who indicated that their children had been diagnosed with intestinal helminths, 7.73% (n=28) of them said that the infection was when the children were between 1 to 6 years old, and these were single infections that were mostly diagnosed at the Clinics (Table 4.11). A total of 8.56% (n=31) of the respondents did not know the type of helminths that were diagnosed (Question F.6; Table 4.11).

Table 4.11: Demographics, infection rate and diagnosis of children being infected with helminths (n=362) (Question F.1-6, APPENDIX 8.B).

Variables	Frequency	Percentages	Variables	Frequency	Percentages
Do you have children?					
Yes	**303**	**83.70**	(blank)	16	4.42
No	43	11.88			
Have your children had a worm infection?					
No	**260**	**71.82**	Not Applicable	38	10.50
Yes	46	12.71	(blank)	18	4.97
What was the age range of the child/children when they had the infection?					
Not Applicable	**297**	**82.04**	< 6 Months	4	1.10
1-6 Years	28	7.73	11-18 Years	3	0.83
(blank)	19	5.25	6-12 Years	3	0.83
6-12 Months	6	1.66	>18 Years	2	0.55
Did the child/children have multiple worm infections?					
Not Applicable	**297**	**82.04**	2 to 5	5	1.38
1	23	6.35	Twice a Year	4	1.10
(blank)	19	5.25	6 to 10	1	0.28
Once a Year	12	3.31	I don't Know	1	0.28
Who diagnosed the infection?					
Not Applicable	**298**	**82.32**	Family Member	2	0.55
Clinic	21	5.80	General Practitioner	2	0.55
(blank)	19	5.25	Nurse	2	0.55
Self	13	3.59	Specialist	2	0.55
I do not remember	3	0.83	Other	0	0.00
What worm was diagnosed?					
Not Applicable	**298**	**82.32**	Roundworm	8	2.21
I don't Know	31	8.56	Tapeworm	4	1.10
(blank)	18	4.97	Pinworm	3	0.83
Mixed	0	0.00	Bilharzia	0	0.00
Other	0	0.00	Hookworm	0	0.00

In response to the question "*do your children wash their hands after going to the toilet?*" (Question F.7, APPENDIX 8.B). The response were as follows: 7.46% (n=27) never, 3.31% (n=12) rarely, 22.93% (n=83) sometimes, 44.20% (n=160) always, 16.85% (n=61) not applicable, and 5.25% (n=19) blank. Alternative preventive methods to hand-washing includes prophylaxis; which was a popular option of the participants (44.75%, n=162) prophylactically

treated their children, with 37.29%% (n=135) not managing proactively (blank responses: 5.80%; n=21)(Question F.8, APPENDIX 8.B). The respondents most commonly prophylactically treated their children every 6 months (27.34%, n=99), 15.47% (n=56) yearly, whilst others (1.38% n=5) elaborated with responses such as "When they get their vaccines at the clinic ", "everyday", and ensuring that they always keep their hands clean".(Question F.9, APPENDIX 8.B). Similarly a large proportion of the participants (48.34%, n=175) indicated that they only started to treat their children when they recognised symptoms (Figure 4.6) (Question F.10, APPENDIX 8.B).

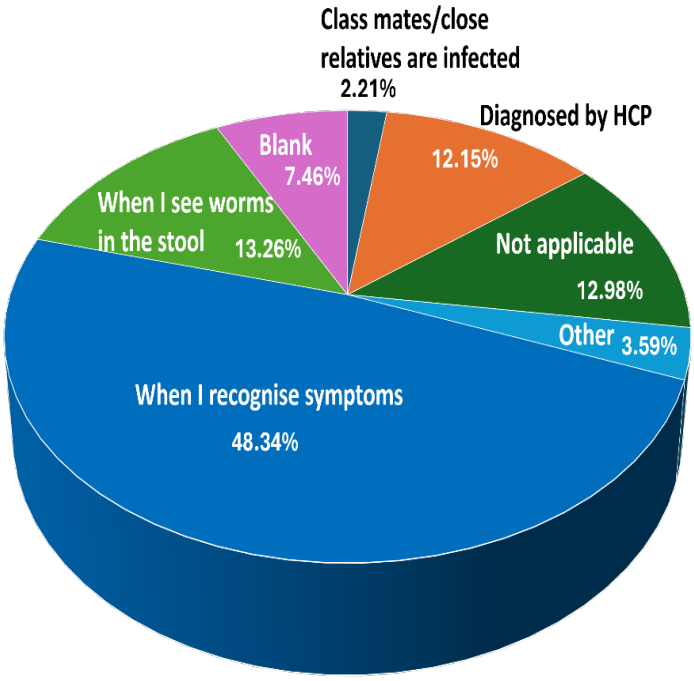

Figure 4.6: Caregivers seeking behaviour when a helminth infection is suspected in children (n=362) (Question F.10, APPENDIX 8.B).

4.2.1.7 Section G: Treatment with Herbal Medication

The majority of the participants (87.85%, n=318) reported that they do not use herbal medication and only 6.63% acknowledged use of herbal medication (Question G.1; APPENDIX 8.B); with 12 diverse alternative herbal or traditional phytomedicines reportedly taken (Table 4.12) (Question G.2; APPENDIX 8.B). The majority of the respondents self-medicated when treating a helminth infection (4.42% (n=16)) and compared to 1.38% (n=5) who consulted traditional healers and 0.28% (n=1) diagnosed by Qualified Registered Complementary

Medicine practitioners and 0.28% (n=1) received herbal medication over the counter with the assistance of a health consultant in pharmacies or health stores (Figure 4.7) Question G.3; APPENDIX 8.B. The form in which the herbal medicine was administered was mostly syrup (1.93% n=7)(Figure 4.8).

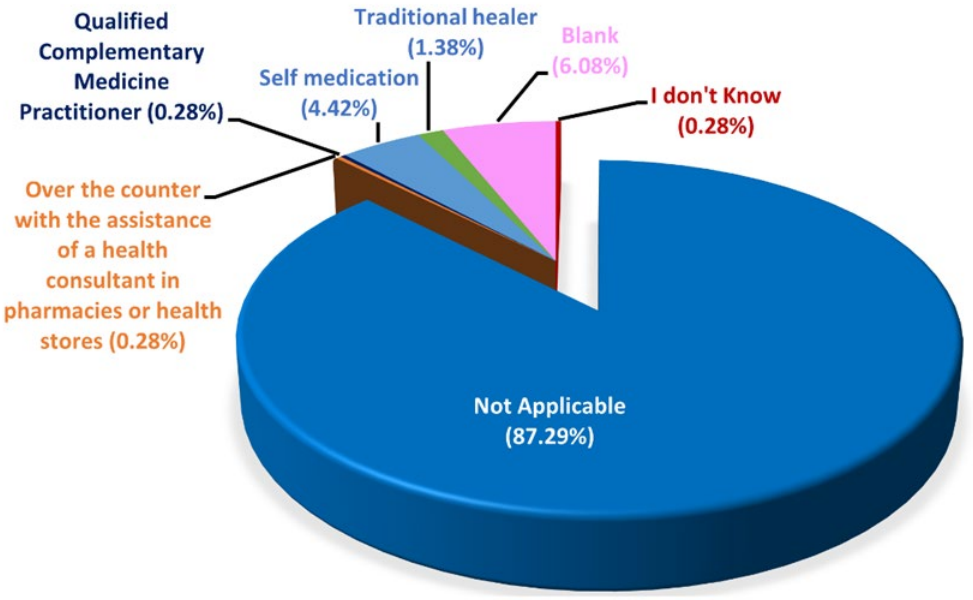

Figure 4.7: Responses to question "Who prescribed the herbal medication? " (n=362) (Question G.3, APPENDIX 8.B).

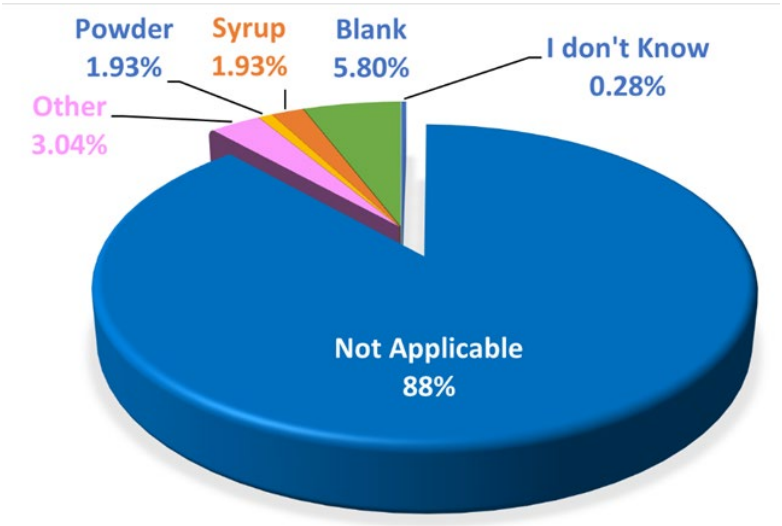

Figure 4.8: Responses to the form of herbal medication given (n=362) (Question G.4, APPENDIX 8.B).

Table 4.12: Use of herbal medication for helminth infections and type of herbal medications used by participants (n=362) (Question G.1 and G,2; APPENDIX 8.B).

Variables	Frequency	Percentages	Variable	Frequency	Percentages
Do not use herbal medication	**318**	**87.85**	**(blank)**	**20**	5.52
Herbal medication use	**24**	**6.63**	Only garlic and ginger	1	0.28
Aloe	4	1.11	*Pitsa*	1	0.28
Imbiza	2	0.28	*Remedio*	1	0.28
Mathunga, mhlonyane	1	0.28	Rooibos herbal tea for children	1	0.28
Mhlonyana	1	0.28	*Sbalaba. imbiza*	1	0.28
Muthi unenyoni	1	0.28	*Vimbela*	2	0.55
Not sure of names	6	1.68	Weed-like herbs	1	0.28

4.2.2 HEALTHCARE PROFESSIONAL

4.2.2.1 Section A: Demographic data of HCPs

Most of the HCPs who participated in the study were females (n=46; 97,87%) and nurses (n=25; 53.19%). Many of the respondents had more than 5 years of experience as HCPs (n=33; 70.21%) (Figure 4.9). Data presented from Questions A.1-A.4 (APPENDIX 8.A) excludes pharmacists as they were invited to participate in the study but did not volunteer to participate.

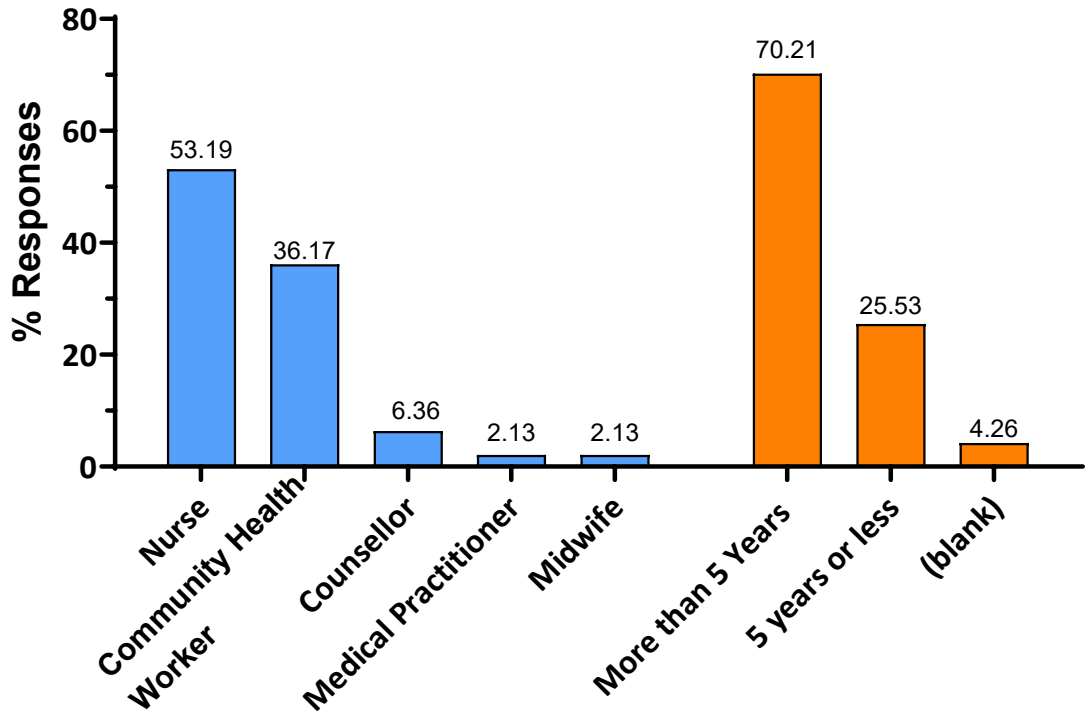

Figure 4.9: The profession of the participating HCPs and duration of work experience (n=47) (Questions A.1-A.4; APPENDIX 8.A).

4.2.2.2 Section B: Assessment of healthcare providers knowledge about helminthiasis

This section assessed HCPs knowledge on helminthiasis and contained 12 questions (B.1-B.12; APPENDIX 8.A). Where question B.1 and B.2 asked the respondents to list the most common helminths that affect humans (Table 4.13) and clinical symptoms (Table 4.14), 61.70% (n=29) of the respondents indicated significant knowledge of intestinal worm infections and were able to list at least one helminth that can affect humans'. With 63.83% (n=30) able to list correct clinical symptoms (Table 4.14).

Table 4.13: HCP's response to common helminths that affect human (n=47) (Question B.1; APPENDIX 8.A).

