A Survey of the Prevalence of Gastrointestinal Parasites and Associated Risk Factors in Children in a Rural City of the Dominican Republic

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Dissertation submitted to the Faculty of the Virginia Polytechnic Institute and State University

in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

in

Education, Curriculum & Instruction

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July 9, 2014

Blacksburg, Virginia

Keywords: *Ascaris lumbricoides*, *Entamoeba histolytica*, *Enterobius vermicularis*, *Giardia intestinalis*, gastrointestinal parasite, children, Dominican Republic

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Abstract

Gastrointestinal parasites impose a great and often silent burden of morbidity and mortality on poor populations in developing countries. Verón, Dominican Republic (DR), is a rural city in the southeastern corner of the country where many Dominicans and Haitians migrate to for work in support and expansion of the tourist industry of Punta Cana. Few studies of the prevalence of gastrointestinal (GI) parasitic infections have been published in the DR. Presently, there is a high prevalence of gastrointestinal parasitic infections throughout the poorest areas of the DR and Haiti. This study investigated the prevalence of GI protozoan and helminth parasites from children at the Rural Clinic of Verón during 2008. Participants provided a fecal sample that was examined microscopically for protozoan and helminth parasites using the fecal flotation technique to concentrate and isolate helminth ova and protozoan cysts. Of 108 fecal samples examined, 107 were positive for one or more parasites. Participant ages ranged from 2–15 years; 52 were males and 56 were females. Percent infection rates were 48.2% for *Ascaris lumbricoides,* 13.9% for *Enterobius vermicularis,* 24.1% for *Entamoeba histolytica,* and 22.2% for *Giardia intestinalis*. 9.3% had double infections. A survey of subject characteristics and risk factors was completed by each parent/guardian. Any plan to reduce GI parasites in children of this region will require a determined effort between international, national, and local health authorities combined with improved education of schools, child care providers, food handlers, and agricultural workers. A special effort must be made to reach out to immigrants and those not part of the public education system and to address microbial water quality.

Acknowledgements

I thank James Palmieri, Ph.D., for his incredible mentorship, support, patience, motivation, and relentlessness in helping me to complete this research and dissertation. You have made me a better researcher, scientist, physician, and person and I am eternally grateful. A very special thank you goes to my husband and statistician, Adam F. Childers, Ph.D., and our son Jack, who encouraged, supported, and inspired me through this journey. Thank you to my advisors, John Burton, Ph.D., Kerry Redican, Ph.D., and Dean Sutphin, Ph.D. for your diligence and knowledge. Thank you to Joe Cacioppo, D.O., for your compassion, mentorship, and dedication in international medicine to underserved populations. Thank you to the survey translators, Euclides Marmolejos Baez, M.D. and Gaston Flores. Thank you to Dominican physicians, Euclides Marmolejos Baez, M.D., Yasar Shafi M.D., and Norberto Rojas, M.D. for your education, influence, kindness, and friendship. Thank you to my parents, William and Maryanne Geers, and my in-laws, David and Joyce Childers, for their love and support. And lastly, thank you to Edward Via Virginia College of Osteopathic Medicine, for your mission to support underserved communities, and for giving me the education and means to do this project.

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Chapter 1: Introduction

Background

The Dominican Republic. The Dominican Republic (DR) is located on the eastern portion of the Caribbean island of Hispaniola, part of the Greater Antilles archipelago. It shares the island with the nation of Haiti, which occupies the western one third of the island. The official language is Spanish. The Dominican Republic has an estimated population of 9.8 million and the country contains 48,400 square kilometers of land, making it the second largest country in the Caribbean (PAHO, 1998, 2012; WHO, 2007a). With the Atlantic Ocean to the north and the Caribbean Sea to the south, the Dominican Republic abides in a tropical climate with a mean annual precipitation of 2.098 meters (PAHO, 2012).

Life expectancy is estimated at 72.8 years (70.1 for males and 75.8 for females) (PAHO, 2012). Unemployment has averaged 16.4% for the last 20 years. Illiteracy rates in persons 10 years of age and older was 10.7% in 2007. The annual percent of children completing elementary school is 75.8%. In 2010, 33.8% of the population was considered to be in general poverty and 10.4% in extreme poverty (PAHO, 2012).

The prevalence and severity of gastrointestinal parasites has a profound impact on human health and development, impacting approximately one third of the world's population (PAHO, 2003). Parasitism is a symbiotic, non-mutual relationship between two organisms, a parasite and a host, in which the parasite is physiologically dependent on the host (Bogitsh, Carter, & Oeltmann, 2013). Gastrointestinal parasites live within the gastrointestinal tract of the host. The Dominican Republic is endemic with gastrointestinal parasitic infections including: *Ascaris lumbricoides*, *Giardia intestinalis*, *Enterobius vermicularis* (pinworm), *Entamoeba histolytica* (amoeba), *Necator americanus* (hookworm), *Trichuris trichiura* (whipworm), *Taenia saginata* (beef tapeworm), and *Taenia solium* (pork tapeworm) (Childers, Palmieri, Sampson, & Brunet, 2014; Gideon, 2007a; Miyata, Hasegawa, Bello, & Baron, 1995). These parasitic infections cause a wide range of symptoms from none to severe and can include not only gastrointestinal symptoms such as abdominal pain or diarrhea, but also constitutional, pulmonary, skin, and symptoms in other systems. For the Dominican Republic, acute diarrhea is one of the top five leading causes for medical consultation (Childers & Palmieri, 2014; PAHO, 2001).

Verón. Verón is a rural city in La Alta Grácia province located in the southeastern corner of the Dominican Republic. The population of Verón is estimated at 8,000 and is made up mostly of migrant families with the average length of residence being only 6 years (J. Scarpaci, 2005). Laborers, often those of very low socioeconomic status migrate from other parts of the Dominican Republic as well as Haiti to Verón to work in highway development, construction, and for the tourist industry centered in resorts scattered along the coastline. Punta Cana, part of the Punta Cana-Bávaro-Veron-Macao municipal district, is best known for its beaches which face both the Caribbean Sea and the Atlantic Ocean, and it has been a popular tourist destination since the 1970s. Migrants come from many provinces of the Dominican Republic including Santo Domingo (14%), Sebo (12%), La Alta Grácia (9%), Barahona (8%), and La Romana (8%) (J. Scarpaci, 2005). There are also a large number of Haitian immigrants who make up an unknown portion of the population (Bartlett, 2012; Childers et al., 2014).

Parts of Verón fit the classic definition of a shantytown, which includes irregular, low-cost dwellings usually located at the periphery of a city, or in this case, on the periphery of the tourism beach resorts. Other parts of Verón are more urbanized neighborhoods and apartments, as well as gated communities (Childers et al., 2014; Sasidharan & Hall, 2012). Many areas of

Verón did not have central piped water sources or sewage removal systems. Shared latrines were common.

The Rural Clinic of Verón was established in 2006 sponsored by the Dominican Ministry of Public Health, or Secretaria de Estado de Salud Pública y Asistencia Social (SESPAS), with Edward Via Virginia College of Osteopathic Medicine (VCOM) and Punta Cana Resort. Dominican physicians are employed in serving the community at the clinic. In addition, VCOM medical students frequent the clinic to work and learn in this medically underserved area.

In a public health survey of Verón conducted in 2005, 69% of 106 randomly selected household heads reported visiting the Rural Clinic an average of 2.5 times during the previous 12 months (J. Scarpaci, 2005). This suggests that patients visiting the Rural Clinic represent approximately two-thirds of the population of Verón. Of those surveyed, some self-reported ailments included headache (77%), stomach pain (64%), fever (31%), diarrhea (17%), and vomiting (15%) in the last 12 months (J. Scarpaci, 2005). In addition, 19% of household heads surveyed reported having a serious illness in the past year (J. Scarpaci, 2005).

Currently the only educational programs in Verón, Dominican Republic for the prevention of human gastrointestinal parasites are academic presentations done by teachers in primary schools and educational brochures distributed by SESPAS. Standard of practice by physicians treating patients with GI parasites includes medical treatment and education for prevention. However, Verón physicians continue to see many cases of gastrointestinal helminths and protozoan infections in the local clinic despite these efforts.

The population of interest in this study includes all patients who visit the Rural Clinic of Verón, which as stated previously, is estimated to represent approximately two-thirds of the Verón population.

Gastrointestinal parasites. There are many different types of endoparasites that can affect humans including: nematodes, cestodes, and protozoans. These parasites can affect a wide range of human organ systems, especially the gastrointestinal (GI) system. Although different stages of the parasite lifecycle can affect human organs other than the GI system such as muscle, brain, lungs, and skin, this study is mainly concerned with parasites affecting the GI system.

The prevalence and severity of gastrointestinal parasites has had a profound impact on human health and development, impacting approximately one third of the world's population (PAHO, 2011). The Dominican Republic is endemic with gastrointestinal parasites including: *Ascaris lumbricoides, Giardia intestinalis, Enterobius vermicularis, Entamoeba histolytica, Necator americanus, Trichuris trichiura, Taenia saginata, and Taenia solium* (Gideon, 2007a; PAHO, 2012). According to the 2011 PAHO report on the national burden of neglected tropical diseases for the Dominican Republic, 871,000 pre-school age children and 2.1 million school-age children are considered the "at risk" population (PAHO, 2009).

Nematodes, phylum Nematoda, are non-segmented roundworms, of which only a small fraction are parasitic (Desponmmier, Gwadz, Hotez, & Knirsch, 2005). Endemic human parasitic GI nematodes found in the Dominican Republic include: *Ascaris lumbricoides; Enterobius vermicularis; Necator americanus; and Trichuris trichiura* (Gideon, 2007a). Eggs of *Ascaris lumbricoides* are found in soil and drinking water contaminated by human feces, or in uncooked foods contaminated by soil or water containing the eggs (Ashbolt, 2004). Up to 10% of the population of the developing world is infected with intestinal worms resulting in approximately 60,000 deaths per year mainly in children, a large percent of which is caused by *Ascaris lumbricoides* (Ashbolt, 2004). The estimated burden of *Ascaris lumbricoides* in the Dominican Republic is greater than 456,000 (Hotez, 2008).

Cestodes, phylum Cestoda, are parasitic tapeworms of various vertebrae hosts (Bogitsh et al., 2013; Desponmmier et al., 2005). Tapeworms are segmented flat worms with an anterior scolex and proglottid segments. In the Dominican Republic, endemic tapeworms that infect humans include *Taenia saginata* and *T. solium* (Gideon, 2007a).

Protozoans are single-celled, eukaryotic, free-living organisms. Those infecting the human GI tract are usually able to replicate within a human host, resulting in hundreds of protozoan parasites in one host within a few days (Desponmmier et al., 2005). Symptoms in the human host can range from none to severe (Bogitsh et al., 2013). Two GI protozoan parasites found in the Dominican Republic are *Entamoeba histolytica* and *Giardia intestinalis* (Gideon, 2007a).

Justification of the Study

The impact of gastrointestinal parasites in the developing world, particularly in children, continues to cause significant human morbidity and mortality despite educational efforts in safe water use, sanitation, hygiene, and advances made in medicine (Childers et al., 2014). The prevalence of diseases caused by parasites in a region is an excellent indicator of the quality of life there (Desponmmier et al., 2005). Globally, an estimated 3.5 billion persons are infected by intestinal helminths and protozoan parasites (Sackey, 2001). In addition, 133 million people worldwide suffer from a high-intensity-load helminth infection, which can lead to dysentery, cognitive impairment, and anemia (Childers & Palmieri, 2014; WHO, 2004). Diarrhoeal diseases have been reported to represent 4% of all diagnosed deaths in the Dominican Republic in 1994 and half of all deaths for children ages one to four (PAHO, 1998). Protozoan and helminth infections have also been associated with malnutrition, dehydration, iron-deficiency anemia, and growth retardation (Chan, 1997; Chan, Medley, Jamison, & Bundy, 1994; Childers et al., 2014; Sackey, Weigel, & Armijos, 2003; Ulukanligil & Seyrek, 2004).

Parasitic infections in preschool and school-age children have a major impact on health due to nutritional factors detrimentally affecting physical growth (PAHO, 2003). Infections caused by these parasites slow the mental and physical growth of children, have long-term effects on educational achievement, rob children of iron, protein and other vital nutrients, and impact both local and national economic activity (Bank, PAHO, & Institute, 2011). Chronic parasitic infections greatly impact the cognitive development of young children in the DR by diminishing the ability to learn, by increasing memory loss, and by lowering overall IQ levels. It has been reported that children chronically infected with gastrointestinal parasites lose on average 3.75 IQ points for each intestinal parasite with which they are infected (Bank et al., 2011; Childers & Palmieri, 2014). Other morbidities associated with gastrointestinal parasitic infections include: intestinal bleeding, anemia, malabsorption of nutrients, loss of appetite, chronic dyspepsia, vitamin A deficiency, protein calorie malnutrition, diarrhea, vomiting, and conditions that may require surgical intervention such as rectal prolapse or intestinal obstruction (Bank et al., 2011) (Carman & Scott, 2004; McLennan, 2000b; Motarjemi, Kaferstein, Moy, & Quevedo, 1993; Ramana, 2012; Sasidharan & Hall, 2012). Parasitic infections can complicate pregnancies and birth outcomes (Bank et al., 2011). In pregnant women, serious anemia from blood and gastrointestinal parasitic infections can be life threatening to the mother and child. Furthermore, gastrointestinal parasites can deplete nutrients from the mother and cause low birth weight in developing infants (Childers & Palmieri, 2014) (PAHO, 2012).

In the development of parasitic prevention programs, one must first describe the prevalence and the associated risk factors for disease specific to a location and culture. While generalized epidemiological evidence is available for the country, only a few studies have been published detailing specific regions of the Dominican Republic with incidence and prevalence of parasites. Furthermore, little information could be found in the literature on the success or failure of parasitic prevention programs in the DR. Only a few comprehensive studies of the prevalence of gastrointestinal parasitic infections in the DR have been published, and the last was in 1995 (Collins & Edwards, 1981; Mackie, Larsh, & Mackie, 1951; Miyata et al., 1995; Vargas, Gomez Perez, & Malek, 1987).

A descriptive study detailing gastrointestinal parasitic infections and associated risk factors in Verón would be of great benefit to local clinical personnel in helping to better treat and provide improved education to their patients. This type of study could also provide data for epidemiologic geographical mapping of the neighborhoods and schools of those children infected. Data mapping may point to concentrated areas of children living with these diseases. If so, these areas could further be investigated to reveal a contaminated water source, contaminated food or animals, or specific hygiene habits making individuals more susceptible to disease. Lastly, in addition to the public health and water surveys conducted in Verón, a prevalence study would help contribute to the multi-dimensional approach to the development of prevention programs of gastrointestinal parasites in children.

Purpose of the Study

The purpose of this research is to investigate the prevalence of gastrointestinal parasites in children ages 2 to 15 years visiting the Rural Clinic, the associated risk factors, and the pattern of geographical distribution of these diseases in Verón, Dominican Republic. This is a descriptive analysis to study and characterize human gastrointestinal parasites for this population. Data collected from this study will be used to formulate hypotheses for future research and to suggest improvements for educational prevention programs to target identified risk factors in this population. Geographical mapping of individual cases may point to sources of a particular parasite, leading to future research in these locations.

Research Objectives

The objectives of this study are as follows:

1. To determine the prevalence of human gastrointestinal parasites in individuals ages 2 to 15 years visiting the Rural Clinic in Verón, Dominican Republic;
2. To determine the risk factors for gastrointestinal parasitic infections in this population;
3. And to investigate patterns of geographic distribution of human gastrointestinal parasitic infections and risk factors.

Terminology

For consistency, the following terms are defined below:

1. Desiccation—process of extreme drying;
2. Diarrhea—greater than 3 watery, loose stools per day;
3. Dysentery—inflammation of the intestines associated with severe diarrhea and fever;
4. Encyst—when an organism enters a protective, inactive stage in its lifecycle until more favorable conditions for growth occur;
5. Failure to thrive—a term used for infants who have poor weight gain and growth over a defined period of time;
6. Fecal-oral transmission—when pathogen-containing feces particles pass from one host and are introduced to the mouth of another host causing disease in the new host; and
7. Soil-transmitted helminths (STH)—intestinal worms that infect humans transmitted by soil contaminated with human feces containing infective eggs. The main STH include

Ascaris lumbricoides, Trichuris trichiura, and Hookworms *Necator americanus* and *Ancylostoma duodenale*.

Brief Overview of the Study

The study was conducted over a two-month period in 2008 beginning in January and ending in February at the Rural Clinic of Verón, supported and funded by Edward Via Virginia College of Osteopathic Medicine, SESPAS, and Punta Cana Resort in the Dominican Republic. Patients, ages 2 to 15 years, visiting the clinic were recruited to participate in the study by the clinic physicians, the vaccination nurse, and/or the researcher. Informed Consent was obtained from a parent/guardian. Patients and parents/guardians who freely consented to this study were asked to provide a stool sample from the child and to answer a questionnaire. The laboratory technician at the Rural Clinic examined stool samples, and parasites present in the feces were identified and documented. The laboratory fee for the stool test was waved and treatment for any detected GI parasite was provided for free at the Rural Clinic.

Significance

As a result of this study, the prevalence of gastrointestinal parasites was documented in the target population. The data was used to gain a better understanding of risk factors for gastrointestinal parasites specific to this location and culture. Furthermore, as a result of this study, it is possible to suggest a more evidence-based, comprehensive approach towards education for the prevention and eradication of these gastrointestinal parasitic infections in Verón.

Chapter 2: Review of Literature

Nematode Infections

Ascariasis. *Ascaris lumbricoides* is a soil-transmitted roundworm that is estimated to infect one quarter of the world's population and 457,000 people in the Dominican Republic (Eddleston, Davidson, Wilkinson, & Pierini, 2005; Hotez, 2008). It is one of the largest of the nematodes that infects humans, with adult worms growing up to 40 cm in the small intestines (Bogitsh et al., 2013). The parasite is spread by fecal-oral transmission, usually when ingesting food or water contaminated with human feces containing infective eggs or by ingestion of raw agricultural products contaminated with soil containing infective eggs (CDC, 2013a; PAHO & WHO, 2014).

After eggs are ingested, larvae hatch in the small intestine, penetrate the intestinal wall and the lumen of a capillary. The larvae then migrate into the venous system, traveling to the liver, through the right heart and to the pulmonary vasculature (Bogitsh et al., 2013). After becoming stuck in alveolar capillaries, the larvae move into alveolar spaces and up to the trachea. Infected individuals cough up the larvae and then swallow them. The larvae take about 6 weeks to mature to adult worms in the small intestine where they mate and the females shed eggs into the human host intestines (CDC, 2013a; Desponmmier et al., 2005).