HCP's response to common helminths that affect humans	Frequency	Percentages
Abdominal pain	1	2.13
By eating mud, environment, and lack of hygiene	1	2.13
Dirty environment, Eating soil, overcrowded	1	2.13
Eating soil, sour milk, too much meat, dairy, and staying in a dirty environment	1	2.13
Flatworm	1	2.13
Hookworm, Roundworms, Tapeworms, Pinworms	1	2.13
Hookworm, Whipworm Roundworms	1	2.13
I don't Know	4	8.51
I don't Know	5	10.64
Mud, Environmental sanitation, Untidy place	1	2.13
Pinworms, Tapeworms, Roundworms	1	2.13
Playing with Soil and not Bathing	1	2.13
Ringworms	2	4.26
Ringworms, Hookworms	1	2.13
Ringworms, Hookworms	1	2.13
Ringworms, Tapeworms	1	2.13
Roundworms	1	2.13
Roundworms, Flatworms, shortworms	1	2.13
Roundworms, Flatworms, Tapeworms	1	2.13
Roundworms, Longworms, flatworms, thinworms	1	2.13
Roundworms, Whipworm, hookworms, *Anglostoma duodenale*	1	2.13
Roundworms, Whipworms, Hookworms	1	2.13
Roundworms, whipworms, hookworms, flatworms, tapeworms	1	2.13
Roundworms	1	2.13
Tape worms, Roundworms	1	2.13
Tapeworm, Ringworm	1	2.13
Tapeworm, Ringworms	1	2.13
Tapeworm, Roundworms	1	2.13
Tapeworms	2	4.26
Tapeworms, RingWorms	2	4.26
Tapeworms, Roundworms, Porkworms	1	2.13
Tapeworms, roundworms, Ringworms	1	2.13
TB, HBP, Cancer, Diabetes	1	2.13
Thin worms	1	2.13
Whipworm, *Ascaris*, Hookworms	1	2.13
Whipworm, Roundworm, hookworm	1	2.13
Worms	1	2.13
Grand Total	**47**	**100.00**

Table 4.14: HCP's response to symptoms of intestinal helminths infections (n=47) (Question B.2; APPENDIX 8.A).

HCP's response to symptoms of intestinal helminths infections	Frequency	Percentages
Abdominal pain, blood and protein loss, diarrhoea	1	2.13
abdominal pain, Diarrhoea, blood loss, protein loss, cognitive growth retardation	1	2.13
Abdominal Pain, Itchy skin	1	2.13
Anal Pain, Scratching skin, loss of appetite	1	2.13
Become thin, Not growing well, develop ringworms	1	2.13
Blood and protein loss, abdominal pain	1	2.13
Blood in urine, loss of appetite and weight.	1	2.13
Children affected do not grow well, and get ringworms	1	2.13
Diarrhoea ,Abdominal pain	1	2.13
Diarrhoea, abdominal pain	1	2.13
Diarrhoea, Abdominal pain, general malaise, weakness, impaired growth and physical development	1	2.13
Diarrhoea, Abdominal pain, Itchy anus, Weight loss	1	2.13
Diarrhoea, abdominal pain, Rash, itching of anus	1	2.13
Diarrhoea, Abdominal pain	1	2.13
Diarrhoea, Blood and protein in Urine, abdominal Pain	1	2.13
Diarrhoea, Vomiting, Abdominal pain, gastrointestinal spasm, loss of weight and appetite.	1	2.13
I don't Know	4	8.51
I don't Know	5	10.64
Itching of the anus	1	2.13
Itching of the child's anus, blood in Urine, ringworms on the head	1	2.13
Itching, Rash, loss of appetite	1	2.13
Itchy anus, visible worms in the stool, stomach pains, weight loss	1	2.13
Itchy Bums	1	2.13
Loss of appetite and weight, child becomes restless and struggles to sleep at night	1	2.13
Loss of appetite	1	2.13
Pain, Diarhoea, abdominal pain	1	2.13
Ringworms, Itchy anus	1	2.13
Ringworms, itchy body and anus, big stomach, loss of appetite	1	2.13
Ringworms, Skin Rush	1	2.13
Ringworms, vomiting, itching	1	2.13
Skin infection, Diarrhoea, Abdominal Pain	1	2.13
Sores on the head and underneath feet	1	2.13
Sores on the head	1	2.13
Vomiting, Fever, loss of appetite, Stomach cramps, and Runny tummy	1	2.13
Vomiting, itchy anus, ringworms	1	2.13
Weight loss, Distended abdomen, Abdominal cramps, Ringworms	1	2.13
Weight loss, Increased appetite	1	2.13
weight loss, loss of appetite, Diarrhoea, vomiting, and stomach cramps	1	2.13
Weight loss, night sweats, Diarrhoea, Fever	1	2.13
Weight loss, visible worms from the stool	1	2.13
Grand Total	**47**	**100.00**

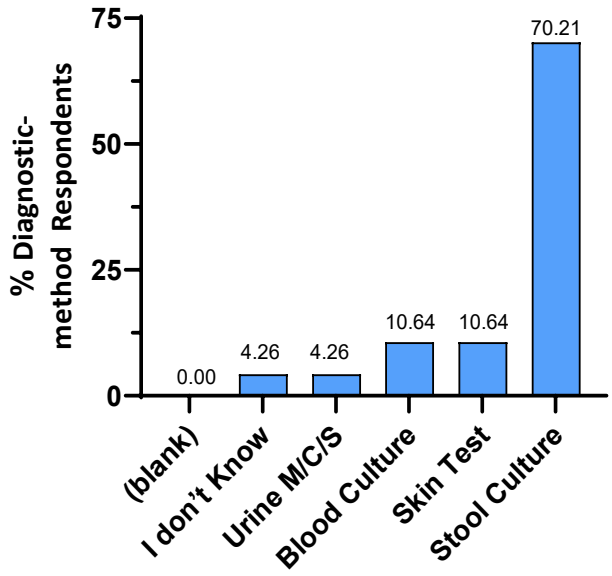

Figure 4.10: HCPs selections on the best method of diagnosis for helminth infections (Question B.3; APPENDIX 8.A).

For question B.3 (APPENDIX 8.A), a stool culture (n=33; 70.21%) was selected as the best method to diagnose helminthic infections (Figure 4.10).For Question B.4 (APPENDIX 8.A), 53.19% (n=25) of the HCP respondents indicated that in order to prevent intestinal helminths, methods could include a combination of provision of adequate water supply, proper health education and environmental sanitation reduction of overcrowding (Table 4.15).

Table 4.15: HCPs responses regarding intestinal helminth infection prevention (Question B.4; APPENDIX 8.A).

HCPs Responses to the best method includes in the prevention of Intestinal Helminth infections	Frequency	Percentage
Provision of Adequate water supply	8	17.02
Proper Health education	12	25.53
Environmental Sanitation	9	19.15
Reduction of Overcrowding	2	4.26
All of the above	25	53.19

Question B.5 and B.6 (APPENDIX 8.A) requested the HCPs to respectively list trade names and active ingredients of the drugs used to manage helminthiasis. Of the 47 HPCs that responded to this question, only 53.19% (n=25) listed Vermox®, Wormstop®, Wormgo®, and Stromectol®

(Table 4.16). For the active ingredients, only 19.15% (n=9) of the respondents were able to list the correct active ingredients, which included albendazole, mebendazole and praziquantel (Table 4.16). Table 4.18 shows the variable responses relating to dosage of antihelminth drugs in question B.7 (APPENDIX 8.A).

Table 4.16: HCPs responses regarding trade name (Question B.5; APPENDIX 8.A).

Variables	Frequency	Percentages
Albendazole	1	2.13
Deworming, Albendazole, Bitricide, Egaten	1	2.13
I cannot remember	1	2.13
I don't Know	13	27.69
Mabendazole	2	4.26
Mebendazole, praziquantel	1	2.13
Mebendazole, praziquantel, piperazine, flubendazole.	1	2.13
Medendazole, Flubendazole, piperazine, praziquantel, pyrantel.	1	2.13
Pills and Injections	1	2.13
Stopworm	1	2.13
Stromectol, Reeses worm medicine, vermox, Albenza, mintazol	1	2.13
vermox	11	23.40
Vermox, Wormstop	2	4.26
Vermox, wormzole	1	2.13
WormGo, VitaminA	1	2.13
wormstop	4	8.52
Wormstop, mebendazole	1	2.13
Wormstop, Vermox,	3	6.39
Grand Total	**47**	**100**

Table 4.17:HCPs responses regarding active ingredients (Question B.6; APPENDIX 8.A).

Variables	Frequency	Percentage
Abendazole, mebendazole	3	6.39
Benzimidazole, praziquantel, doxycycline	1	2.13
Depressants	1	2.13
I don't Know	34	72.42
Mebendazole	5	10.64
Mefloquine 250mg orally weekly	1	2.13
Minerals and Protein	1	2.13
starch	1	2.13
Grand Total	**47**	**100**

Table 4.18: HCPs response in relation to the question "*How are prophylactic drugs administered including dosage for children and adults?*" (n=47) (Question B.7; APPENDIX 8.A).

Drug administration and dosage	Frequency	Percentage
I don't know	21	44.6
Orally	3	6.38
100mg 2/2 daily for 3 days.	2	2.13
1 from 2 years onwards	1	2.13
1 tablet	1	2.13
100mg 2/2 daily for 3 days	1	2.13
200mg for children 2 tablets for 3 days.	1	2.13
2 tablets/ once a day for 3 days	1	2.13
400mg oral stat dose every 6 months (24 months to 5 years). 200mg oral stat dose every 6 months (12 months to 18months)	1	2.13
5ml of deworming syrup once a day	1	2.13
Administered orally, dosage vary according to weight and age.	1	2.13
Adults- doxycycline 100mg orally daily, when used with quinine it is used 1 to 3days. Children- 2 pills per day for 3 days.	1	2.13
Children- 1g orally per day for 3 days	1	2.13
Children up to 2 years- 500mg daily for one day. Adults- 100mg daily for one	1	2.13
Children 2 pills per day for 3 days. Adult 1 pill for 14 days.	1	2.13
Deworming	2	2.13
For Children it is administered in 500mg stat dose every six months	1	2.13
In children every six months	1	2.13
Mebendazole	1	2.13
Monthly	1	2.13
Praziquantel	1	2.13
Vermox® - orally 12 hourly for 3 days. Children 1-2years-100mg hourly for 3 days. Children older than 2 years and adults - 500mg single dose	1	2.13
Wormstop®	1	2.13
Community Health Worker	2	4.26

Question B.8 (APPENDIX 8.A) querying whether the HCP knew if their patients used herbal medication to treat a helminth infection and the product names, indicted that 95.74% (n=45) of the respondents indicated that they have no knowledge on whether their patients were using herbal medications or not. Of the 4.29% of responses using herbal medications, the

following were identified, garlic, pumpkin seeds, cardamon oil (2.13%; n=1) and 2.13% (n=1) were not sure of the names of the herbal medication.

Question B.9 to B.12 were related to the South African guidelines for the treatment of helminthiasis. Over 70% of the participants indicated that they were not aware of the South African Guidelines for helminth infections and only 27.66% (n=13) indicated that they were aware that it was a notifiable disease (Figure 4.11). The majority of the HCPs (65.96%) indicated that they believed the forms to report a notifiable condition is obtained at the Clinics/Hospitals rather than the Department of health premises/website (21.28%; n=10) (Figure 4.12). Majority of the HCPs respondents reported a lack of knowledge regarding where the forms for notifiable disease should be submitted 54.12%; (n=24)(Table 4.19)

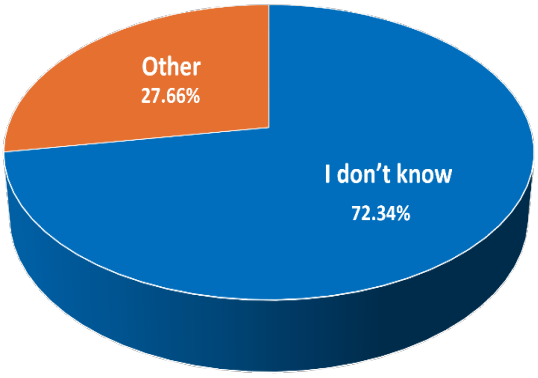

Figure 4.11: Responses to when HCP participants were asked if they were aware of the South African guidelines for the treatment of helminthiasis (n=47) and whether helminth infections are notifiable diseases in South Africa. (Question B.9 and B.10; APPENDIX 8.A)

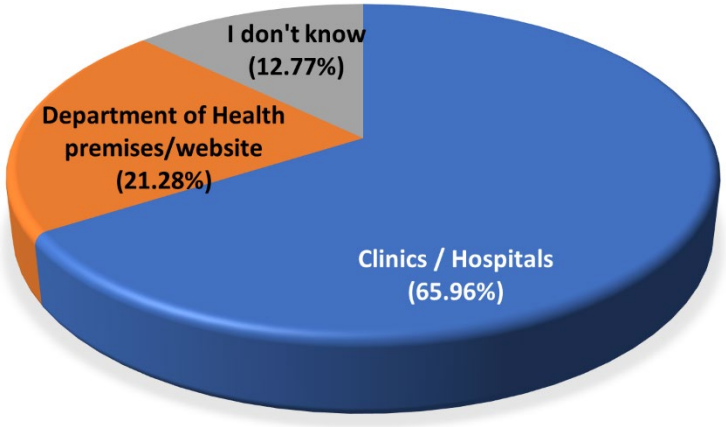

Figure 4.12: HCPs response in relation to the question "*Do you know where to obtain the forms for a notifiable disease?*" (n=47) (Question B.11; APPENDIX 8.A).

Table 4.19: HCPs response in relation to the question "*Do you know where to submit the forms for a notifiable disease?*" (n=47) (Question B.12; APPENDIX 8.A).

Variable	Frequency	Percentages
Clinic	5	10.65
Community Health Worker	2	4.26
Department of Health	5	10.65
I don't know	24	51.12
Management	1	2.13
No	1	2.13
Yes	7	14.90
Yes- from coordinators for the specific department	2	4.26
Grand Total	**47**	**100**

4.2.2.3 Section C: Further Information

This section was aimed at HCPs who were parents and would be agreeable to complete the General Public questionnaire, or if additional information was required to ensure the HCPs knowledge was upskilled (Table 4.20). A total of 72.34% (n=34) of the HCP respondents indicated that they would be interested in additional information on the diagnosis and management of intestinal helminth infections and 65.96% (n=31) would require more information regarding the procedures to be follow for the submission of documents for notifiable disease. Out of the 77.34% (n=34), 12.77% (n=6) of the total sample specifically indicated a preference for receiving additional information on email, 17.02% (n=8) as information brochures, and 42.55% (n=20) through workshop.