The majority of ascariasis infections are without symptoms, but the most common symptoms is upper abdominal pain (Bogitsh et al., 2013). Larval stage ascariasis, which occurs 1-7 days after infection can, in rare instances, cause a pulmonary reaction called Loffler's syndrome, characterized by pneumonia, eosinophilic infiltrates, and elevated levels of IgE (Desponmmier et al., 2005). Larvae circulating in the central nervous system can cause convulsions, meningism, and insomnia (Eddleston et al., 2005). Although rare, granulomas of the eye can also be caused by migrating larvae (Desponmmier et al., 2005). When the *Ascaris* worm load is heavy, it may cause an intestinal obstruction and even death. Occasionally worms may perforate the intestines, cause peritonitis, penetrate the liver, or obstruct the biliary tract (Bogitsh et al., 2013; Desponmmier et al., 2005).

Treatment for ascariasis is a single dose of albendazole, mebendazole, or pyrantel pamoate, is usually effective. Piperazine citrate is used in cases of intestinal obstruction to paralyze the worms and allow them to be expelled by intestinal peristalsis (Bogitsh et al., 2013; Desponmmier et al., 2005; Smith, DeKaminsky, Niwas, Soto, & Jolly, 2001). Surgery is sometimes required for obstruction. Steroids are used for pneumonitis induced by migrating and molting larvae, followed by albendazole 2-3 weeks later. Prevention and control of ascariasis includes health education, public sanitation, scrupulous personal hygiene with proper washing of the hands after using the bathroom and before eating or preparing meals, avoiding ingesting soil or water that may be contaminated with human feces, and wash, peel, or cook raw vegetables and fruits before consuming, particularly those grown in soil fertilized with manure (Bogitsh et al., 2013; CDC, 2013a). *Ascaris* eggs can be killed by direct sunlight and temperatures greater than 45 degrees Celsius, but the eggs are resistant to cold and most detergents (Eddleston et al., 2005).

Enterobiasis. *Enterobius vermicularis*, also known as pinworm, is a common helminth infection worldwide, particularly in children, with a broad geographic range (Eddleston et al., 2005; Kucik, Martin, & Sortor, 2004). The most common symptom is peri-anal itching. Transmission can occur by fecal-oral contamination from person-to-person, soil transmission, and also from contaminated surfaces such as toilets, clothing, and toys (CDC, 2013b). Risk factors include population congestion, institutionalization, and infected family members (CDC, 2013b). Pinworms can infect humans from beds and also by retro-infection, in which the larvae hatch at the anus and migrate up into the bowel (Bogitsh et al., 2013; Eddleston et al., 2005).

After eggs are ingested, larvae hatch in the small intestine and migrate to the large intestine. The adult worms live freely in the human large intestine where they mature (Bogitsh et al., 2013; Desponmmier et al., 2005; Eddleston et al., 2005). The life cycle is completed within 4-6 weeks of ingestion. Adult worms mate and the males die soon after copulation. Female worms migrate to the anus at night where she expels her eggs and dies. Eggs embryonate and become infectious in 6 hours. Larvae hatch on the skin near the anus and then crawl inside the rectum, and cause intense anal pruritus to the host. Scratching of the anus by the host can contaminate hands and fingernails, which in turn can be ingested by the host or passed in person-to-person contact by fecal-oral transmission (Bogitsh et al., 2013; CDC, 2013b; Desponmmier et al., 2005).

Itching of the perianal area can lead to cellulitis and extreme discomfort. Pinworms can also migrate into the vagina of female hosts and cause infection. Other symptoms include insomnia, restlessness, enuresis, and loss of appetite (Eddleston et al., 2005). Aberrant sites of *Ascaris* infection include the appendix, liver, fallopian tubes, bladder, and peritoneum (Bogitsh et al., 2013; CDC, 2013b; Desponmmier et al., 2005).

Treatments of E. vermicularis include pyrantel pamoate, albendazole, or mebendazole. Since neither albendazole nor mebendazole kill eggs or larvae, re-treatment is required 2 to 3 weeks after the original therapy (CDC, 2013b).

Hookworm. The hookworm is a soil-transmitted helminth and is the number one cause of iron-deficiency anemia worldwide (Eddleston et al., 2005). It is estimated that 576-740 million people worldwide are infected with hookworm, more commonly in areas with warm, moist climates (CDC, 2013c). There are two major species of hookworm that can infect humans: *Necator americanus* and *Ancylostoma duodenale*. *N. americanus* is more common in the Americas, Southeast Asia, Sub-Saharan Africa, China, and Indonesia, while *A. duodenale* isolated more in southern Europe, northern Africa, northern Asia, India, and parts of South America (Desponmmier et al., 2005; WHO, 2007b).

A. duodenale is considered more pathogenic because it is larger, can cause greater blood loss, produces more eggs, and has several transmission modes besides skin penetration (Bogitsh et al., 2013; Desponmmier et al., 2005). However, because this research is focused in the Dominican Republic where only *N. americanus* is present, the majority of information discussed on hookworm will be in relation to this species. Both humans and dogs can be hosts for *N. americanus* (Bogitsh et al., 2013).

Transmission to humans occurs when third-stage filariform larvae are ingested or penetrate the skin, usually on the feet, and then migrate through the bloodstream to the lungs (CDC, 2013c; Desponmmier et al., 2005; Eddleston et al., 2005). The third-stage larvae migrate out of alveolar capillaries and into alveoli spaces. They crawl up the bronchi and trachea and then are swallowed into the stomach by the infected individual. Two molts occur in the small intestine and the adult worm develops. The *N. americanus* adult worms attach to the mucosal surface of the intestines via rounded cutting plates, resulting in chronic, low-grade blood loss (Bogitsh et al., 2013; Desponmmier et al., 2005; Eddleston et al., 2005). Each adult worm can suck 0.01-0.02 ml of blood per day and the female *N. americanus* worm produces about 10,000 eggs a day (Desponmmier et al., 2005). The most serious effects of hookworm are anemia and protein deficiency caused by blood loss at the site of the intestinal attachment of the adult worms. When hookworms continuously infect children, iron and protein deficiencies result and can retard growth and mental development (CDC, 2013c).

After eggs leave the host, eggs immediately embryonate to the four- and eight-cell stages immediately. They then develop to the first-stage larvae in 48 hours if deposited in warm, moist sand or soil. The larvae feed on debris, grow, and molt twice before becoming infective third-stage (L3) filariform larvae. L3 larvae migrate to elevated points in the environment such as rocks or the top of grass where they are more likely to come into contact with human skin (CDC, 2013c; Desponmmier et al., 2005). Factors that aid in hookworm transmission are shaded sandy soil, rainfall of 75-125 cm during warm months, poor sanitation or the use of human excrement for fertilizer which contaminates the soil with egg-containing feces, and a population that (by choice or necessity) comes into contact with contaminated soil (Bogitsh et al., 2013).

Initial symptoms of hookworm infection include pruritus, erythema, and a papular rash at the site of larval penetration often called a ground itch (Gideon, 2007b). If larvae migrate to the lungs, a Loeffler-like pneumonitis may result with coughing, wheezing, and diffuse opacities on chest X-ray, similar to *Ascaris*-induced Loeffler's Pneumonitis. Heavy hookworm infections have also been linked to cognitive deficits and stunted growth in children (CDC, 2013c; Desponmmier et al., 2005). While some infected individuals remain asymptomatic, other symptoms may include anemia, abdominal pain, diarrhea, loss of appetite, weight loss, heart failure, fatigue, and even death (Bogitsh et al., 2013; Gideon, 2007b; Rey, 1980).

Treatment for hookworm is albendazole or mebendazole. Prevention includes wearing shoes and avoiding bare skin contact with soil in areas where hookworm larvae are common or human or dog feces are likely to be in the soil or sand (CDC, 2013c). Improved sanitation to include the sanitary disposal of human excrement, proper disposal of dog feces, treatment of infected individuals, and health education are also important in the prevention of *N. americanus* infection (Bogitsh et al., 2013).

Trichuriasis. Whipworm infection or trichuriasis is caused by *Trichuris trichiura*, a soil-transmitted helminth, and is estimated to infect more than one billion people worldwide (Bogitsh et al., 2013) While infections can be asymptomatic, *T. trichiura* is often a serious cause of morbidity in children. Infections are usually heavier in children, who are more likely to come into contact with contaminated soil and the disease may lead to diarrhea, colitis, bloody stools, abdominal pain, weight loss, anemia, rectal prolapse, cognitive deficits, and growth stunting (Bogitsh et al., 2013; CDC, 2013e; Gladwin & Trattler, 2004; Rey, 1980).

Human infection occurs from ingestion of soil contaminated with embryonated *T. trichiura* eggs. The larvae hatch in the small intestine and penetrate the epithelium, where they mature. The adult worms then migrate into the large intestine where they embed themselves in the submucosa and fertilization occurs as they release eggs (Bogitsh et al., 2013; CDC, 2013e). Adult worms can survive for 2 to 8 years in the human host (Bogitsh et al., 2013).

The diagnosis of *T. trichiura* is made by microscopically identifying eggs in fecal matter (CDC, 2013e). Eggs are amber in color and have a characteristic barrel-shape with two small polar plugs on each end while the adult parasite resembles a bullwhip (Gladwin & Trattler, 2004).

Treatment for whipworm is usually mebendazole, albendazole, or ivermectin (CDC, 2013e). Prevention measures include proper disposal of human feces, hand-washing, wash, peel, or cook all raw vegetables and fruits before eating, and school periodic de-worming programs (CDC, 2013e).

Protozoan Infections

Amebiasis. Amebiasis is caused by infection with the protozoa *Entamoeba histolytica*. This infection is one of the leading causes worldwide of diarrhea. Approximately 480 to 500 million people are infected worldwide, although only 10% are symptomatic (Bogitsh et al., 2013; Eddleston et al., 2005; Nagata et al., 2012). Infection can progress from watery to bloody diarrhea and, if untreated, may be fatal. The parasite is passed from person to person by fecal-oral transmission when food or water become contaminated with human feces containing cysts and can also be passed during sexual contact (CDC, 2010). In addition to gastrointestinal infection, amoebas can also spread to extra-intestinal sites, such as the liver, lungs, and brain, leading to serious disease (Bogitsh et al., 2013; Nagata et al., 2012; Rey, 1980). Of note, *Entamoeba dispar* and *Entamoeba coli* are both non-pathogenic amebae which are also passed by fecal-oral transmission and can be found in stool samples of asymptomatic individuals (CDC, 2010).

E. histolytica cysts and trophozoites are passed in feces and infection occurs when matures cysts are ingested from contaminated food, water, and hands (CDC, 2010). Trophozoites excyst in the small intestine and migrate to the large intestine. Trophozoites then multiply by binary fission and produce cysts, both of which are passed into feces. Trophozoites can remain in the intestinal lumen without causing disease resulting in asymptomatic carriers or they invade the intestinal mucosa, enter the bloodstream and cause extraintestinal disease (CDC, 2010). Cysts shed in feces may remain viable and infective for up to two months outside the human host in cool, moist conditions (Eddleston et al., 2005). The presence of red blood cells in the cytoplasm of a suspected trophozoite help to make the positive diagnosis, otherwise *E. dispar* may be the organism (non-invasive infection). The presence of Charcot-Leyden crystals, or needle-shaped crystalline structures, in the feces also helps in the diagnosis, however, these crystals can also be see in both *Trichuris trichiura* infections as well (CDC, 2010; Desponmmier et al., 2005).

While many individuals infected with *E. histolytica* may remain asymptomatic, invasive amebiasis may be manifested as amebic dysentery or chronic amebiasis (Bogitsh et al., 2013). Symptoms of amebic dysentery may include bloody mucoid diarrhea, fever, and abdominal pain while chronic amebiasis may have recurrent attacks of diarrhea with seeming interval remissions with milder symptoms (Bogitsh et al., 2013). Ulceration of the intestines can lead to necrosis of the bowel or peritonitis and present similarly to ulcerative colitis. Extraintestinal infections occur in the liver, lungs, and rarely in the brain (Bogitsh et al., 2013; CDC, 2010; Desponmmier et al., 2005). Risk factors for amebic dysentery include age less than 50 years old, male sex, HIV infection, and history of hepatitis B or syphilis (Nagata et al., 2012).

Treatment involves rehydration and symptomatic care. Medications include metronidazole followed by diloxanide furoate or paramomycin sulfate. Prevention of amebiasis is strongly related to safe drinking water access (WHO, 2004).

Giardiasis. The most common human protozoal pathogen of the gastrointestinal tract is *Giardia intestinalis* (Bogitsh et al., 2013; Eddleston et al., 2005). It affects approximately 2% of adults and 7% of children worldwide (CDC, 2011). Fecal-oral transmission is the usual route of contamination when individuals eat food or drink water contaminated by *Giardia*-containing feces or by direct transmission from contaminated hands. Other vertebrae hosts, such as dogs and cats, can carry *Giardia* species as well (CDC, 2011). A person infected with *G. intestinalis* may shed 1 to 10 billion infective cysts daily in their feces and as few as 10 cysts can lead to disease in another person (CDC, 2011).

Once a human ingests a cyst, excystation occurs in the small intestine as two trophozoites are produced. The trophozoites multiply by longitudinal binary fission and can attach to intestinal mucosa by their ventral discs (CDC, 2011). While both cysts and trophozoites pass in feces, only cysts can live outside the host and may be viable for months in cold water (Bogitsh et al., 2013; CDC, 2011; Desponmmier et al., 2005).

For the majority of Giardiasis cases, the disease is self-limiting, but reoccurrence does happen (Bogitsh et al., 2013) For those who develop the disease, the most common symptom is diarrhea (Desponmmier et al., 2005; Eddleston et al., 2005). Other symptoms include gas, chronic malabsorption syndrome and failure to thrive, steatorrhea or fatty diarrhea, abdominal cramping, gas, nausea and vomiting, dehydration, and gas. Diarrhea may last for months if untreated, varying in intensity (Bogitsh et al., 2013; CDC, 2011; Desponmmier et al., 2005; Gideon, 2007a; Rey, 1980). Other physiologic responses to Giardiasis include IgA immune production and gluten sensitivities. The severity and duration of the infection depends on both the immune and non-immune defenses of the host and the parasite's ability to evade them (Bogitsh et al., 2013; CDC, 2011; Desponmmier et al., 2005; Rey, 1980).

Diagnosis is confirmed by microscopic identification of *G. intestinalis* cysts in feces and multiple specimens may be required to increase the sensitivity as the cysts can be excreted intermittently (Bogitsh et al., 2013; CDC, 2011). Fecal immunoassays are the most sensitive and specific (CDC, 2011). Rehydration and symptomatic relief are usually used for treatment, as well as anti-giardial drugs such as metronidazole, tinidazole, and nitazoxanide. Prevention is similar to that of *E. histolytica* and includes hand-washing after using the bathroom and before eating or preparing food as well as proper water treatment (Bogitsh et al., 2013; CDC, 2011; Desponmmier et al., 2005; Eddleston et al., 2005).

Cestode Infections

Taenia saginata. Commonly referred to as the beef tapeworm, *Taenia saginata* is a segmented tapeworm infecting humans that can reach 35 to 60 cm in length, and is the most common large tapeworm in humans (Bogitsh et al., 2013). Cattle, an intermediate host, ingest the T. saginata eggs or gravid proglottids. Oncospheres hatch and penetrate the cow's intestinal wall, and are then carried by blood or lymph to intramuscular connective tissue where they develop into cysticerci. Infection to humans occurs when a human ingests cysticerci present in undercooked beef. The wall of the cyst is digested in the small intestine and the worm is freed. It then everts its scolex and attaches to the intestinal wall using its four sucker disks where it matures to an adult worm in 8 to 10 weeks (Bogitsh et al., 2013; CDC, 2013d; Desponmmier et al., 2005). The adult *T. saginata* worm produces 1,000 to 2,000 proglottids with infectious eggs measuring about 16 x 8 mm. They detach from the intestinal wall and pass out with feces or migrate out the anus. Each *T. saginata* proglottid can shed up to 100,000 eggs per day for 10 years or more (CDC, 2013d; Eddleston et al., 2005).

While the disease may be asymptomatic, other symptoms include abdominal pain, distension, epigastric fullness, anorexia, and nausea (CDC, 2013d; Eddleston et al., 2005). An infected human may notice a highly motile proglottid as it exits the anus in their bedding, clothing, or in feces. Diagnosis is made by the presence of *T. saginata* proglottids in feces, since most *Taenia* eggs are morphologically indistinguishable from one another (Bogitsh et al., 2013).

Treatment of *T. saginata* is praziquantel or niclosamide. Prevention measures include cooking whole cut beef to greater than 63 degrees Celsius and ground beef to greater than 71 degrees Celsius and the disposing of human feces away from cattle (CDC, 2013d; Eddleston et al., 2005).

Taenia solium. The pork tapeworm, *Taenia solium*, similar to the beef tapeworm, is passed to humans by the ingestion of undercooked pork containing cysticerci larvae. It is estimated that up to 6% of the population of endemic regions, such as the Dominican Republic, are infected (Desponmmier et al., 2005).

The life cycle of *T. solium* is similar to that of *T. saginata* except that pigs are the intermediate host (CDC, 2013d). Human infection occurs when *T. solium* cysticerci from undercooked pork meat are ingested by humans and digested in the small intestine where they can grow into adult tapeworms at up to eight meters in length after three months (Bogitsh et al., 2013; CDC, 2013d). Adult *T. solium* worms can produce about 1,000 proglottids and each gravid proglottid can produce about 50,000 eggs (CDC, 2013d).

Adult *T. solium* will not develop in pig's intestines if cysticerci are ingested. However, unlike *T. saginata, T. solium* can cause human cysticercosis. Humans do not get cysticercosis by eating undercooked infected pork; this is how humans are infected with *T. solium* tapeworm. Human cysticercosis occurs when a human ingests *T. solium* eggs from human feces of an individual who has the adult *T. solium* tapeworm. Autoinfection can occur. The T. solium oncospheres hatch in the human intestine, invade the intestinal wall, and migrate to striated muscle, brain, liver, or other tissue. Human cysticercosis may be asymptomatic, or can be very serious and life-threatening infection leading to seizure, headache, cerebral edema, anaphylaxis, stroke, ataxia, blindness, and death. The CDC considers cysticercosis to be a Neglected Parasitic Infection (CDC, 2014).

Symptoms for intestinal *T. solium* tapeworm infection are similar to *T. saginata* and include nausea, diarrhea, anorexia, distention, and vague abdominal pain. Patients are often asymptomatic until they discover proglottids in their feces, clothes, or bed and become alarmed.

Diagnosis is made by microscopic identification of proglottids from feces (Bogitsh et al., 2013; CDC, 2013d). Neurocysticercosis diagnosis can be made by CT or MRI (CDC, 2014).