Table 4.20: Further Information section C (APPENDIX 8.A).

Question		Yes (Frequency; Percentage)		No (Frequency; Percentage)	
C.1	As a parent/guardian would you be prepared to complete an additional questionnaire on helminth management within your household?	23	48.94	24	51.06
C.2	Would you like additional information on the diagnosis and management of helminth infections?	34	72.34	13	27.66
C.3	Do you require further information regarding the procedures to submit the necessary documents for a notifiable disease?	31	65.96.	16	34.04

4.3 PART 2: QUALITATIVE FINDINGS

Thirty HCP participants from three clinics took part in the qualitative part of the study instead of four as the 4th one was under renovations and not functioning (Table 4.21).

Table 4.21: Number of focus group participants per clinic.

Clinic	# Of HCP Participants	Date of Discussion
Clinic O	5	28-Oct-22
Clinic M	10 (Group 1); 8 (Group2)	01-Nov-22
Clinic C	7	11-Nov-22

4.3.1 EMERGENT THEMES

This part of the study aimed to gather information about the participant's expressions and opinions in a form of focus group interviews. The verbatim quotes of participants supported the themes and are indicated in italics. The quotes have been coded; PN = participants number and FGN = focus group number e.g., P1, FG(X) means participant 1 from focus group (number). The main prevailing issues as shown in Table 4.22 included lack of trainings for HCPs, rare cases of infections, deworming programmes, misinformed/ unknowledgeable population, community outreach programmes, susceptibility to infection because of a crowded population, limited staff, poverty, and malnutrition, increases unemployment rate. The listed categories generated three emergent themes which provided a structure of the findings from this study namely: Socio-economic status/issues, available measures, suggestions/ ideas to enhance knowledge.

Table 4.22 Themes and sub-themes that were generated from focus group interviews.

Theme	Sub-theme
Socio-economic Issues	● Large Population ● Poverty and Malnutrition ● High unemployment rate
Available prevention measures	● Deworming programmes ● Limited information provided to patients. ● Rare helminth infection cases
Trainings and community outreach	● Trainings ● Community outreach ● Increase number of staff

4.3.1.1 Theme 1: Socio-economic Issues

Socio-economic status of Soweto is that of a low to middle income category, with low education levels. This is most likely to play a role on the lack of knowledge regarding helminthiasis for the community. The participants indicate that large population, poverty, and education as the most common factors. The following phrase taken from the focus group discussion supports this statement:

"Over population, poverty and malnutrition conditions, unemployment." This was listed as contributing factors to the limited knowledge seen in the community.

[P3, FG3]

"*Yes, it would have contributed when you look back because of, like you are saying living in a poverty area, you don't get to get proper food, and there was not much information given in terms of your diet at your whatever. Your whatever….so anything that you juggle, it would contribute to these things coming out*."

[P1, FG2]

"*I think, we are taught about these worms we will be equipped enough to educate the community, for now since we don't have enough information, I don't think even if we educate, we will be giving them more information*."

[P6, FG3]

"*My sister likes to call me and says her child is eating too much so she needs deworming pills. I mean the child could be eating because of they have appetite, you know, it might not be worms. So, we are not having enough information at all*.

[P1, FG2]

Further to the above, some HCPs added that Soweto is very crowded, with most yards having backrooms and shacks of multiple families, they further indicated that the community does not understand the impact of internal worms.

4.3.1.2 Theme 2: Available prevention measures

Some HCPs indicated that helminthiasis is not very common at their clinics because there is adequate sanitation and immunization. The following statement from the focus group discussions supports this:

"For me, it is no longer more often because of recently ever since...eh, with this uhm…what do you call this? When kids come for their immunization and what what what what, they get to be dewormed. Every time when they come, they get some deworming tablets and so forth. Its rare cases but growing up we use to see these things a lot, I have also had them as a child, and they took them and put inside a bottle."

[P1, FG2]

"Fortunately, I would say the area that we are at, most of the creches they don't use umhlabathi (soil) in their creches cause children will get worm from areas where there is soil and where there are rivers, that is mostly where they would get the worm infestations from, and then, erh we have got cleaned swimming pools, so we don't have a big problem…hence the percentages are still low. Cases are very low and those are rare cases. And then the other thing is, we do deworm from 6 months neh …from 1 year. So our system, the community they are aware because they do bring their children for the immunizations."

[P8, FG3]

Deworming is provided when children are brought in for the immunizations. Parents are informed about the medication and what they are used for. Due to the living conditions in Soweto, most people in the community do not follow a particular diet, and do not have enough knowledge about STH. Some of the Nurses have not had any helminth infection cases, they have also indicated that the cases for children older than 5 years are referred to the Doctors. There is a lot of misconception around intestinal helminths, some HCP indicated that ringworms can be a sign of helminthiasis and some think that the infection only applies to children. There are already Nurses reaching out to the communities, however not for intestinal helminth infections, as such it was suggested that if these Nurses could be trained on helminth infections, it would be beneficial to the community.

The following statements corroborated the misconceptions:

"In my time working at EPI, I've seen mothers bringing kids because they have ring worms, the reason it's a problem is because its either our community is ignorant, or they are misinformed. In terms of hygiene, it's one of the issues have picked up, so I have seen kids with rings worms and when you look, they just know that there are worms, but they do not know what they are and how they come about." *[P1, FG1]*

4.3.1.3 Theme 3: Trainings and community outreach

The HCPs have indicated that they have limited trainings regarding helminthiasis hence the lack of knowledge. They had all agreed that they will highly benefit from trainings such as workshops, some had also suggested that the distribution of pamphlets with some information regarding helminthiasis might also work, especially if they are in different languages. They have further suggested that an outreach programme might benefit the community e.g. reaching out to creches and schools. Health promoters are needed in the clinics to educate and create awareness not only for the HCPs but also the General public. This will lessen the burden on the HCPs that are seeing patients at the clinics. The following phrases supports the above statement:

"Yes, workshops will work, she is right. Its better because we are able to engage with one another, we are able to teach, it becomes teachable unlike reading. To verbalize it, it is much better."

[P1, FG2]

"Another thing that would be better is to get pamphlets for patients and workshops for the staff members."

[P6, FG2]

"In my opinion I wouldn't say that on this specific topic but maybe on a specific section, maybe how to diagnose, example for this study that you did, with the questionnaires I realised that there are more gaps, and we just give prophylactic and no process they need to follow, so we just know this on the surface."

` [P1, FG1]

"I think, we are taught about these worms we will be equipped enough to educate the community, for now since we don't have enough information, I don't think even if we educate, we will be giving them more information."

[P6, FG3]

"Having pamphlets in different languages to be distributed in the community."

[P7, FG3]

"We also need health promoters, there must be posts allocated to us. Here at the clinic, we don't have a health promoter, so while patients are waiting, they will be addressing them. As much as we are using our outreach team, our outreach team most of the time by 9am they go out to the community so there is no one remaining to give talks as well. That individual will need also to be trained and empowered."

[P8, FG3]

"*I think looking into health promotion, as we work with the outreach team to reach out…so if…, it's just that we are understaffed. So, if we have enough staff doing the outreach and teaching the communities, because of the lack of staff in our clinics, we are rushing to see the patient and sometimes health education is not there. Health promotion and education to help the community. We are not able to educate on the spot, you may say something to one patient and not be able to say it to another as we feel rushed due to being understaffed.*"

[P1, FG1]

The following statement is from a participant that felt that the HCPs are also not knowledgeable about helminthiasis and that they should be the target for training as they will educate the community.

"*I think, we are taught about these worms we will be equipped enough to educate the community, for now since we don't have enough information, I don't think even if we educate, we will be giving them more information."*

[P6, FG3]

5 CHAPTER FIVE: DISCUSSION

5.1 INTRODUCTION

Soil transmitted helminth infections are the most common infections worldwide (WHO, 2023). They have become a significant global burden, especially in developing countries (Tembo et al., 2022) and they affect the poorest and most disadvantaged communities with poor access to clean water, sanitation, and hygiene (WHO, 2023). Personal practices, sanitation, and lack of community knowledge are some of the factors which contribute to its prevalence in South Africa. Understanding the community's perception and practices is crucial in addressing helminth infection issues (Nath et al., 2018). This study aimed to evaluate the knowledge and management of helminth infections in the community and HCP in the clinics based in Soweto.

5.2 QUANTITATIVE STUDIES

5.2.1 DEMOGRAPHIC CHARACTERISTICS

This section highlights the common factors that influence the prevalence of intestinal helminth infections as shown in other studies along with the links and gaps compared to the current study. Socioeconomic status, education, living conditions and access to healthcare place a crucial role in understanding the burden of intestinal helminth infection around the globe. It also provides oversight on the different challenges that the HCP face to address and manage these infections. An Indonesia study reported a significant association between socio-demographic factors and knowledge; some have indicated that participants' knowledge, coupled with their socio-demographic characteristics, can predict their practice and hygiene (Lee et al., 2023). Lustigman et al. (2012) have reported on associations between family income and the level of knowledge; people with a higher family income were more likely to have a good attitude and knowledge regarding helminth infections.

Furthermore, one of the KAP studies done in Thailand reported that people who earn a high income are most likely to be educated (Narkkul et al., 2022). However, no association was noted between the GP's income and education in the current study (p=0.381). It was further

noted that 67.98% of the participants who earned less than R5000 per month were knowledgeable about helminth infections (Table 4.1).

In this study, it was observed that the general public participants who have secondary and tertiary education were likely to have a higher knowledge of helminth infections, and with 44.75% of the participants providing prophylactic treatment to their children compared to their counterparts without any formal education (Table 4.1).

5.2.2 KNOWLEDGE ABOUT HELMINTH INFECTIONS

The first objective of the study was to determine the knowledge of helminth management amongst community members. The finding showed that most of the general public participants were aware that helminth infections exist (66.85%), and the major source of this information was listed as "Clinics" (Table 4.4). These findings were consistent with that undertaken in Nakhonsi Thammarat , a rural area in Thailand who reported that the majority of their participants had received information on helminthiasis from public health personnel (Narkkul et al., 2022). The study also reported that participants who gained knowledge through this source had significant knowledge of helminth infections. The latter was contradictory to the findings of the current study as there was no significant relationship ($p=0.155$) between the participants' major source of information and their ability to list at least one helminth that they knew or were able to explain what intestinal worms were, the mode of transmission and prevention. Most participants indicated that they had not had any helminth infections in the past, and the same applied to their children. Only 12.71% indicated that their children had had helminth infections in different stages of their lives; with the majority of the infections between the ages of 1 and 6 years attending creches who are most likely to either play with sand or acquire the infection from other children.

The second highest listed source of information on helminths was family and friend's category (Table 4.4). It has been reported that peers and community members tend to provide inaccurate information due to limited health-related knowledge (Oguh et al., 2020); which confirms that if the communities are educated with the relevant knowledge, they could educate each other on causes and preventative measures against helminthiasis (Oguh et al., 2020). For those mothers (66.85%) who indicated that they were aware of helminthic

infections, were able to list at least one mode of transmission. Which is similar to that reported in a Nigerian study who reported that most mothers had knowledge about helminth infections but did not know its cause and mode of transmission (Oguh et al., 2020). In a Thailand study, participants who indicated that their source of information was from public health personnel showed a good level (33.5%) of knowledge compared to those who got their information from other sources (Television, books, radio, community leaders, family members, and neighbours (Narkkul et al., 2022).

Various intervention strategies have been explored such as using newspapers, posters, radio and television for creating awareness of helminthiasis in their communities. This has shown to reduce the prevalence of helminths infections by 44% (Palmeirin., 2016). Training of HCPs is as important, HCPs in the current study have indicated that training in a workshop form will be beneficial for them in filling the gap in management and diagnosis of intestinal helminth infections. Workshops have proven to be beneficial where nurses knowledge improved on different type of disease areas and their medications (Attari et al., 2017).

In a study undertaken in the Ingwavuma area in the uMkhanyakude district, KwaZulu-Natal, South Africa, a total of 79.6% of the participants had heard about helminths (Sacolo-Gwebu et al., 2019). However, a large proportion did not have detailed information, only 32.4% could list the causes, and 42.9% were able to list prevention measures (Sacolo-Gwebu et al., 2019). These findings further supported the current study where most of the general public participants (66.85%) indicated that they had heard of helminths, and yet 63.22% and 69.01% could not provide more information regarding the causes and transmissions, respectively (Table 4.4). In the current study, the major causes of helminth infections were listed as eating contaminated food, unclean and undercooked food or pork, and playing with soil. As in other studies, contaminated water, food, uncooked vegetables, and unclean fruits overlapped those listed in the current study (Kassaw et al., 2022).

However, another study, including the current study have also recorded misconceptions by the general public; where participants thought that helminth infections were caused by eating dairy products and junk foods (Oguh et al., 2020). Two-thirds of the general public participants (63.54%) in the current study were aware that helminths are harmful to an individual's health

(Figure 4.3). However, recognising this did not equate to taking measures to be knowledgeable about the condition and how it can be prevented. In other studies, conducted in Bangladesh, Kenya, South Africa, and Ethiopia, it has been reported that a low level of knowledge and high awareness existed amongst the population (Sacolo-Gwebu, 2019). This could be due to limited knowledge regarding causes, signs, symptoms, routes of transmission, prevention, and diagnosis. Similar findings were also reported regarding the prevention of helminthic infections (Table 4.8). Knowledge on preventative measures is important and makes the patients less dependent on the HCPs. This can reduce the burden as the knowledge will be transferred from generation to generation. The generational knowledge transfer is a powerful method of education to protect the community and family. According to Gong et al. (2023) the family communication is crucial, because it has the ability to encourage or discourage certain behaviours. The parent-child communication has an impact on the child's development and this can be carried through to adulthood.