Preferred treatment for *T. solium* is praziquantel or niclosamide. Praziquantel can also be effective against the adult worm (CDC, 2013d). However, if cerebral cysticerci are present, praziquantel could destroy cysticerci and cause central nervous system manifestations (Eddleston et al., 2005). Prevention includes cooking pork thoroughly or freezing it at -10 degrees Celsius for a minimum of 5 days (Desponmmier et al., 2005). Protecting pigs from consuming human feces and hand washing are also important preventative measures.

Worldwide Studies of Gastrointestinal Parasites in Children

Many studies have examined prevalence of childhood GI parasites and associated risk factors. In a study in school children in Kashmir, India, stool samples were collected from 514 children from 4 different schools in Srinagar City and examined by use of direct smear and zinc sulfate concentration techniques and then stained with Lugol's solution for protozoal examination (Wani et al., 2007). A survey with the child's mother was also conducted detailing several possible risk factors. Of the children surveyed, 46.7% tested positive for a helminth and/or protozoa. *A. lumbricoides* was present in 28.4%, *G. intestinalis* in 7.2%, *T. trichiura* in 4.9%, and *T. solium* or *T. saginatum* in 3.7%. Furthermore, 2.5% had infection with more than one parasite. Significant associations with infection included water source (river, stream, and well), condition of the water (not boiled), defecation site (open latrine), personal hygiene (dirty nails), and maternal education ($p < 0.05$). Children ages 5-8 years showed the highest prevalence at 63.0%, but this was not statistically significant ($p > 0.05$) (Wani et al., 2007).

Another study conducted in rural Brazil in 2002, described the prevalence of fecal-oral transmitted parasites in children ages 1 to 5 years and identified factors associated with transmission, particularly environmental factors (Teixeira & Heller, 2006). The researchers divided participating children into two groups: exposed and non-exposed. Exposed children lived in dwellings lacking sanitary infrastructure, did not perform hygienic practices, and/or lived in close proximity to transmission vectors. Non-exposed children lived in dwellings with adequate sanitary infrastructure, had satisfactory hygienic practices, and had no contact with transmission vectors. Approximately 12,000 inhabitants in 29 settlements of Juiz de Fora were selected for the study. There were 659 parent interviews conducted with 753 children participating in the study. Half were considered "exposed." Fecal samples were collected from the children and examined using the Hoffmann-Pons-Janer method of fecal examination. Results demonstrated 42.4% of the children were positive for a GI parasite, a similar finding to the previous study's prevalence of 46.7% (Teixeira & Heller, 2006; Wani et al., 2007). Specific parasites identified included 14.7% *A. lumbricoides*, 8.6% *T. trichiura*, 17.1% *G. intestinalis*, 0.1% *Hymenolopis nana*, 11.0% *E. histolytica*, and 1.1% *E. vermicularis*. Variables related to the diseases were also similar to the previous study, and included child's age, family income, number of household members, consumption of water from shallow wells or natural resources, lack of a covered domiciliary water reservoir, and the presence of sewage flowing in the street ($p < 0.05$) (Teixeira & Heller, 2006). These findings suggest that it is important to include multiple sub-variables in regards to questioning families about water usage and consumption, for example, in identifying possible risk factors for these parasites.

Another study by Sacket et al. investigating risk factors for gastrointestinal parasites was conducted in rural Ecuador and examined the prevalence, predictors, and consequences on growth and iron status in children by gastrointestinal parasites (Sackey et al., 2003). The study was conducted in 5 small villages in northwest Ecuador. There were 244 children ages 0.2-14 years included in the study. Three serial stool samples were collected from each child and analyzed by light microscopy with a direct smear using isotonic Lugol's solution. The questionnaire to the parents addressed socio-demographic information, housing, and water and sanitation characteristics, with multiple sub-variables under each category. Results showed a much higher prevalence than the previously mentioned studies, with 90% of the subjects infected with at least one GI parasite. *A. lumbricoides* was present in 39.9% of children in the study, *G. intestinalis* in 25.2%, *T. trichiura* in 19.7%, *Entamoeba* sp. in 18.5%, and *A. duodenale* in 1.7%. Associated risks for *G. intestinalis* were geography (residence and proximity of one's house to the neighbor's house) and high intra/peri-domilliciary domestic animal concentration (> 20 animals). Residence, high domestic animal concentration, drinking from a river source, and paternal occupation of agriculturalist were associated with an increased risk for *Entamoeba* sp. Age less than 84 months and satisfactory household garbage disposal were associated with reduced risk of amebiasis. The study also determined that mothers of children with ascariasis were significantly less educated compared to mothers of children without infection, a finding that is also supported the study by Wani et al. (Sackey et al., 2003; Wani et al., 2007).

The role of animals in the transmission of GI parasites in humans is an important area of concern. Sackey et al. found that high intra/peri-domilliciary domestic animal concentration (>20 animals) was a significant associated risk for infection by *G. intestinalis* and *Entamoeba* sp. (2003). This point leads to the another study, conducted by Traub et al., which examined the role of dogs in the transmission of GI parasites in a rural tea-growing community in northeastern India (Traub, Robertson, Irwin, Mencke, & Thompson, 2002). The investigators tested fecal samples from 101 randomly selected dogs and 328 randomly selected humans on three different tea estates. Questionnaires were filled out by participants in regards to household information, personal characteristics, hygiene, water sources, health, and dog ownership and contact. Dog-owner participants also filled out a second questionnaire about their dogs' demographics, diet, defecation and roaming patterns, frequency of deworming, vaccination status, and access to a veterinarian. Human and dog fecal samples were collected and stored in 5% formal saline and 2.5% potassium dichromate and were transported to Australia for examination. Laboratory staff used fecal float technique with water followed by centrifuge floatation in zinc sulfate and sodium nitrate before examining under microscope. The prevalence of at least one GI parasite in dogs was 99%. Thirteen different parasites in various stages were observed. Many dogs had three or more parasites (60.4%). *Entamoeba* sp. were found the most commonly observed parasites in the dogs (90%). Similarly, *Entamoeba* sp. were also the most common GI parasite in humans, infecting 42% of the population tested. *A. lumbricoides* was present in 36% and *T. trichiura* in 32% of human participants. Age was a significant factor in ascariasis, with the highest egg intensities found in children 3-5 and 6-10 years old. From those surveyed, 45% had direct contact with dogs. Interestingly, there was no significant relationship between dog ownership or contact and ascariasis. Ascariasis was more common in dogs whose owner had at least one family member who defecated outside in the environment. The study concluded that dogs contribute to the dissemination of parasites on the tea estates and pose a significant public health threat to those communities (Traub et al., 2002). Another article by the same authors from the same study detailed predictors of human GI parasites to include socioeconomic status, age, household crowding, level of education, religion, use of outdoor footwear, defecation practices, pig ownership, and water source (Traub, Robertson, Irwin, Mencke, & Andrew Thompson, 2004).

Defining specific risk factors for GI parasites is important in the development of educational and preventive measures against these diseases specific to a region. The above-mentioned studies all identified significant infection in their populations. Common themes of risk factors identified in the above studies include water source, defecation practices, hygiene, socioeconomic status, parental occupation and education, animals living in and near the home, and age. At the same time, each study varied slightly in risk factors and each has cultural differences specific to country and region. This literature review is not exhaustive and is limited by the studies it covers. There may be other well-established risk factors documented in other studies.

Implications for practice from the aforementioned studies include the prerequisite of establishing prevalence and risk factors for a given population prior to the introduction of prevention education programs. Early investigation is needed in the development of a questionnaire to examine types of water sources, defecation practices, and possible cultural/religious barriers to the study.

Public Health and Gastrointestinal Parasites

Infections with gastrointestinal parasites and diarrhoeal diseases continue to have major impact on health worldwide. Prevention and eradication requires a comprehensive and multi-dimensional approach that includes treatment of infected individuals, education, improved hygiene and toilet facilities, and water purification. The World Health Organization states that approximately 88% of all cases of diarrhea are attributable to unsafe water and inadequate sanitation and hygiene (WHO, 2004).

Poor water sanitation in the Dominican Republic contributes to endemic diseases (Childers & Palmieri, 2014; Childers et al., 2014). In 2012, it was estimated that 36 million people in the Caribbean and Latin America did not have access to improved drinking water (WHO & UNICEF, 2014). A 29% reduction in morbidity due to ascariasis and a 4% reduction from hookworm infection can be achieved by providing access to safe water and sanitation facilities and better hygiene practice (WHO, 2004). Furthermore, WHO states that interventions in hygiene education and instruction in hand-washing can lead to a reduction in diarrhoeal diseases by up to 45% (WHO, 2004). Inadequate supply of clean water is a significant source of infection for not only those parasites discussed in this paper, but also cholera, schistosomiasis, E. coli, viruses, and typhoid. In fact, the United Nations has declared that 2005-2015 is the “Water for Life” decade to promote a greater focus on water-related health issues. Strategies for integrated water resources management are an integral part of environmental management and health (WHO, 2004).

It is estimated that 94% of all diarrhoeal cases are attributed to the environment (Pruss-Ustun & Corvalan, 2006). Intestinal nematode infections like ascariasis, trichuriasis, and hookworm can be transmitted from the soil, food, and water contaminated by infected feces—all related to environmental causes (Pruss-Ustun & Corvalan, 2006).