The general public participants' response gives a clear picture of the disease burden in Soweto, and it confirms the HCP statements that there are not many helminth infection cases at the clinics. However, ensuring that the HCPs are equipped with the necessary knowledge to make a proper diagnosis is very crucial to ensure that there is minimal misdiagnosis of the condition due to lack of knowledge and education. It is also very important to educate the community about the infection, especially its signs and symptoms and prevention. A total of 48.34 % of the general public participants indicated that they start treating their children when they recognise the symptoms (Figure 4.6), so it is very important that they are aware of these symptoms and that they can easily recognise them for quicker diagnosis and treatment.

5.2.3 PERSONAL PRACTICE

Another objective of this study was to determine common health practices among caregivers in the Soweto community. In this study, it was indicated that (n=338, 93.37%) of the participants had access to piped water, and only a small percentage relied on other sources such as rain, rivers, and wells, i.e. 0.28%, 1.38%, and 3.87%, respectively (Table 4.2). Studies have identified a high prevalence (45%) of helminth infections among individuals who rely on rain, well and river water as their major source of drinking water compared to a lower

prevalence (10%) of those who use pipe water (Amoani et al., 2022). Amoani et al. (2022) reported a significant association (p=0.013) between the source of drinking water and helminth infections was observed. A total of 93.37% in the current study indicated the use of pipe water as their major source of drinking water, which contributed to the low number of previous infections recorded, where 76.80% indicated that they had not had any helminth infections before (
Table 4.9). The incidence of STH infections was more likely to be associated with low water quality with unsafe sanitation contributing to low water safety (Sengupta et al., 2012).

The majority of the general public participants indicated that they always wash their hands (76.24%), fruits (75.69%), and vegetables (86.19%) before eating and preparing food (Table 4.3). Hand washing has been identified as an important measure to eradicate helminth infections, especially among children and is a key parameter that prevents the faecal-oral transmission of helminths (Tiruneh, Geshere, Ketema, 2020). Many studies have focussed on accessing knowledge and hygiene practices in school children of different age groups, where it has been found in two Indonesian primary schools the school children had poor personal practices. The children did not wash their hands with soap before eating and after defecation and were less likely to wear shoes (Nasution et al., 2019). This was not an isolated observation and has been reported on several occasions; such that this basic hygiene preventative method is crucial to be taught to scholars (Labana et al., 2021).

However, it has previously been observed that participants may exaggerate responses that reflect more desirable water, sanitation, and hygiene related practices (Nery et al., 2019). Indeed, in the current study, there were minimal risky or sanitary-related issues reported, with most 76.24, of the participants reported that they always wash their hands, fruits and vegetables respectively. Therefore, it might be significantly challenging to identify an accurate and unbiased method to measure water, sanitation, and hygiene behaviours in a population.

5.2.4 DISEASE MANAGEMENT AND PREVENTION

Over 600 million learners worldwide are infected with intestinal helminths, with approximately 1.5 million school-age children estimated to be severely ill due to STHIs. In South Africa, there is a 40-90% prevalence rates among school children (Department of Basic

Education, 2021). STHIs are most prevalent amongst disadvantaged children who live in densely populated and under-serviced areas such as informal settlements. High levels of infection have been documented amongst children in South African provinces, including KwaZulu-Natal, the Eastern Cape, Mpumalanga, the Western Cape, and Gauteng (Department of Basic Education, 2021). The South African approach to disease management and prevention is emphasised in the National Strategic Plan for the Prevention and Control of Non-Communicable Diseases (NSP 2022–2027).The strategy aims to reduce population mortality in relation to non-communicable diseases and to improve health outcomes through prioritizing prevention and control, promotion of health and wellness, implementing strategies to reduce disease progression, and to promote and support national capacity for high-quality research and development for the prevention and control of non-communicable diseases (National Department of Health, 2022).

The South African Government has implemented school health services, which include onsite health services provided to school children at their respective schools. As part of the onsite services, learners should be dewormed in schools. All parents are asked by the school to sign and return the consent form to the school, giving permission for their child to receive anthelmintic medication (South African Medical Research Council, 2007). Like South Africa, other African regions and countries offer free anthelmintic-deworming campaigns in the form of mass drug administration. Mass drug administration is a means of delivering safe and inexpensive medication based on the principle of preventative chemotherapy, where the population is offered treatment without prior diagnosis (Makaula et al., 2022).

However, it is indicated that these services were not enough to control the infections (Nath et al., 2020). There is still a gap in specific preventative and control measures and a concern regarding persistent infections and reinfections that were observed. Despite the intervention of mass drug administration, other studies have reported the gaps, misconceptions, and side effects of these drugs. They have also noted a poor compliance status due to inadequate health promotional activities (Nath et al., 2020).

The current study shows that only 44.75% of the general public participants provide prophylactic treatment to their children between school and Clinic visits **.** A total of 29.83% of

the participants indicated that washing hands, fruits, and vegetables, avoiding playing with soil, cooking meat well, disinfecting unclean areas, and drinking lots of water can prevent helminthic infections (Table 4.8). This is similar to the responses provided by the mothers who were interviewed in the Kassaw et al. (2022) Ethiopian study, and it was reported that contaminated water, contaminated food, uncooked vegetables, and unclean fruits were the major culprits. Furthermore, more than a third of the participants in the current study (38.95%) could not list any preventative measures (Table 4.8). This was contrary to the findings of a Nigerian study, which showed that 100% of the participants listed sanitation and personal hygiene as major preventative measures (Oguh et al., 2020). This highlights the importance of education to ensure personal hygiene goes hand in hand with safe water such as to have a complementary impact on STH prevalence.

5.2.5 RECOMMENDED ANTIHELMINTH DRUGS

The first step to eradicate helminths is to reduce its prevalence by eradicating them through medication in order to improve health status. This should be coupled with alterations in health lifestyle and sanitation (Trasia, 2021). The WHO recommends health hygiene education and provision of adequate sanitation (WHO, 2023). There are currently very limited studies evaluating HCPs knowledge on STHI drugs. A study on schistosomiasis in Tanzania showed that all interviewed HCPs knew that praziquantel was the recommended drug for schistosomiasis; however, they also mentioned the following namely, ciprofloxacin, erythromycin, mebendazole, albendazole, and vitamin B complex (Mazigo et al., 2023). In this study, 86.3% of the participants were able to list the correct dosage of praziquantel which was mentioned as 40mg/kg. The current study revealed that 53.19% of the HCP participants were able to list at least one correct antihelminth drug. Only 27.66% of the participants in the current study were able to mention correct doses for the treatment of helminthiasis (Table 4.18).

5.2.6 USE OF SELF-MEDICATION

The current study also investigated the use of alternative therapies to those recommended by the South African Department of Health. A total of 16.02% of the community participants indicated that they do not take any action when they start getting symptoms such as diarrhoea and stomach cramps, while 7.73% take other forms of treatment (Table 4.10).

Most of those who took other forms of treatment indicated the use of saltwater solutions, vinegar, and bicarbonate solutions to treat their symptoms. These home remedies have multiple health benefits either relate or unrelated to parasites eradication. Anecdotal evidence show that saltwater flush can be effective in short term bowel cleanse (Healthline, 2024). There is no scientific evidence to prove the effectiveness of saltwater in the eradication of parasites rather that is used as a laxative in attempts to evacuate the bowel (Sharkey and MacNaughton, 2023a).Research has noted that most vegetables are contaminated with parasitic cysts and eggs and washing these vegetables with vinegar seemed to be effective against among other *A. lumbricoides* eggs (Vannatha et al., 2022). Bicarbonate soda is known to have a variety of gastrointestinal benefits such as heartburn; however, there is minimal evidence on its benefit for the eradication of parasites other than altering the bowel pH and inducing bowel movement (Sharkey and MacNaughton, 2023b).

Although a number of general public participants (87.85%, n=318) reported that they do not use herbal medication, this does not necessarily imply lack of knowledge they could still be knowledgeable but do not see the need for using them. Some of the participants preferred to use herbal medication 6.63% (n=24) (Table 4.12). This was either through self-medication or visiting traditional healers and qualified complementary medicine practitioners. Some individuals resorted to plant leaves and roots as an unorthodox method for the treatment of intestinal worm infection. Some of the herbs taken include *mhlonyana*, *imbiza*, *vimbela*, and *muthu we nyoni* (Section 4.2.1.7). The findings of the current study are similar to those of the KAP study on the control of ST in parts of south-eastern Nigeria, where it was found that 15.7% and 14.7% of the respondents self-medicated or took herbal medication, respectively (Oguh et al., 2020).

Many cultural groups still rely on the use of traditional medication for treatment and prevention of several conditions despite the significant advances in synthetic drugs (Sotenjwa, 2020). *Mhlonyana,* known as the African wormwood in English, is an ancient herb that is known to treat colds and flu. The active ingredients of *Artemisia* species have been shown to inhibit schistosomiasis. In doing so the plant metabolites inhibit pro-inflammatory cytokine expression, leading to the inhibition of two important parasite enzymes, schistosome cytochrome-C peroxidase and thioredoxin glutathione reductase. Thereby increasing the susceptibility and decreased viability of the parasite during its different stages (Taljaard, Haynes, and Kooy 2023). *Imbiza* is herbal decoction which is mainly used to ease childbirth, facilitates the healing of the belly button and to protect newborn babies from different

illnesses. More in line with eradicating a helminth infection is that is described to be used to drain dirt from the baby's stomach (Ramulondi, de Wet, and Ntuli, 2022). But no study could be found to have investigated these traditional medicines in helminth management.

There are also currently no scientific publications on *vimbela*, and *muthi we nyoni*. *Muthi we nyoni* is a traditional mix that is known to help with indigestion acting as an antacid and reflux (muthi wenyoni antacid, n.d.). *Vimbela* is typically an ointment used to relieve body pain and assist with sleep, but no connection to parasite management could be found in the literature.

5.3 QUALITATIVE DISCUSSION OF FINDINGS

This phase of the study examined the experiences and perceptions of HCPs regarding knowledge and management of helminthiasis at the three clinics in Soweto. Based on the feedback from the NCPs three main themes that stood out were socio-economic issues, available measures, and suggestions to enhance knowledge. To note most of the HCPs who agreed to participate in the open discussion were females (97.87%) with more than five years of experience as HCPs with 53.19% of the participants were nurses (Figure 4.9).

5.3.1 EMERGENT THEMES

The findings in this study demonstrated that socio-economic issues such as large population, poverty and malnutrition, and high unemployment rate were the main contributing factors. Research has shown that people who come from a low socio-economic background tend to be less educated and, as a result, less knowledgeable about certain conditions (Malavade, 2015). Most HCPs had limited knowledge of the dosage of anthelminthic medication. On the other hand, HCPs showed poor to moderate knowledge in terms of being able to list the different types of helminths; where 61.70%, 63.83, and 68.09 were able to provide at least one worm, at least one clinical symptom and the common method of diagnosis respectively. These findings were similar to several other studies when assessing knowledge of schistosomiasis causes, signs, and symptoms among HCPs in Saudi Arabia, where only 36% of their participants had strong knowledge regarding signs and symptoms (Alghabbashi et al., 2022). This indicates that the observations in Soweto translate to those reported in Africa, a

continent which demands a superior knowledge of tropical diseases and management. However, HCPs indicated that they have limited resources to diagnose and manage helminth infections since helminthiasis is not very common at their clinics because there is adequate sanitation and immunisation, and deworming programmes are in place.

Other findings from the focus group discussions indicated the requirement for training in the form of workshops or designing pamphlets to provide to the patients. It was deduced in this study that the Clinics are understaffed, and the number of patients that come in daily is too many for the HCPs to attend to and still be able to provide some health education. A suggestion came forth for health educators to educate the patients while they were in the waiting room. Although there are some community workers who are assisting in outreach programmes, they also are not able to cover every household, and there are some community areas that do not have a community worker allocated to it. It would also benefit the community if the community health worker included a discussion about helminth infections during their visits.

It was also noted that respondents who have received some form of training had a higher knowledge related to helminth infections compared to those without any training. It Is, therefore, important to scale up training efforts, especially in communities where the majority of the people have not received any previous training as seen in this study, especially with HCPs. None of the HCPs indicated that they had received any form of training related to helminth infections, although it would have been covered in their undergraduate curricula. However, re-inforce of this knowledge is needed especially if the pathology or infection is managed. Hence the community workers were not able to educate the community accordingly (Rwamwejo et al., 2022). To address this knowledge gap, there is a need to review and revise the current deworming programmes as this will ultimately improve the ability of community workers to identify signs and symptoms of the infection in the community (Rwamwejo et al., 2022).

It has been reported that the current government run deworming programmes in Indonesia have been unsuccessful in reducing helminth infections (Nasution et al., 2019). Furthermore, despite the significant progress that has been made to reach helminth-infected communities

through mass drug administration, there has been low drug distribution coverage in schools for several reasons. One key piece of advice from this study was the communication between the programme and the caregivers/child was essential to ensure a high attendance of the children on the day of drug administration. As such a notice/note needs to be given to the children and their caregivers regarding the date and time of the deworming session would reduce the number of children absent on the day and might increase the coverage (Asfaw, Hailu and Beyene, 2022). In contrast, Adriko et al., 2018 have reported that deworming campaigns have shown a significant decrease in the number of infected cases compared to regions that do not have these services.

In the clinics included in this study, the nurses do, however, provide deworming tablets to children, provided that the clinic card indicates a missed dose or an upcoming clinic visit. Some of the community members are still required to go to the clinics as there are not enough community health workers to cover all areas. This leads to the concerns raised by HCPs working at the clinics, who indicated that there is not enough time to provide health education to patients due to high patient to HCP ratio. Children are given deworming medication during the routine immunisation check-ins, which are likely to be every six months from 1 year to 6 years. This is in line with the WHO 2023 strategy for the control of STH, which suggests the integration of deworming with the days that children are due for their vaccines at the clinics. The latter programme appears to be perinatal as 44.75% of the general public participants indicated that their children are receiving prophylactic treatment every six months.

A study conducted in a rural area in South Africa recorded a different set of themes that could also contribute to the gap in helminth knowledge amongst public. It was noted that the source of information, misconception and knowledge, attitude, sanitary practices, and health seeking behaviour stood out in this study. The participants in the study indicated that they did not have much information about helminth infections and some of them thought that the condition can heal on its own without taking treatment. These were the type of participants that had a negative attitude towards helminthiasis (Sacolo-Gwebu, 2019).

A Rwandan study highlighted the importance of mobilization programmes within communities; it has been noted that the community members are facilitating the deworming

programmes and ensuring that children receive their tablets. This is in line with the observations in this study regarding outreach teams that go out in the community to provide deworming tablets (Rwamwejo et al., 2022). However, a limitation that was noted in the current study Is the shortage in the outreach team as Soweto is a very large and highly populated township. Such services are very beneficial to the community because they can easily access the services without travelling to the clinics. Rwamwejo et al. (2022) also indicated that the community leaders suggested complementary and preventative measures to the community to prevent infections. This highlighted the positive attitude of the community and their willing to learn and help each other. Such implementation could benefit any community facing the burden of intestinal helminths. In the current study one of the themes that emerged included lack of trainings for HCPs, as well as the community outreach teams, this would highly benefit the communities and lessen the burden on HCPs.

5.4 SOUTH AFRICAN DEPARTMENT OF HEALTH GUIDELINES

An important objective of the current study was to establish whether the HCPs follow the South African Department of Health therapeutic guidelines and what measures they take in the management of intestinal helminths. At the end of 2018, the South African government policy changed, and helminth infections were reclassified as a notifiable disease, where they were classified under category two, notifiable medical conditions, which requires written or electronic notification within seven days of diagnosis (NICD, 2018). The South African Department of Health are to be notified of all cases within 7 days and following laboratory confirmation by the HCP receiving the results. This can be done electronically (APPENDIX 8.Q) or on paper (NICD, 2023).

Public health surveillance includes the collection of information regarding specific notifiable diseases to reduce morbidity and mortality and to improve health. One of the common ways this is carried out is through the Notifiable Disease Surveillance System. The system aims to identify the notifiable conditions before the cases become numerous to prevent or control (Chimsimbe et al., 2022). The Notifiable Disease Surveillance System helps health departments monitor disease patterns and implement control measures to prevent the spread of such diseases. In different parts of the world, health authorities have implemented a system to help

track such conditions. The effectiveness of this system is dependent on the HCPs and their compliance with the notifiable disease notification system (Chimsimbe et al., 2022).

The Notifiable Disease Surveillance System was developed to curb the spread of emerging and re-emerging notifiable diseases (Benson, Levin and Rispel, 2018). Many countries have made it mandatory for the HCP to notify certain medical conditions upon laboratory confirmation or suspicion. However, despite all the legislation set, many countries are still experiencing underreporting as a common problem.

The current study revealed that HCP participants had minimal knowledge regarding the South African guidelines for notifiable conditions (72.34%) (Figure 4.11). The findings of the current study are like those from the Ekhuruleni municipality, in Kwazulu-Natal, SA that revealed that there was poor knowledge of the description and characterisation of notifiable disease (Thompson, Shirinde and Mbonane, 2022). These findings are consistent with those of a study conducted in South Africa assessing HCPs compliance with the notifiable disease surveillance system , which reported that a high percentage of the HCPs did not notify the conditions correctly and that most of the Infection Control Nurses indicated that they were reporting these to other HCPs hoping that they would report the cases accordingly to the South African Department of Health (Benson, Levin and Rispel, 2018).

It is generally agreed that that it is crucial that the HCPs' awareness of notifiable tropical diseases especially Neglected Tropical Diseases (NTDs) such as STH is improved as they play a crucial role in the diagnosis, treatment, and management of these diseases (Elfar, Asem and Yousof, 2020). Training covering tropical diseases should be included in the HCPs' undergraduate and post-graduation curricula. Although it is essential to ensure that the existing curricula adopted in medical, pharmacy and nursing education in developing countries fulfil the clinical and epidemiological needs of these diseases, there is a limited number of studies assessing the knowledge level of medical and nursing students regarding NTDs (Elfar, Asem and Yousof, 2020).

Another study has shown a low percentage range (4.3-23.9%) of HCPs and health science students were able to correctly identify the names of individual notifiable diseases (Elfar, Asem and Yousof, 2020).

Similarly in the current study, only 22.93% of the general public participants were able to correctly provide the names of the parasites, and about 5% knew how to prevent the infections from spreading.

This study has identified a gap in terms of awareness of this legislation, and it raises a concern about what procedures are being followed for positive cases. In a previous study, HCPs have been agreeable to training on notifiable disease guidelines and surveillance systems to better equip the HCP regarding the process that should be followed upon confirmation of positive cases (Benson, Levin, Rispel., 2018). Strengthening the knowledge of the HCP should go hand in hand with the implementation of other previously discussed community measures, including practising good hygiene practices and sanitation.

5.5 INTERPRETATION OF RESULTS AND INTEGRATION OF DATA

The study used a mixed-method design to determine the knowledge of helminthiasis amongst community members and HCPs in Soweto clinics. The design was divided into quantitative and qualitative phases. The researcher first conducted the quantitative study, followed by the qualitative study, and they both were analysed simultaneously. Upon analysis and comparison, the study showed a gap in the community's knowledge of helminthiasis. Although it was noted that the majority of the community members are aware of helminthiasis, many of them were not aware of the causes and preventative actions. It has also been noted that the community members practiced good hygiene behaviour, as many of them indicated washing their hands before preparing food, washing fruits and vegetables, and washing hands after visiting the toilet.

Furthermore, the majority relied on information provided by the HCP at the clinics, which might be questionable as it was noted in the qualitative findings that the HCP requires training to better equip their patients. It has also been reported that the community members rely on family and friends for information, which also implies that there was an influence from the community members. Furthermore, there are also HCPs that are not able to recognise the signs and symptoms of intestinal helminthiasis, and this could lead to misdiagnosis and the

provision of incorrect medication. There have been some misconceptions identified in both groups, such as ringworms being a sign of intestinal helminthiasis, which shows that there is a need for intervention in Soweto. This was supported by several studies with similar findings (Masaku et al., 2017). It also raised some concerns that the general public was also relying on each other for information regarding helminth infections, yet the population at large seemed to not have enough information regarding helminthiasis. This could lead to misconceptions, as we have seen in the current study, where some participants thought that helminth infections were caused by bacterial infections in dairy products, and they have also been mistaken as ringworms, a fungal infection.

Several issues were raised during the focus group discussions, such as limited staff, the community being ignorant, lacking resources to equip the community. The HCP expressed that they were willing to learn through training and workshops, especially those going out to the communities, as intestinal helminthiasis is not part of their curricula. Although deworming services are provided to the clinics, it would be beneficial to the primary health clinics' staff and communities if they received training to better understand the conditions and treat patients.

Another major issue that transpired during the open discussions was that the HCPs were not aware that helminthiasis is a notifiable disease and needs to be reported. They were not aware of the process that needed to be followed for a positive case. This is a concern because it leads to misreporting and, along with the minimal knowledge that may lead to misdiagnosis and could affect the well-being of the community. Therefore, it is crucial to have the HCPs at the Soweto clinics trained on intestinal helminthiasis and the South African Department of Health reporting system for notifiable diseases.

This indicated that, although they were aware of the infections, either inadequate health education was provided to help them understand the infections, causes and prevention, or the sources were providing incorrect information. It is crucial to have knowledge of notifiable disease surveillance systems to understand the process and functionality for proper reporting of cases to the relevant authorities. Lack of knowledge could lead to underreporting or incorrect reporting of notifiable conditions.

6 CHAPTER SIX: CONCLUSION, LIMITATIONS, AND RECOMMENDATIONS

6.1 CONCLUSIONS

In South Africa, there is inadequate information on the prevalence, risks, cure rates, and re-infection rates of helminths infections (Adams et al., 2005). Most helminth control programs and research focus on treatment and less on environmental considerations and health education that can ensure long-term sustainability. For this reason, equipping community members with the basic knowledge and background of helminth infections might lessen the occurrence of infection in communities and reduce hospital admissions, which will in return lessen the burden on HCPs in public clinics and hospitals. Research is crucial in this field to improve the knowledge of the people in the Soweto community, as well as their HCPs. The outcomes of the research can be used to innovate new tools for intervention and education.

Based on this study, it can be concluded that there is a relatively high awareness that helminths infections exist by both general public and HCP participants in Soweto. However, it has been noted that attitude, knowledge of transmission and preventative actions is very poor. There is a critical need to further educate the HCPs to empower their decision-making skills, as well as to empower the public with the necessary knowledge and skills to ultimately protect themselves from acquiring helminth infections. Irrigation of vegetables and crops with wastewater or contaminated river water can also be a main mechanism of transmission of STH. Therefore, government authorities should address the problem of sewage water treatment before use (Banach and Van Der Fels-Klerx, 2020). The community will therefore be able to identify risky behaviours and provide possible solutions such as exercising good hygiene practices, including washing hands with soap, washing fruits and vegetables before consumed or prepared, and even be able to suggest primary healthcare services to their fellow community members by recognising the symptoms of an infected person.

This will enhance adherence and sustainability of the intervention programs which may lead to people changing their attitudes, beliefs, cultural or behavioural attributes that exposes them to intestinal helminth infections. In addition, many of the HCPs are either not notifying the South African Department of Health of these infections or incorrectly reporting them, this indicates that clear instructions and a easily accessible platform or app are needed to optimise the functioning of the surveillance systems in South Africa.

6.2 LIMITATIONS

The study took place in three clinics in Soweto, therefore the finding from this study cannot be generalized to other clinics in the Gauteng or South African context. The questionnaires for the general public participants had multiple choice responses, which were easy to tick off for the participants and may have not been a true reflection of their knowledge if they had not been prompted with possible answers. The researcher also faced difficulties in conducting focus group discussions as clinics were usually very busy and it was difficult to organise the nurses to be in one room at the same time. During the focus groups the HCP participants were not very engaged, even though this was a voluntary exercise. This could be due to them not feeling comfortable or feeling like they are being evaluated on how they are conducting their work, or it is possible that they could have held back some information as they were not free to voice their opinions.

Furthermore, the study showed female predominance and this could have been because the pre- and post-natal wards at the clinic are occupied by most females and most of the data from this study was collected from these wards. Also, intestinal helminths are more common in children and most mothers are the ones that take children to the clinic when they are sick compared to fathers and hence the high percentage of females for this study.

6.3 RECOMMENDATIONS

- The findings of this study have contributed to the understanding of the knowledge, attitude, and perception of helminthiasis in Soweto community and the HCPs. The study has shown that there is a gap in knowledge for both the community members and the HCPs. There are several contributing factors that were mentioned to justify this. The following ideas may be beneficial to the community of Soweto including their HCPs:
- Arranging pamphlets or posters in community halls, clinics, and community health centres. The pamphlets or posters can be in different languages preferable three of the most common languages spoken in Soweto i.e., isiZulu, Sesotho, and Xitsonga and another one in English.
- Training for community healthcare workers, as they can easily access the community because they visit the patients at their homes. The HCPs have shown a positive attitude towards receiving training and are more willing to include a helminthiasis topic in their community curricula.
- The training of the HCPs working in the clinics in the format of workshops will provide them with the necessary knowledge to diagnose, treat, and educate patients at the clinics.

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8 APPENDICES

APPENDIX 8.A: Questionnaire health care providers.

KNOWLEDGE AND MANAGEMENT OF HELMINTHS INFECTIONS IN COMMUNITY HEALTH CENTRES AND CLINICS BASED IN SOWETO, SOUTH AFRICA.

PARTICIPANT NO.: HCP.A:

A	PERSONAL INFORMATION: (DEMOGRAPHY)
1.	**Ward working in:**
2.	**Job description:**
3.	**How many years have you worked as a health care professional?** Years:
4.	**Gender:** ☐1. Male ☐2. Female

B	ASSESMENT OF HEALTH WORKERS KNOWLEGDE ABOUT HELMINTHS
B.1	**What are the most common helminths that infect humans?** 1. 2. 3. 4. 5.
B.2	**What are the clinical symptoms of a helminth's infection?** 1. 2. 3. 4. 5.
B.3	**What is the best method to diagnose Helminthic infection?** 1. ☐ Blood Culture 2. ☐ Urine M/C/S 3. ☐ Stool Culture 4. ☐ Skin Test 5. ☐ Serological test 6. ☐ Other (Specify):

B.4	**What are the ways to prevent helminthic Infection?** 1 ☐ Provision of Adequate water supply 2. ☐ Proper Health education 3. ☐ Environmental Sanitation 4. ☐ Reduction of Overcrowding 5. ☐ All of the above
B.5	**Please list the trade names of the drugs used to manage helminthic infection.** 1. 2. 3. 4. 5.
B.6	**Please list the active ingredients in the drugs listed in Question B.5?** 1. 2. 3. 4. 5.
B.7	**How are prophylactic drugs administered including dosage for children and adults?**
B.8	**Do know if your patients have used herbal medicine to treat a helminth infection?** **If so, please give the names of these products:** ☐ 1. Yes ☐ 2. No 1. 2. 3. 4.
B.9	**Which are the South African Guidelines for the Treatment of Helminthiasis?** ☐ I don't know
B.10	**Are helminthic infections a notifiable disease in South Africa?** ☐ 1. Yes ☐ 2. No

B.11	Do you know where to obtain the forms for a notifiable disease? ☐ 1. Clinics / Hospitals ☐ 2. Department of health premises/website
B.12	Do you know where to submit the forms for a notifiable disease?
C	**FURTHER INFORMATION**
C.1	As a parent/guardian would you be prepared to complete an additional questionnaire on helminth management within your household? ☐ 1. No ☐ 2. Yes ☐ 3. Email address: For the link
C.2	Would you like additional information on the diagnosis and management of helminth infections? ☐ 1. No ☐ 2. Workshop ☐ 3. Information brochure ☐ 4.Email address:
C .3	Do you require further information regarding the procedures to submit the necessary documents for a notifiable disease? ☐ 1. No ☐ 2. Yes ☐ 3. Email address:
THANK YOU FOR TAKING TIME TO PARTICIPATE IN THIS STUD	

APPENDIX 8.B: Questionnaire general public.