Households in Verón use a variety of toilet types. The most commonly used include: shared-outdoor latrines (47%); followed by outdoor latrines on their properties (32%); in-house flush commodes (10%); in-house latrines (7%); and other (5%) (J. Scarpaci, 2005). Toilets and disposal of human and animal waste play a role in disease transmission (Smith et al., 2001). As of 2012, 2.5 billion people worldwide do not have access to an improved sanitation facility. While it is estimated that 82% of those living in Latin America and the Caribbean use improved sanitation, 90% of those who do not live in a rural area (WHO & UNICEF, 2014).

Treatment and prevention with medications are important in controlling these parasites. The 2001 World Health Assembly set a goal to be treating 75% of all school-aged children with albendazole, an anti-helminth medication, by 2010 (PAHO & WHO, 2014). Albendazole is effective in treating hookworms, roundworms, pinworms, tapeworms, and whipworm. It also prevents re-infection for several months. Also vaccination designs are being investigated (PAHO & WHO, 2014).

The literacy rate of the Dominican Republic for adults is approximately 90.1% (UNICEF, 2013a). With the city population of Verón at around 8,000 individuals, this leaves around 1,040 people who would be unable to read a pamphlet on prevention. An important note is that Verón's population consists of many Haitian immigrants. While the exact number of Haitian immigrants in Verón is unknown, the adult literacy rate for Haiti in 2012 was only 48.7% (UNICEF, 2013b). The added percentage of Haitian immigrants in the population lowers the total literacy rate for Verón. Furthermore, many Haitian immigrants to Verón do not speak Spanish, only Creole. Therefore, in the development of an educational program for parasite prevention, part of the program design should be directed in a way that would not require reading.

Gastrointestinal Parasites in the Dominican Republic

Few comprehensive studies of the prevalence of gastrointestinal parasitic infections in the DR have been published (Childers et al., 2014; Collins & Edwards, 1981; Mackie et al., 1951; Miyata et al., 1995). There has been a scattering of published reports involving groups of tourists who have returned to their country of origin (Spain, USA) who reported parasitic infections following a stay in the DR (Paez Jimenez et al., 2004; Vermund, LaFleur, & MacLeod, 1986). One of the few comprehensive reports was published in 2011 by PAHO on the prevalence and intensity of soil-transmitted helminths in Latin American and Caribbean countries (PAHO, 2011). This report was constructed from data collected between 2000 and 2010; PAHO reported an absence of any major published study on STH for the Dominican Republic. This is in great contrast to Haiti for which PAHO reported several definitive published studies on STH, even though Haiti and the DR share the same island (PAHO, 2011). In October 2009, PAHO approved resolution CD49.R19 stating the commitment of PAHO's member states to eliminate or reduce neglected diseases, including STH, to levels that would be no longer be considered a public health problem by year 2015 (Ault, Nicholls, & Saboya, 2012; PAHO, 2009; Saboya, Catala, Nicholls, & Ault, 2013). This published study reported PLoS neglected tropical diseases (NTD) for STH, which included a total of 236 publications and research articles from 1995 to 2009 in primary scientific journals. These were analyzed for Latin American and Caribbean nations; none of which contained publications reporting data from the DR. PAHO concluded that there was an overall deficiency of definitive reports published for the DR (Saboya et al., 2013).

Historically, most of the definitive studies of surveys of water-borne or soil-transmitted parasites in the DR were published more than 30-50 years ago. For example, a survey published by in 1951 on the prevalence of gastrointestinal parasitic infections, was conducted among labor populations of two sugarcane plantations in the DR during the summer of 1949 and the winter of 1950; both plantations were several kilometers inland from the coast (Mackie et al., 1951). 1,038 fecal specimens were examined promptly for helminth eggs and protozoan cysts following delivery of samples to their laboratory. They reported a prevalence of *E. histolytica* at 34.2%, *G. intestinalis* at 4.9%, *A. lumbricoides* at 20.1% and *E. vermicularis* from only 2 adults sampled (Mackie et al., 1951).

In a study by Collins and Edwards (1981), they reported sampling feces for the presence of parasites in a population of 453 individuals from rural areas of the DR and found a prevalence of 22.7% *T*. trichiura, 11% *A. lumbricoides*, 0.2% *G. intestinalis*, and 7.9% *E. histolytica, 2.6%* hookworm sp., and 8.8% *E. vermicularis* (Collins & Edwards, 1981). They concluded that parasitism was considered a common condition in rural populations in the DR and that *A. lumbricoides* was one of the more frequently encountered helminths. *E. vermicularis* was the most common helminth reported in children less than 10 years old and in older adult patients. (Collins & Edwards, 1981).

A study by Miyata, et al (1995) collected 1,547 stool specimens from 2 urban and 10 rural localities of the Dominican Republic. Feces were examined using the Kato-Katz smear and formalin-ether concentration techniques. Harada-Mori culture was applied for samples from 2 regions and Agar-plate culture was used for another region. Seven helminth and 7 protozoan species were identified and prevalence varied more specifically on region. Summary of results showed a helminth prevalence of *T. trichiura* at 48.4%, *A. lumbricoides* at 25.5%, Hookworm (*Ancylostoma duodenale* and *Necator americanus*) at 12.9%, *Strongyloides stercoralis* at 2.9%, *E. vermicularis* 0.4%, *Hymenolopis nana* 1.7%, and *Hymenolopis diminuta* at 0.1%. Protozoan prevalence showed *E. histolytica* at 1.5%, *Entamoeba hartmanni* 1.9%, *Entamoeba coli* 21.1%, *Endolimax nana* 5.2%, *Iodamoeba buetschlii* 2.7%, *G. intestinalis* 5.4%, and *Chilomastix mesnili* at 0.5% (Miyata et al., 1995).

Travelers, Immunocompromised, and those who Emigrated from the DR

Travelers' diarrhea (TD) affects 8-50% of travelers; incidence varies according to travelers' country of origin and destination (Leung, Robson, & Davies, 2006). The DR is considered a high-risk destination. TD is often acquired through fecal-contaminated foods and water. Consuming food from street vendors is associated with enhanced risk (Leung et al., 2006). Young children are at particular risk because they have a propensity to touch multiple objects and to put them in their mouths. Children are less selective in sources and types of foods ingested and their gastrointestinal immunity is not as robust as adults (Leung et al., 2006; Stauffer, Konop, & Kamat, 2002). Although viral pathogens such as the Norovirus and Rotavirus may be responsible for up to 10% of cases of TD, parasitic infections account for a small minority of cases of TD lasting only a few days (Ryan, Madoff, & Ferraro, 2011). Protozoan parasites such as *G. intestinalis* and *E. histolytica*, are less common causes of TD but protozoan parasites increase in importance when diarrhea lasts for longer than 2 weeks (Leung et al., 2006; Okhuysen, 2001). Travelers with diarrhea lasting more than 10-14 days should be evaluated for any number of intestinal parasites including *E. histolytica*, and *G. intestinalis* (DuPont & Capsuto, 1996; Okhuysen, 2001; Ryan et al., 2011).

There are sporadic reports of tourists who became infected with gastrointestinal parasites following visits to the DR. For example, during 2002, while vacationing at a hotel in Punta Cana, many Spanish tourists complained of illness upon returning home (Paez Jimenez et al., 2004). The Spanish National Centre of Epidemiology initially identified 76 cases of gastroenteritis in these tourists. They stayed in the same hotel in Punta Cana; their holiday package included all meals and beverages served by the hotel. All of the Spanish tourists consumed tap water and ice solely from the hotel's private water well. Symptoms included abdominal pain, vomiting, fever, chills, nausea, headache, bloody diarrhea and constipation; several required hospitalization. Cysts of *E. histolytica* were recovered from several of the patients while in the DR and 3 of 51 stool samples were positive for *Giardia* antigen (ELISA) when tested in Spain (Paez Jimenez et al., 2004). In persons living for 1-12 months in high risk areas of the Caribbean, especially in the DR and Haiti (DuPont & Capsuto, 1996), a chronic malabsorption syndrome, tropical sprue (TS) is often seen. TS, usually a diagnosis of exclusion, is characterized by foul smelling stool, cramping, bloating, mild, moderated abdominal pain, weight loss, anorexia and fever; *G. intestinalis* and *E. histolytica* are characteristically found in those diagnosed with TS (Sheth & Dwivedi, 2006).

The number of immunocompromised international travelers has been increasing since the onset of the AIDS epidemic in the early 1980's and since the increase in usage of immunosuppressive and anti-inflammatory drugs for a variety of illnesses (Baaten et al., 2011; Norman & Lopez-Velez, 2011). Prevention of tropical and parasitic infections in immunocompromised travelers constitutes a special risk group who often do not seek nor receive adequate travel advice (Norman & Lopez-Velez, 2011). The immunocompromised traveler is at greater risk of acquiring multiple parasitic infections that may result in persistent diarrhea often caused by *G. intestinalis* and *E. histolytica* (Norman & Lopez-Velez, 2011; Slack, 2012).

Prolonged diarrhea lasting greater than 14 days occurs in 1-3% of travelers; protozoan infections often include *G. intestinalis* and *E. histolytica* which account for the majority of cases (Slack, 2012). *G. intestinalis* is the most common parasitic agent of persistent diarrhea and increasingly found in areas of low sanitation. *G. intestinalis* can be found in 5-7% of stools in the general population of the United States, and in 15%-30% of stools in endemic areas. *G. intestinalis* is the most likely pathogen to infect travelers (Ross & Cripps, 2013; Slack, 2012). *E. histolytica* has also been implicated in both diarrheal and invasive diseases affecting the liver and the other organs. The majority of patients who travel to endemic areas are asymptomatic or have intermittent diarrhea with mild abdominal tenderness (Ross & Cripps, 2013; Slack, 2012).