KNOWLEDGE AND MANAGEMENT OF HELMINTHS INFECTIONS IN COMMUNITY HEALTH CENTRES AND CLINICS BASED IN SOWETO, SOUTH AFRICA.

PARTICIPANT NO.: GP.A:

A.	PERSONAL INFORAMATION: (DEMOGRAPHY)
A.1	**Study number:**
A.2	**Ethnic group (Tribe):**
A.3	**Age:**
A.4	**Gender:** ☐ 1. Male ☐ 2. Female
A.5	**Address:** Town: District: Province:
A.6	**The highest level of education?** ☐ 1. Never went to School ☐ 2. Primary ☐ 3. Secondary ☐ 4. Tertiary/University ☐ 6. Others (please specify):
A.7	**Occupation (Work):**
A.8	**Average Family Month Income:** R
A.9	**Number of Residents (People) in the same House:**
A.10	**Number of rooms in your House:**
B.	**SOURCE OF WATER, ENVIRONMENT AND SANITATION CONDITIONS:**
B.1	**What is the main source of Water used for drinking?** ☐ 1. River ☐ 2. Pipe water ☐ 3. Well ☐ 4. Rain ☐ 5. Others (please specify):
B.2	**What sort of toilet do you have at your home of residency?** ☐ 1. Have a flush toilet in own home ☐ 2. No flush toiled in the house ☐ 3. No toilet in the house ☐ 4. Pit toilet on own property ☐ 5. Pit toilet – communal ☐ 6. Chemical toilet in house ☐ 7. Chemical toilet on own property ☐ 8. Chemical toilet – communal ☐ 9. Other (please specify):

B.3	**How is the toilet waste disposed?** Toilets leads to…. ☐1. Sewer pipes ☐2. Septic tank ☐3. Other places ☐4. Others (please specify):
B.4	**How do you dispose household Garbage waste?** ☐1. Municipality removal & disposal ☐2. Dispose of in open field ☐3. Dispose of in a river ☐3. Burying ☐4. Burning ☐5. Disposal at city dump ☐5. Others (please specify):
C.	**PERSONAL PRACTICIES**
C.1	**Do you wash your hands before eating?** ☐1. Never ☐2. Rarely ☐3. Sometimes ☐4. Always
C.2	**Do you use body soap when washing your hand?** ☐1.Never ☐2. Rarely ☐3. Sometimes ☐4. Always
C.3	**Do you use antiseptic soap when washing your hand?** ☐1. Never ☐2. Rarely ☐3. Sometimes ☐4. Always
C.4	**Do you wash fruits (grapes, apple, and mango) before eating them?** ☐1. Never ☐2. Rarely ☐3. Sometimes ☐4. Always
C.5	**Do you wash vegetables before eating?** ☐1. Never ☐2. Rarely ☐3. Sometimes ☐4. Always
C.6	**Do you eat pork?** ☐ 1. Yes ☐2. No
C.7	**Do you know how to recognize worm infected meat?** ☐1. Yes ☐2. No
D	**KNOWLEDGE ABOUT INTESTINAL WORMS INFECTIONS**
D.1	**Did you ever hear about intestinal worms before this time?** ☐1. Yes ☐2. No

D.2	**If yes, where did you hear about intestinal worms?**
D.3	**What are intestinal worms?**
D.4	**Give types of names of intestinal worms you know.** 1. 2. 3. 4.
D.5	**Do you think that worms are good or bad for people's health?** ☐1. I think worms are good for health ☐2. I think worms are harmless ☐3. I think worms are harmful ☐4. I do not know
D.6	**How do people get infected with worms?** 1. 2. 3. 4.
D.7	**Have you had an intestinal parasite/worm infection?** ☐1. Yes ☐2. No
D.8	**If yes, when was the last time?** ☐1. Less than 3 months ago ☐2. Six months ago ☐3. One year ago ☐4. More than a year ago ☐5. When I was a child ☐6. I do not remember
D.9	**How can we prevent intestinal worms?** 1. 2. 3. 4. 5.
D.10	**Do you think human faeces can be source of worm infection?** ☐1. Yes 2. No ☐3. I don't know ☐

E	TREATMENT AND TREATMENT-SEEKING BEHAVIOUR
E.1	**Have you been on treatment for intestinal worm infections over the following?** ☐1. <6 months ☐2. 6 – 12 months ☐3. 1 – 5 years ☐ 4. > 5 years ☐5. Not been treated
E.2	**What medication did you take to eradicate worm infection?** ☐1. Mebendazole - (Vermox) ☐2. Albendazole - (Zentel/Bendex) ☐3. Piperazine – (Padax) ☐2. Niclosamide - (Yomesan) ☐3. Praziquantel – (Biltricide/Cysticide) ☐4. Cannot remember ☐5. Other (please specify):
E.3	**If you suffer from diarrhoea or abdominal pain, what do you do?** ☐1. Nothing ☐2. Take Traditional Medicinal plants ☐3. Go to traditional healer ☐4. Go to clinic/doctor ☐5. Go to clinic/ pharmacist ☐6. Other (please specify)
	WORM MANAGEMENT OF CHILDREN
	Do you have children?
F.1	☐1. Yes ☐2. No
F.2	**Have your children had a worm infection?** ☐ 1. Yes ☐2. No
F.3	**What was the age range of the child/children when they had the infection?** ☐1. <6 months ☐2. 6-12 months ☐3. >1-6 years ☐4. >6-11 ☐5. >11-18 years ☐6. >18 years
F.4	**Did the child/children have multiple worm infections?** ☐1. 1 ☐2. 2-5 ☐3. 6-10 ☐4. Once a year ☐5. Twice a year
F.5	**Who diagnosed the infection?** ☐1. Self ☐2. Nurse ☐3. General practitioner ☐4. Clinic ☐5. Specialist ☐6. Family member ☐7. I don't remember ☐8. Other (please specify):

F.6	**What worm was diagnosed?** ☐1. Roundworm ☐2. Hookworm ☐3. Pinworm ☐4. Mixed ☐5. Tapeworm ☐6. Bilharzia ☐7. I don't know ☐8. Other (please specify):
F.7	**Do your children wash their hands after going to the toilet?** ☐1. Never ☐2. Rarely ☐3. Sometimes ☐4. Always
F.8	**Do you prophylactically treat your children to prevent an infection?** ☐1. No ☐2. Yes
F9	**How often to you prophylactically treat your children?** ☐1. Once a year ☐2. Every six months ☐3. Other (please specify):
F.10	**When do you treat your child?** ☐1. When I see worms in the stool ☐2. When I recognize the symptoms ☐3. Diagnosed by Healthcare Provider ☐4. Classmates/close relatives are infected ☐5. Other (please specify):
G	**TREATMENT WITH HERBAL MEDICATION**
G.1	**Do you use any herbal medications for the treatment or prevention of worm infections?** ☐1. No ☐2. Yes
G.2	**If yes, which herbs do you use?**
G.3	**Who prescribes the herbal medication?** ☐1. Qualified Complementary Medicine Practitioner ☐2. Traditional healer ☐3. Over the counter with the assistance of a health consultant in pharmacies or health stores ☐4. Self- medication ☐5. Other (please specify): _____

G.3	**In what form is the herbal medication given?** ☐ 1. Powder ☐ 2. Capsules ☐ 3. Tincture (Alcoholic extracts) ☐ 4. Syrup ☐ 5. Other (please specify)
H	**FURTHER INFORMATION**
H.1	**Would you like additional information on worm and management?** ☐ 1. No ☐ 2. Information brochure ☐ 3. Workshop ☐ 4. Email:
THANK YOU FOR TAKING TIME TO PARTICIPATE IN THIS STUDY	

APPENDIX 8.C: Focus group questions

KNOWLEDGE AND MANAGEMENT OF HELMINTHS INFECTIONS IN COMMUNITY CLINICS BASED IN SOWETO, SOUTH AFRICA.

To be administered to healthcare providers

Name of interviewer: _____

Name of Interviewee: _____

Date: _____

Question Guidelines

1. Do you think helminths infections are a common health problem in in the community? If yes, why do you think this is the case?
2. Soweto is a very populated township, with most people living in poverty with limited access to primary healthcare, health education, proper toilets, safe and clean water, electricity, employment. What do you think of this, and do you think it contributes to or have an impact the number of cases seen at the clinic?
3. What are the common helminths infection cases that you have treated, and have you noticed a trend in the cases at the clinic?
4. Do you think that you have proper training required to diagnose, treat, and enforce adherence to treatment, and to also provide health education to patients?
5. If not, what type of training do you think is required and in what manner?
6. If yes, what specialized training did you have and how do you implement this to help your community?
7. Do you think that there is anything, you can do as health professionals to help the community better understand and manage helminth infection?

APPENDIX 8.D: Consent form audio recording of study participation

KNOWLEDGE AND MANAGEMENT OF HELMINTHS INFECTIONS IN COMMUNITY HEALTH CENTERS BASED IN SOWETO, SOUTH AFRICA

I hereby consent to audio recording of the interview[1], or focus group discussion[1], or classroom interaction[1]

I understand that:

- The recording will be stored in a secure location (a locked cupboard or password protected computer) with restricted access to the researcher and the research supervisor.
- The recording will be transcribed and any information that could identify me will be removed,
- The recordings will be erased within either (a) two (2) years of the publication of the research findings, or (b) six (6) years, if no publications arise from this research
- Anyone wishing to access this information in the future will first have to obtain the approval of the Human Research Ethics Committee (Medical) of the University of the Witwatersrand, Johannesburg
- Direct quotes from my interview, without any information that could identify me, may be cited in the research report or other write-ups of research.

Name of Participant: _____

Date: _____

Place: _____

Signature or mark _____

Witnessed by:

Name of Witness: _____

Signature: _____

Date: _____

APPENDIX 8.E: Information Sheet

Department of Pharmacy and Pharmacology
School of Therapeutic Sciences, Faculty of Health Sciences · Private Bag 3, Wits, 2050, South Africa
Tel: +27 11 717 2542 · E-mail: 668389@students.wits.ac.za · www.wits.ac.za

Monday, October 05, 2020

Dear Potential Participant,

My name is Portia Tonie a Master's student from the Division of Pharmacology, Department of Pharmacy and Pharmacology, Faculty of Health Sciences, University of the Witwatersrand Johannesburg, South Africa. I will be working on a project titled: "Knowledge and management of helminths infections in Community Health Centres based in Soweto, South Africa". The aim of this research project is to determine the knowledge and management of helminthic infection in three Community Health Centers in Soweto. As part of this project, I would like to invite you to complete a questionnaire designed to collate information about your knowledge of worm infections, how to prevent infections and to treat an infection. This activity will take around 15 - 20 minutes. Furthermore, I would also like to invite you to participate in a focus group discussion that will consist of an average of 8 to 10 people per group, the discussion will take approximately 30 minutes.

You will not receive any direct benefit from participating in this study. Participation is voluntary and there are no disadvantages or penalties for not participating. You may withdraw at any time or not answer any question if you do not want to. The survey will be completely confidential and anonymous as I will not ask for your name or any identifying information, and the information you supply will be held securely and not disclosed to anyone else. The data from this questionnaire will be aggregated so that no single response will be identified. I may use a response to emphasize a particular result, however this will be anonymized.

If you have any questions afterwards about this research, feel free to contact me on the details listed below. This study will be written up as a dissertation, which will be available online through the University library website. It may also be published in scientific journals and presented at academic meetings, but your identity will not be revealed. If you wish to receive a summary of this report, I will be happy to send it to you upon request. If you have any queries, concerns or complaints regarding the ethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee (medical), telephone: + 27(0)11-717-1408, email: hrec-medical.researchoffice@wits.ac.za.

Yours sincerely,

Portia Tonie, 668389@students.wits.ac.za, 072 659 8122 (Student)

Prof Robyn van Zyl, robyn.vanzyl@wits.ac.za, 083 312 0228 (Supervisor)

APPENDIX 8.F: Participant consent sheet

PARTICIPANT CONSENT SHEET

Project Title: *TITLE: Knowledge and management of helminths infections in Community Health Centers based in Soweto, South Africa*

1. I have been given a Participant Information Sheet which explains the nature and processes involved in this study, which is attached hereto;
2. I was given time to read it, or had it read to me, in the language I best understand;
3. I was given time to ask any questions I wanted to and found any answers given to me to be reasonable and satisfactory;
4. I believe I fully understand why the study is being conducted and what the intended outcomes will be;
5. I understand that there will be no immediate benefit to me, should I agree to participate, nor will I receive any payment; conversely, participation will not cost me anything but my time;
6. I understand that, even if I initially consent to take part in the study, I may subsequently withdraw at any time and would not be required to give any reasons; if that happened, any data collected about me for the purposes of the study would immediately be destroyed, unless I give consent for it to be retained
7. I have been given a range of contact details, listed below. If I require further information or become concerned about any aspect of this study I am free to speak to any of these contacts.
   Portia Mbushi, Investigator, telephone no. 0726598122, or by e-mail at 668389@students.wits.ac.za
   Prof Robyn van Zyl, Supervisor, on telephone no. 011-717-2542, or by e-mail at robyn.vanzyl@wits.ac.za
   Professor CB Penny, Chairperson of the Human Research Ethics Committee (Medical) at the University of Witwatersrand, on telephone no. 011 717 2301, or by e-mail at Clement.Penny@wits.ac.za.
   Ms. Z Ndlovu or Mr Rhulani Mkansi, Committee Secretariat, telephone numbers.: 011 717 2700 or 011 717 1234,
   or by e-mail at: Zanele.Ndlovu@wits.ac.za or *Rhulani.Mkansi@wits.ac.za*

Signature or mark : _____

Witnessed by:

Name of Witness: Signature:

Date:

APPENDIX 8.G: Clinic M facility manager's approval

PHARMACOLOGY

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Department of Pharmacy and Pharmacology
School of Therapeutic Sciences, Faculty of Health Sciences · Private Bag 3, Wits, 2050, South Africa
Tel: +27 11 717 2542 · E-mail: 668389@students.wits.ac.za · www.wits.ac.za

Thursday, December 09, 2021

CEO name and Hospital details: Thulile Mtuethwa Meadowlands Clinic

Dear:

RE: REQUEST FOR PERMISSION TO CONDUCT RESEARCH AT X ACADEMIC HOSPITAL

My name is Portia Tonie, a registered MSc Pharmacology student at the University of Witwatersrand in Johannesburg. The research I am to conduct for my master's dissertation involves the " Knowledge and management of helminths infections in Community Health Centers based in Soweto, South Africa". This project will be conducted under the principle supervision of Professor Robyn van Zyl.