There have been reports of children and adults who have immigrated to New York City from the DR bringing with them parasitic infections. A study, conducted at a major New York City medical center, reported parasitic infections in immigrants from the DR (Vermund et al., 1986). Of the 41,958 stool samples examined, 7,803 were positive for parasitic infections. Parasitic protozoa accounted for 53.8% of all isolates seen from 1971 through 1984. These included *G. intestinalis* (75.4%) and *E. histolytica* (20.1%). In addition, 38% were positive for intestinal helminths; stool samples included eggs of *A. lumbricoides* (9.5%) and *E. vermicularis* (10.9%) (Vermund et al., 1986). Neeley et. al. (1998) reported parasitic infections in immigrant children newly enrolled in the New York City school system. Of these immigrants, 119 (38%, ages 4-18, mean 10 years) were from the DR. All the children in this study were asymptomatic yet 74% were infected with one or more of the following: *E. histolytica* (24%), *G. intestinalis* (21%), and *A. lumbricoides* (6%) (Neeley, Lechuga, Rochon, & Fitzpatrick, 1998).

Presently, there suspected to be a high prevalence of intestinal parasitic infections throughout the poorest areas of the DR and Haiti (Bitran, Martorell, Escobar, Munoz, & Glassman, 2009; Hotez, 2008; Hotez, Bottazzi, Franco-Paredes, Ault, & Periago, 2008). Inhabitants of the DR are infected with a number of gastrointestinal parasites including: Nematodes (*A. lumbricoides, E. vermicularis, N. americanus, T. trichiura*); Cestodes (*T. saginata, T. solium*); and Protozoa (*E. histolytica, G. intestinalis*). These parasites cause a wide range of gastrointestinal symptoms from mild to severe and are often associated with diarrhea. In the DR, acute diarrhea is one of the top five reasons given for medical consultation. Poor water sanitation is a significant cause of endemic disease in the DR. The estimated burden of ascariasis in the DR surpasses 456,000 cases per year (Hotez, 2008). Children are particularly affected by *A. lumbricoides* (WHO, 1981). At the global level it is estimated that all intestinal parasitic infections affect more than one-third of the world's population with the highest rates of infection in school-age children (Ault et al., 2012). Growth stunting usually occurs between 6 months and 2 years of age (Ault et al., 2012; Hotez et al., 2008). PAHO estimated that less than 46% of individuals living in rural areas of the DR have access to clean drinking water and only 16% of the entire population has sanitary sewage disposal services. WHO reports 1.8 million deaths annually from diarrheal diseases, with 88% attributed to inadequate sanitation, poor hygiene, and unsafe water supplies; 95% of deaths were in children less than five years old (Baum, Kayser, Stauber, & Sobsey, 2014; PAHO, 2011; Periago et al., 2012).

Chapter 3: Methodology

Research Design

Institutional Review Board. In the present study, approval was obtained in December 2007 from the Institutional Review Board (IRB) at the Edward Via Virginia College of Osteopathic Medicine prior to the start of any data collection or subject recruitment (see Appendix G).

Sample. The target population for this research included all children ages 2 to 15 years old visiting the Rural Clinic of Verón in Verón, Dominican Republic. The sample chosen for this study was a sample of convenience. Any child visiting the Rural Clinic for any reason with a parent/guardian was recruited to participate in the study. Clinic physicians, medical students, nurses, and the researcher recruited subjects and their parents/guardians to participate in the study.

Informed Consent. No coercion took place at any time to invoke participation. All participants were required to have a parent or guardian sign the Informed Consent and be present when the test results were given and the survey was conducted. Participants and a parent/guardian were informed of the risks and benefits and signed the Informed Consent (see Appendix A). Informed Consent forms were made available in Spanish and Creole, and if the parent/guardian was illiterate, then the survey was read to them (see Appendices B and C).

Risks and Benefits. The risks from providing a stool example were minimal since defecation is a natural life process. Some possible risks included anal fissure, hemorrhoids – though these are more likely a chronic problem. It is also possible that in trying to obtain a fecal sample, the patient may have contaminated their hands with fecal material and possibly passed on diseases to other persons if hands were not properly washed.

The risks from completing the survey included emotional consequences, since some questions refer to socioeconomic status, lifestyle, and education. Participants may have experienced feelings of guilt, depression, anxiety, or inadequacy in answering these questions.

The benefit of participation to individuals was that the stool test and treatment were at no cost. A stool exam usually costs about thirty Dominican pesos, which was roughly equivalent to $1 US dollar in 2008, and this amount can be significant to many poor families. Participants who tested positive received a free medical exam at the Rural Clinic. Many people have mild or no symptoms from gastrointestinal parasites, although it may be affecting the body. It is also known that many of the parasites are endemic to this region. This free exam allowed any participating child's parent/guardian to know the patient's gastrointestinal parasite status and be treated if they were infected.

The benefits of the survey are that participation in this research allowed data detailing prevalence and risk factors for gastrointestinal parasites to be identified. This information can be used to develop an education and prevention program in the future. Also, in identifying risk factors in this study, local physicians will be able to improve their care for this population. And lastly, geographic mapping of parasite prevalence may point to a possible source of infection such as a well, public toilet, or higher risk areas to live or go to school where GI parasites are more prevalent.

Instruments

Stool specimen collection and analysis. Data was collected from January to February 2008. Subjects and parents/guardians willing to participate in the study and who understood and signed the Informed Consent were given an 8oz sterile specimen cup and asked to provide a stool sample. Participants defecated a small amount (approximately 1/3 full or 2 ounces) into the specimen cup and closed the lid tightly. Stool samples may also have been taken from a child's diaper using a tongue blade and placed into the specimen cup. It was recommended that hands be washed thoroughly with soap and water after using the toilet and handling the stool specimen. Stool samples were required to be returned to the clinic laboratory within 12 hours of defecation and were instructed to be stored in a cool place out of sunlight until brought to the laboratory. The Rural Clinic laboratory technician, trained and educated in the Dominican Republic, examined stool samples, using the both the thick smear technique and the formalin-ether technique under light microscopy.

The participants and parents/guardians were given the results of the stool test on a piece of laboratory paper and verbally notified of the results. The child could then be examined and treated appropriately by a physician at the Rural Clinic. If the stool test was negative, participants may do nothing or still see a physician for any reason if they wished. Participants and their parents/guardians may have chosen to go to another clinic or hospital for medical evaluation and treatment if they so desired.

Participants were assigned a number, which was recorded with the results of the stool samples and on the survey. Confidentiality was kept at all times by the researcher and clinic staff. The stool results and surveys were stored in a file in a locked room in the clinic until the study was completed. The results, surveys, and informed consents were then taken back to the United States by the researcher and stored in a locked box in a secure location.

Survey. After submitting the stool sample to the laboratory, the participant and/or participant's guardian were asked to complete a survey in their native language (see Appendices D, E, and F). If the subject could not read, the questionnaire was read aloud to them by the researcher or by the research assistants. The survey was designed to include questions detailing the participants' characteristics, household characteristics, subjective symptoms, and general health and hygiene questions.

Participation incentive. A 16-ounce bag of uncooked rice was given to the parent/guardian as an incentive for participation upon return of the stool sample and completion of the survey.

Validity and Reliability

Internal Validity. Threats to internal validity from the survey included mortality, location, instrumentation, and instrument decay. It is possible that after patients with their parents/guardians received the results of the stool sample, they did not wish to participate in the survey. Some may not have been able to stay at the clinic long enough to fill out the survey due to work or other responsibilities. Reception of stool test results and participation of the survey was done on the same day to limit loss of subjects.

Conducting the surveys in the clinic was often very noisy and distracting, which may have interfered with the participants and/or parents/guardians to answer questions correctly and accurately.

The survey lacked in reliability testing, however, face validity and content validity were used to improve the survey prior to its initiation. Threats to validity are that the questions and terminology may not have been completely clear to participants. Parents or guardians may not have been asked for assistance with reading if they were too embarrassed to admit to illiteracy or if they reading level was just very low. Participants may feel rushed when filling out a survey and may not ask questions that they have. Participants may not be completely honest when filling out the survey because of the discussion of sensitive issues such as financial status, personal health, and education.

There may have been a high influx of participants on a given day, which may have rushed the researcher, technician, or secretary in conducting the research, producing less accurate results.

External Validity. The sample portion of participants for the study is likely not a true representation of all of Verón, in which case the results cannot be applied to the entire population of Verón. The results better correlate with those patients visiting the Rural Clinic of Verón. Furthermore, the study was done in 2008, and Verón has changed in the last 6 years as the population increases, immigrants establish permanent residency, roads are improved, and education, water sources, and access to health care have improved. Another threat to external validity, was as word of mouth spread that the clinic was offering free testing of gastrointestinal parasites, persons who were feeling ill or suspected they may have parasite (or their parents) would be more likely to have taken advantage of this study and come to the clinic when they may not normally have come there. Also, participants who have more frequent stools (diarrhea) can more easily produce a stool sample to provide for the study at the time they were visiting the clinic, instead of returning later with the specimen, possibly making the prevalence higher. Because loose stools may be a symptom of several gastrointestinal parasites, again, infected individuals may be more likely to participate. In order to address this threat to validity, the questionnaire asks about the subject's current symptoms, which allowed the results to be analyzed into a symptomatic and non-symptomatic population.