I am seeking your permission to administer a structured-questioners to the healthcare providers (Doctors, Nurses, Pharmacists) and members of the public visiting your clinic in order to assess their knowledge on antihelmintic management and to know whether South African guidelines on helmintic management are being adhered to. The questionnaire can be done on-line or paper based in a short period of time and will not interfere or disrupt the activities of the participants or hospital. Additionally I will like to conduct focus groups with the healthcare professionals in your facility, this will take approximately 30 min to complete.

All information collected in this study will be kept confidential in a separate file on a computer only accessibly to me and my supervisors. I will apply for the Human Research Ethics Committee of the University of Witwatersrand for approval to conduct this study.

Please could you sign below or grant me a signed letter of acknowledgement if you agree for me to conduct research in your institution. Please do not hesitate to contact me if you require any additional information.

Thank you so much in anticipation of your kind support.

Yours sincerely,

Portia Tonie, 668389@students.wits.ac.za, 072 659 8122 (Student)

Prof Robyn van Zyl, robyn.vanzyl@wits.ac.za, 083 312 0228 (Supervisor)

Thulile Mtuethwa
Facility Manager

Print your name and tittle here.

Signature and Stamp.

MEADOWLANDS CLINIC
PRIVATE BAG X21
Date: 9/12/21
293 Zone 2 M/Lands, Gauteng Province
Tel: 0 ... 6 337

Date

WRIM

THERAPEUTIC Sciences

FACULTY OF HEALTH SCIENCES

Page 1 of 1

APPENDIX 8.H: Clinic C facility manager's approval

PHARMACOLOGY

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Department of Pharmacy and Pharmacology
School of Therapeutic Sciences, Faculty of Health Sciences · Private Bag 3, Wits, 2050, South Africa
Tel: +27 11 717 2542 · E-mail: 668389@students.wits.ac.za · www.wits.ac.za

07.02.2022

To Whom it May Concern

RE: REQUEST FOR PERMISSION TO CONDUCT RESEARCH

My name is Portia Tonie, a registered MSc Pharmacology student at the University of Witwatersrand in Johannesburg. The research I am to conduct for my master's dissertation involves the " Knowledge and management of helminths infections in Community Health Centers based in Soweto, South Africa". This project will be conducted under the principle supervision of Professor Robyn van Zyl.

I am seeking your permission to administer a structured-questioners to the healthcare providers (Doctors, Nurses, Pharmacists) and members of the public visiting your clinic in order to assess their knowledge on antihelmintic management and to know whether South African guidelines on helmintic management are being adhered to. The questionnaire can be done on-line or paper based in a short period of time and will not interfere or disrupt the activities of the participants or hospital. Additionally I will like to conduct focus groups with the healthcare professionals in your facility, this will take approximately 30 min to complete.

All information collected in this study will be kept confidential in a separate file on a computer only accessibly to me and my supervisors. I will apply for the Human Research Ethics Committee of the University of Witwatersrand for approval to conduct this study.

Please could you sign below or grant me a signed letter of acknowledgement if you agree for me to conduct research in your institution. Please do not hesitate to contact me if you require any additional information.

Thank you so much in anticipation of your kind support.
Yours sincerely,
Portia Tonie, 668389@students.wits.ac.za, 072 659 8122 (Student)

Prof Robyn van Zyl robyn.vanzyl@wits.ac.za 011-717-2542 (Supervisor)
Prof S Shelley Schmollgruber Shelley.Schmollgruber@wits.ac.za 011-717-2542 (Supervisor)

CHIAWELO CHC
1755
Rihlampfu Str
Chiawelo
07 FEB 2022
Tel: 011 982 3275
010 345 4328

Sylvia Mavila Facility Manager

07/02/22

Print your name and tittle here. **Signature and Stamp.** **Date**

Page 1 of 1

APPENDIX 8.I: Clinic X facility manager's approval (Not used due to renovations)

PHARMACOLOGY

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

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Prof S Shelley Schmollgruber Shelley.Schmollgruber@wits.ac.za 011-717-2542 (Supervisor)

ZOLA CHC 780-3 BENOILE ROAD
P.O. KWA-XUMA 1868
07 FEB 2022
TEL: 011 986 0699 FAX: 011 634 4088
ZOLA CHC

Johanna Modiane Modisae 07.02.2022.

Print your name and tittle here. **Signature and Stamp** **Date**

Page 1 of 1

WRIM

Therapeutic Sciences

FACULTY OF HEALTH SCIENCES

APPENDIX 8.J: Clinic O facility manager's approval

PHARMACOLOGY

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Department of Pharmacy and Pharmacology
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07.02.2022

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Yours sincerely,
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Prof Robyn van Zyl robyn.vanzyl@wits.ac.za 011-717-2542 (Supervisor)
Prof S Shelley Schmollgruber Shelley.Schmollgruber@wits.ac.za 011-717-2542 (Supervisor)

GAUTENG DEPT OF HEALTH
MOFOLO COMMUNITY HEALTHCARE
07 FEB 2022
1415 ELIAS MOTSOALEDI ROAD
TEL: 011 983 5441

Ntombenhle Losaba
Print your name and tittle here.

Signature and Stamp.

Date

Page 1 of 1

APPENDIX 8.K: Approval from the Johannesburg Department Of Health

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

Joburg
a world class African city

Research Committee of Johannesburg Health District

Enquiries: Prof S. Moosa | 0824466825 (WhatsApp) | shabir@profmoosa.com

DATE: 18th November 2021

ATT: Dr Portia Tonie

EMAIL: shelley.schmollgruber@wits.ac.za

Dear Madam

STUDY TITLE: KNOWLEDGE AND MANAGEMENT OF HELMINTHS INFECTIONS IN COMMUNITY HEALTH CENTRES BASED IN SOWETO, SOUTH AFRICA

NHRD REF. NO.: GP_202111_041

OFFICIAL APPROVAL

The District Research Committee has reviewed your application. This letter serves as a final approval letter for this study.

The following conditions must be observed:

- The facilities in which the research will be conducted are listed below
- These facilities will be visited from**: 2021/11/18 to 2022/11/17**
- Participants' rights and confidentiality will be maintained all the time.
- Neither the District nor the facility will incur any additional cost for this study.
- No resources (Financial, material and human resources) from the above facilities will be used for the study.
- The study will comply with Publicly Financed Research and Development Act, 2008 (Act 51 of 2008) and its related Regulations.
- You will submit a copy (electronic and hard copy) of your final report. In addition, you will submit an annual progress report to the District Research Committee.
- If this is academic research then your supervisor and the University will ensure that these reports are being submitted timeously to the District Research Committee.
- The District must be acknowledged in all the reports/publications generated from the research and a copy of these reports/publications must be submitted to the District Research Committee.
- You will liaise with the manager/s listed below as relevant before initiating the study.

1

We reserve our right to withdraw our approval, if you breach any of the conditions mentioned above. Please feel free to contact us, if you have any further queries.

On behalf of the District Research Committee, we would like to thank you for choosing our District to conduct such an important study.

Regards,

Prof S. Moosa
Chairperson: District Research Committee
Johannesburg Health District
Date: 18th November 2021

List of Facilities Approved

- **Chiawelo CHC**
- Meadowlands Zone 2 Prov Clinic
- **Mofolo CHC**
- **Zola CHC**

List of Managers

Sub District/ Hospiital	Sub District Manager/ Area Manager	Contact No.	Cell phone	Email
ABCEF	Ms Lombuso Matlala	011 440 1259	082 307 0267	Lombuso.Matlala@gauteng.gov.za
D	Ms Maria Mazibuko	011 674 1200	082 781 9919	Maria.Mazibuko@gauteng.gov.za
G	Mr Peter Mathole	011 213 9603	072 483 6839	Peter.Mathole@gauteng.gov.za
CoJ A	Ms Nelly Shongwe	011 237 8010	082 467 9276	nellys@joburg.org.za
CoJ B	Ms Zanozuko Mbane	011 718 9656	082 551 5804	zanozukom@joburg.org.za
CoJ C	Mr Tebogo Motsepe	011 761 0200	084 655 5420	TebogoMot@joburg.org.za
CoJ D	Ms Busi Phiri	011 986 0164	082 467 9386	busip@joburg.org.za
CoJ E	Mr Vusi Mazibuko	011 582 1504	082 464 9547	VusiM@joburg.org.za

CoJ F	Mr M Monyamane	011 681 8130	082 467 9423	mathibem@joburg.org.za
CoJ G	Ms Olga Kruger	011 211 8936	083 286 0388	olgak@joburg.org.za
Southrand Hospital	Dr N. Maleka	011 681 2002	071 872 6649	Nobantu.Maleka@gauteng.gov.za
Bheki Mlangeni Hospital	Mrs MC Makhetha	011 241 5792	082 768 1069	Makabedi.Makhetha@gauteng.gov.za
Edenvale Hospital	Dr. ZG Zitha	011 321 6157	082 749 3123	Zakhelegoodman.Zitha@gauteng.gov.za

APPENDIX 8.L: Focus Group discussion Invitations







APPENDIX 8.M: Focus group transcript Clinic C

Introductions have already been done before the recording started.

Interviewer: Do you think helminths infections are a common health problem in the community? If yes, why do you think this is the case

Participant#1: In my time working at EPI, I've seen mothers bringing kids because they have ring worms, the reason it's a problem is because its either our community is ignorant, or they are misinformed. In terms of hygiene, it's one of the issues have picked up, so I have seen kids with rings worms and when you look, they just know that there are worms, but they do not know what they are and how they come about.

Interviewer: So, they do not know what causes the worms or maybe do not take it seriously?

Participant#1: Soweto is crowded.

Interviewer: Yes, Soweto is very populated and one of the reasons I chose to do the research here, it also hits home for me because I grew up here and growing up saw these things and I was fortunate enough to study in the health science field and I can at least give back to the community, and just add on to what you said as well. **Interviewer summing up what the participant said** [*These things are there but, there are obviously some families maybe do not have a lot of knowledge? They don't feel the need to seek for help or prevent these things, to them it is something that will come and go?*]

Interviewer: Is there anyone else that would like to add on? Or can we move on to the next Question? Can we move on?

Participants: *nods*

Interviewer: Okay, So the next question is Soweto is a very populated township, with most people living in poverty with limited access to primary healthcare, health education, proper toilets, safe and clean water, electricity, employment. What do you think of this, and do you think it contributes to or have an impact in the number of cases seen at the clinic? We did also touch on in our previous response, but do you guys think that it can contribute?

Participant#1: Proper sanitation is there neh, but the issue is when for example a child is holding an apple and they do not wash it before they eat and going to the toilet and not washing their hands, we do not actually see a lot of cases here.

Interviewer: Okay, Thank you. And then uhm…what are the most common helminths infections that you have seen? I might just pass this one as you have mentioned that you hardly have any such cases.

Participant#2: since working at the ANC, I have not had any worm infection cases.

Interviewer: Okay, uhm…. Do you think that you have proper training required to diagnose, treat, and enforce adherence to treatment, and to also provide health education to patients?

Participants: No, No , No.

Interviewer: That is a big NO…"Laughter".

Participants: "Laughter"

Interviewer: Okay, alright..uhm so you said "no", what types of trainings do you think you require and in what manner? It could be discussions, workshops, online trainings, what do you think you need? Is there a specific training that you think you need?

Participant #2: Discussions or workshops.

Participant #1: General discussions. There is not a lot of issues in the community that would need a big training.

Interviewer: If we were asking on a different disease area, would you still say general trainings and discussions?

Participant #1: In my opinion I wouldn't say that on this specific topic but maybe on a specific section, maybe how to diagnose, example for this study that you did, with the questionnaires I realised that there are more gaps, and we just give prophylactic and no process they need to follow, so we just know this on the surface.

Interviewer: Neh, but it's not in depth?

Participant #1: Yea. Health education

Interviewer: Alright uhm…so do you think that there is anything, you can do as health professionals to help the community better understand and manage helminth infection?

Participant #1: I think looking into health promotion, as we work with the outreach team to reach out…so if…, its just that we are understaffed. So, if we have enough staff doing the outreach and teaching the communities, because of the lack of staff in our clinics, we are rushing to see the patient and sometimes health education is not there. Health promotion and

education to help the community. We are not able to educate on the spot, you may say something to one patient and not be able to say it to another as we feel rushed due to being understaffed.

Interviewer: Do you guys also feel that health education and promotion would help?

Participants: Yes

Interviewer: I think that was the last question that I had, uhm thank you so much for taking part in the discussion and to answer the questionnaires, I appreciate it so much. Uhm also just to close up, do you guys have any questions? If you do not have any questions at the moment, the information sheet that I have provided has my contact details in case you need to reach out to me.

Thank you so much, enjoy the rest of your day and you can help yourself with some snacks.

***End

APPENDIX 8.N: Focus group transcript Clinic M

Introductions have already been done before the recording started.

Interviewer: I am going to start the recording neh, please let me know when everyone is done.
Interviewer: So, I will be asking a few questions, so feel free to engage, and also you do not have to respond in English, which ever language you are comfortable in, I speak 9 languages so feel free to respond in any language that you prefer.
Interviewer: So, my first Question is, do you guys think that helminths infections/ worm infections are a common health problem in in the community? If yes, why do you think this is the case? Is it something that you have seen from your patients?
Participant#1: No
Interviewer: I saw a "No", does everyone agree or is there anyone else that has a different view?
Participants: Yes we agree, it is not common [*response from multiple participants*]
Interviewer: So, we all agree?
Participants: Yes
Interviewer: Alright, now as we all know that Soweto is a very populated township, with most people living in poverty with limited access to primary healthcare, health education, proper toilets, safe and clean water, electricity, employment. What do you think of this, and do you think it contributes to or have an impact the number of cases seen at the clinic?
Participant#2: TB is very common,
Interviewer: Oh, so TB is very common?
Participants: Yes
Interviewer: Anyone else that feels that the living conditions in Soweto contributes to the number of cases we see in the clinic?
Participant#3: over population, poverty and malnutrition conditions, unemployment.
Interviewer: Okay, So What are the common helminths infection cases that you have treated, and have you noticed a trend in the cases at the clinic? We have different types of worms, has anyone of you had a patient that was diagnosed with any of the worms?
Participant#4: Not very common

Interviewer: Do you think that you have proper training required to diagnose, treat, and enforce adherence to treatment, and to also provide health education to patients? Do you think that you are equipped enough?

Participant#4: You mean in general?

Interviewer: No no, specific to worm infections. Do you think you are equipped enough to provide some education to the patients when they come?

Participants: No, we don't.

Interviewer: Since you say that you do not have proper training. what type of training do you think is required and in what manner? There is quite a variety of trainings, what do you think you need? What do you think you might benefit from.

Participants: Workshops [*Majority mentioned this*].

Interviewer: Is there anyone else that feels that they need something else?

Participants: [*Silence*]

Interviewer: So, we are all in the same page?

Participants: [*All Nods*.]

Interviewer: Okay, now the last question that I have is: Do you think that there is anything, you can do as health professionals to help the community better understand and manage helminth infection?

Participant#6: Awareness

Participant#6: I think, we are taught about these worms we will be equipped enough to educate the community, for now since we don't have enough information, I don't think even if we educate, we will be giving them more information.

Interviewer: Okay, thank you. Is there anyone else that wants to add to that?

Participants#7: Having pamphlets in different languages to be distributed in the community.

Interviewer: I like that you mentioned different language because not everyone is able to communicate in English.

Participant #8: We also need health promoters, there must be posts allocated to us. Here at Meadowlands we don't have a health promoter, so while patients are waiting they will be addressing them. As much as we are using our outreach team, our outreach team most of the time by 9am they go out to the community so there is no one remaining to give talks as well. That individual will need also to be trained and empowered.

Interviewer: And I understand that even if there is a lot of us here, we are all busy consulting, **so there is no one dedicated to that specific role?**

Participant#8...uhm yes

Interviewer: Okay, thank you so much, so that was my last question, uhm do you guys have any questions for me or any concerns. This is my last day here…otherwise the is a form…information form, my contact details are at the bottom. The form is written healthcare provider information sheet.

Participant#8: Also, just to add regarding the issues of the cases that we see regarding children with worms.

Interviewer: Mhm…

Participant#8: Fortunately, I would say the area that we are at, most of the creches they don't use umhlabathi (soil) in their creches cause children will get worm from areas where there is soil and where there are rivers, that is mostly where they would get the worm infestations from, and then, erh we have got cleaned swimming pools, so we don't have a big problem…hence the percentages are still low. Cases are very low and those are rare cases. And then the other thing is, we do deworming from 6 months neh …from 1 year. So our system, the community they are aware because they do bring their children for the immunizations. So they do get the deworming tablets. So, we do prevent, so its sort of like a prevention. We also give vitamin A to prevent eye blindness and good eye site and all that. So at least we are doing something as a community, as much as they may not be 100% knowledgeable, on the other side we may have been lagging to inform them what this vitamin they are used for hence they will come back and say they don't know.

Interviewer: Yes, and I think it also brings us back to the point that you mentioned on having a health promoter, so that would really help…if they are given these things we know that there is someone that is already helping to inform them what they need to do, why they are doing it and for how long…So thank you very much, those are really good points.

End

APPENDIX 8.O: Focus group transcript Clinic O

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Participant#1: In my time working at EPI, I've seen mothers bringing kids because they have ring worms, the reason it's a problem is because its either our community is ignorant, or they are misinformed. In terms of hygiene, it's one of the issues have picked up, so I have seen kids with rings worms and when you look, they just know that there are worms, but they do not know what they are and how they come about.

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Thank you so much, enjoy the rest of your day and you can help yourself with some snacks.

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APPENDIX 8.P: Ethics Clearance certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG	HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

Office of the Deputy Vice-Chancellor (Research and Innovation)

TO:	Dr P Tonie School of Therapeutic Sciences Department of Pharmacy and Pharmacology Division of Pharmacology Medical School University E-mail: portia.mbushi@gmail.com
CC:	Supervisor: Professors R van Zyl and S Schmollgruber <Robyn.vanZyl@wits.ac.za> and <HREC-Medical Research Office@wits.ac.za>
FROM:	Mr Iain Burns Human Research Ethics Committee (Medical) Tel: 011 717 1252 E-mail: Iain.Burns@wits.ac.za
DATE:	2021/12/08
REF:	R14/49
PROTOCOL NO:	**M210907** (This is your ethics application reference number. Please quote it in all enquiries, oral or written, relating to this study.)
PROJECT TITLE:	*Knowledge and management of helminths infections in Community Health Centres based in Soweto, South Africa*

Please find attached the Clearance Certificate for the above project. I hope it goes well and that an article in a recognized publication comes out of it. This will reflect well on your professional standing and contribute to Government funding of the University.



MSWorks2000/Iain0007/Clearscan.wps

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

R49 Dr P Tonie

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
CLEARANCE CERTIFICATE NO. M210907

NAME: (Principal Investigator)	Dr P Tonie
DEPARTMENT:	School of Therapeutic Sciences Department of Pharmacy and Pharmacology Division of Pharmacology Medical School University
PROJECT TITLE:	*Knowledge and management of helminths infections in Community Health Centres based in Soweto, South Africa*
DATE CONSIDERED:	2021/10/01
DECISION:	Approved conditionally
CONDITIONS:	Evidence of management approval from the study sites must be submitted to the HREC (Medical)
NOTE:	If contact information regarding student study participants is required, please contact the Registrar's office - <Nicoleen.Potgieter@wits.ac.za>
SUPERVISOR:	Professors R van Zyl and S Schmollgruber
APPROVED BY:	Dr CB Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	2021/12/08

This Clearance Certificate is valid for 5 years from the date of approval. An extension may be applied for.

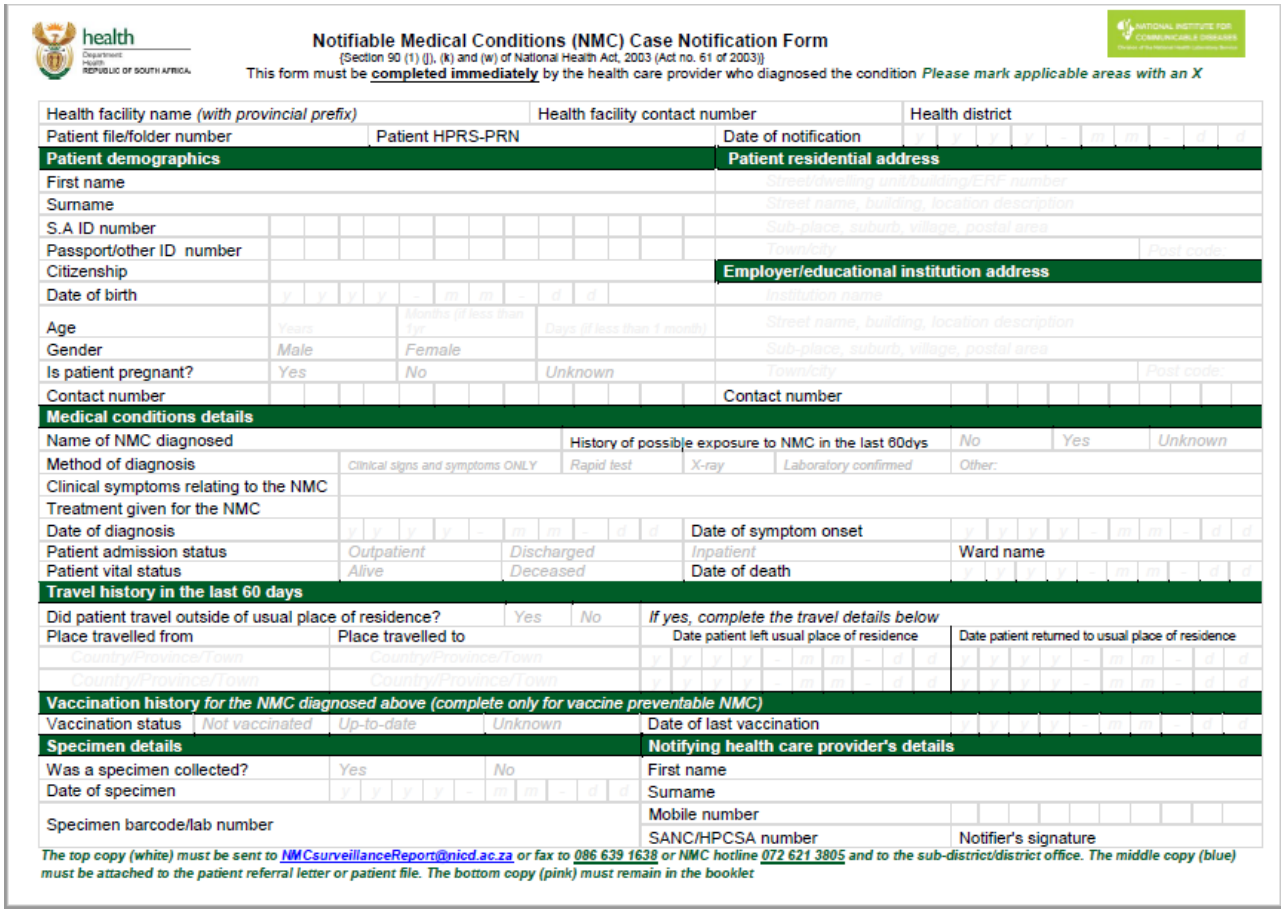
DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office secretariat on the 3rd floor, Phillip Tobias Building, Parktown, University of the Witwatersrand, Johannesburg.

I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated from the research protocol as approved, I/we undertake to submit details to the Committee. **I agree to submit a yearly progress report**. When a funder requires annual re-certification, the application date will be one year after the date when the study was initially reviewed. In this case, the study was initially reviewed in September and therefore reports and re-certification will be due in the month of **September** each year. Unreported changes to the study may invalidate the clearance given by the HREC (Medical).

Signature of Principal Investigator _____ Date _____

APPENDIX 8.Q: NMC case notification form



health
Department: Health
REPUBLIC OF SOUTH AFRICA

Notifiable Medical Conditions (NMC) Case Notification Form

{Section 90 (1) (j), (k) and (w) of National Health Act, 2003 (Act no. 61 of 2003)}

This form must be **completed immediately** by the health care provider who diagnosed the condition *Please mark applicable areas with an X*

Health facility name *(with provincial prefix)*			Health facility contact number	Health district
Patient file/folder number	Patient HPRS-PRN		Date of notification	y y y y - m m - d d
Patient demographics			**Patient residential address**	
First name			Street/dwelling unit/building/ERF number	
Surname			Street name, building, location description	
S.A ID number			Sub-place, suburb, village, postal area	
Passport/other ID number			Town/city	Post code:
Citizenship			**Employer/educational institution address**	
Date of birth	y y y y - m m - d d		Institution name	
Age	Years	Months (if less than 1yr)	Days (if less than 1 month)	Street name, building, location description
Gender	Male	Female		Sub-place, suburb, village, postal area
Is patient pregnant?	Yes	No	Unknown	Town/city / Post code:
Contact number			Contact number	

Medical conditions details					
Name of NMC diagnosed		History of possible exposure to NMC in the last 60dys	No	Yes	Unknown
Method of diagnosis	Clinical signs and symptoms ONLY	Rapid test	X-ray	Laboratory confirmed	Other:
Clinical symptoms relating to the NMC					
Treatment given for the NMC					
Date of diagnosis	y y y y - m m - d d	Date of symptom onset	y y y y - m m - d d		
Patient admission status	Outpatient	Discharged	Inpatient	Ward name	
Patient vital status	Alive	Deceased	Date of death	y y y y - m m - d d	

Travel history in the last 60 days				
Did patient travel outside of usual place of residence?	Yes	No	*If yes, complete the travel details below*	
Place travelled from	Place travelled to		Date patient left usual place of residence	Date patient returned to usual place of residence
Country/Province/Town	Country/Province/Town		y y y y - m m - d d	y y y y - m m - d d
Country/Province/Town	Country/Province/Town		y y y y - m m - d d	y y y y - m m - d d

Vaccination history *for the NMC diagnosed above (complete only for vaccine preventable NMC)*				
Vaccination status	Not vaccinated	Up-to-date	Unknown	Date of last vaccination y y y y - m m - d d
Specimen details			**Notifying health care provider's details**	
Was a specimen collected?	Yes	No	First name	
Date of specimen	y y y y - m m - d d		Surname	
Specimen barcode/lab number			Mobile number	
			SANC/HPCSA number	Notifier's signature

The top copy (white) must be sent to NMCsurveillanceReport@nicd.ac.za or fax to 086 639 1638 or NMC hotline 072 621 3805 and to the sub-district/district office. The middle copy (blue) must be attached to the patient referral letter or patient file. The bottom copy (pink) must remain in the booklet