Data Analysis

Data was recorded into a spreadsheet format in Microsoft Excel and then analyzed using statistical analysis with Minitab. Laboratory data from the stool analyses provided a prevalence of gastrointestinal parasites for this target population. The survey questions detailing characteristics of the population allowed possible correlations between individual characteristics and the presence of parasites. Survey questions that relate to symptoms of disease have been compared to infection rates to examine the differences of symptoms for a given parasite to the asymptomatic portion of individuals. Risk factors related to prevalence were analyzed to determine if there is a statistical significance between disease and particular risk factors. Gastrointestinal parasitic infections identified were cross tabulated with the survey questions and examined for significance using the chi-square test to look for parasite-specific associations.

Chapter 4: Results and Discussion

Data Collected

During January through February 2008, 137 parents/guardians signed the Informed Consent for their children to participate in the study. Of those agreeing to participate in the study, 135 surveys were completed. Of those who completed the survey, 28 failed to provide a stool sample. 110 stool samples were collected. Of those whose stool specimens were collected, 2 did not fill out a survey. The following data presented is from the 108 subjects who completed the survey and provided a stool sample. 52 were males and 56 were females. The average age of the child in the study was 5.3 years old, with the median age being 4 years. Of the 56 females in the study, 2 had begun their menses and none were pregnant.

Prevalence of Gastrointestinal Parasites

Results. Analysis of the stool samples revealed 52 subjects were positive for *A. lumbricoides* (48.2%). 15 stool samples were positive for *E. vermicularis* (13.9%). 24 stools were positive for *G. intestinalis* (22.2%). 26 stools samples were positive for *E. histolytica* (24.1%) (see Figure 1). Only one child was uninfected by a parasite (0.9%). Ten subjects had a co-infection with 2 parasites identified (9.3%).

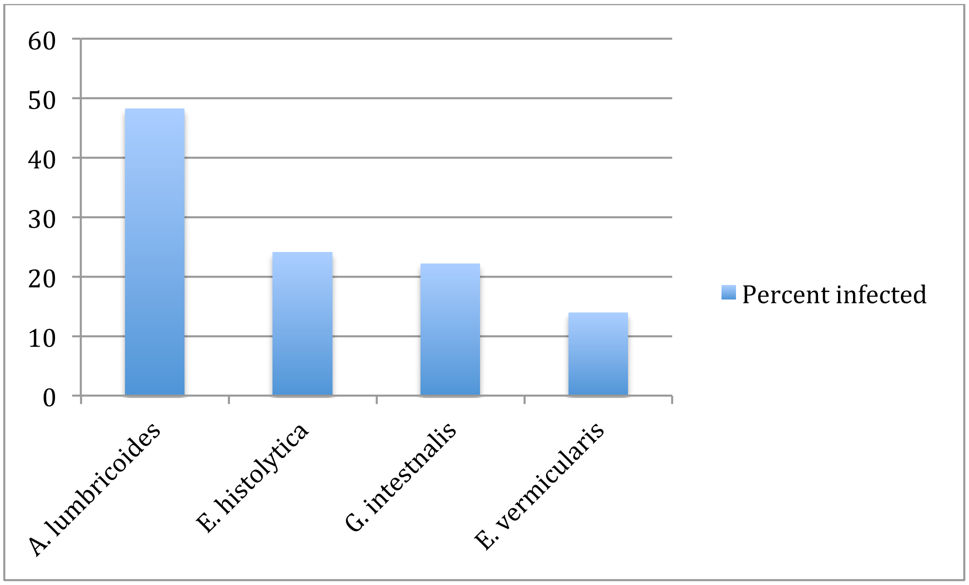

Figure 1. Percent of children in the study infected with each gastrointestinal parasite.

There was no statistical significance for prevalence between males and females (see Figure 2). However, a one-way analysis of variance showed a statistically significant difference between mean ages. The average age of a child infected with *A. lumbricoides* was 5.9 years, *E. vermicularis* 6.0 years, *G. intestinalis* 5.7 years, and *E. histolytica* 3.4 years of age. Furthermore, a paired difference test showed that the average age of a child identified with *E. histolytica* (3.4 years) was different than the other 3 GI parasites identified.

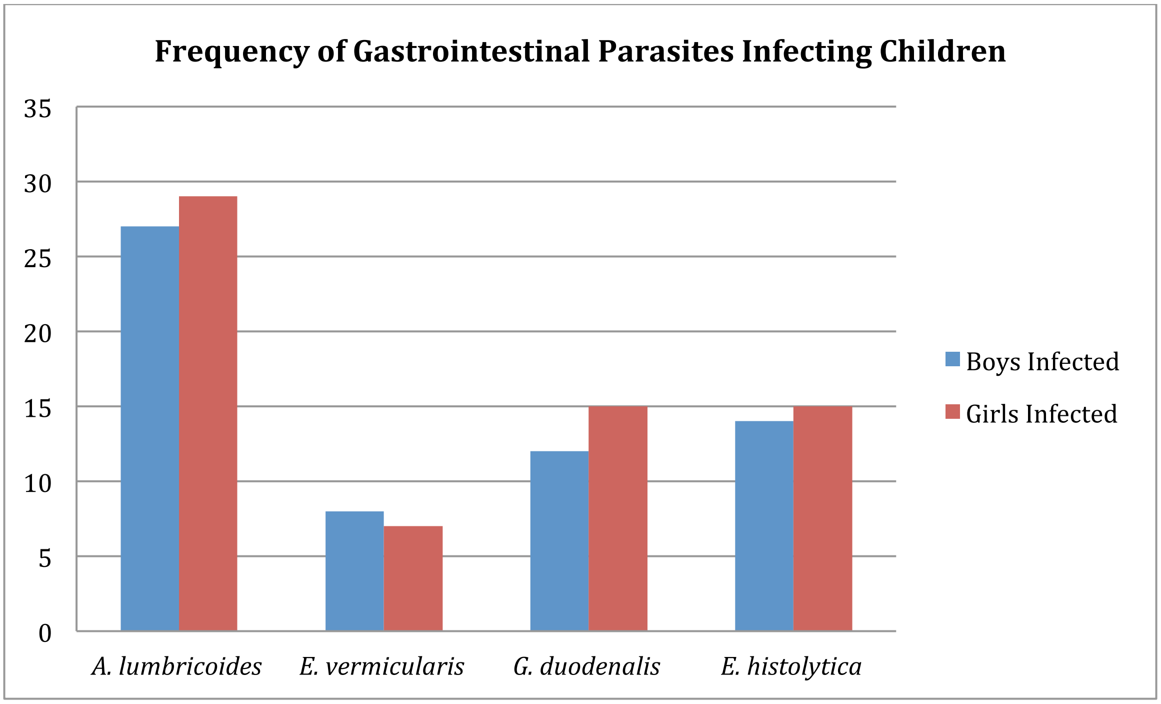

Figure 2. Frequency of gastrointestinal parasites in male and female children. This figure illustrates the number of cases of GI parasite identified from 108 stool samples in both male and female.

There were differences in prevalence reported among the last 4 major studies published in the Dominican Republic (see Table 1) (Childers et al., 2014; Collins & Edwards, 1981; Mackie et al., 1951; Miyata et al., 1995). Of note, the publication by Childers et al., in 2014 included data collection into 2011, whereas the data presented in this dissertation is that collected only in 2008.

GI Parasite	Study			
	Mackie (1951)	Collins (1981)	Miyata (1995)	Childers (2008)
T. trichiura	58.9	22.7	48.4	-
A. lumbricoides	20.1	11	25.5	48.2
Hookworm sp.	59.2	2.6	12.9	-
G. intestinalis	4.9	0.2	5.4	22.2
E. vermicularis	0.19	8.8	0.4	13.9
E. histolytica	34.2	7.9	1.5	24.1

Table 1. Percent of each GI parasite found in various studies in the Dominican Republic

The most concerning finding was the absence of *T. trichiura* and Hookworm species in the current study. Both of these diseases have been considered endemic to the DR and the lack of identification of these parasites raises the concern for misidentification of the organisms or lack in technique. Another important difference was the high prevalence of *G. intestinalis* and *E. vermicularis* compared to the other studies. All the studies in Table 1 except the current study included adults in their studies and this may have played a roll in the variation of findings. Also the studies were done in various localities throughout the DR with variance in temperature and precipitation and the significant gap in time between the studies also may contribute to fluctuations in prevalence.

Survey Data

City of residence. The majority of children in the study resided in the city of Verón (88.0%). Other cities of residence of the subjects included Punta Cana (5.6%), Cabeza de Toro (2.8%), Fruisa (1.9%), Juanillo (0.9%), and El Ceibo (0.9%). The most common neighborhoods, or barrios, where subjects resided included Villa Playwood (18.5%), Cosovo (11.1%), Barrio Nuevo (8.3%), Villa la Fe (8.3%), Villa Europa (6.5%), Punta Cana (5.6%), and Cristinita (3.7%).

Birth place. Regarding place of birth, 99.4% were born in the Dominican Republic, 4.6% were born in Haiti, and 1 child (0.9%) was born in the United States. 41.7% were born in la Altagracia province (the province where Verón is located), 17.6% were born in Santo Domingo, 6.5% in San Pedro de Macorís, 4.6% in Monte Plata, and 3.7% in Barahona. Only 34.3% of subjects had lived their entire life in Verón.

Participation in prior Scabies study and treatment. A door-to-door study in 2007 had been done for the treatment of scabies, and only 2 subjects in the current study had participated in the Scabies study and received treatment for it. One subject was positive for *E. histolytica* and the other subject had both *A. lumbricoides* and *E. vermicularis*.

School enrollment. There were 56.5% of subjects in the study who were enrolled in school. The most commonly attended schools were Centro de Educativo Cristiano de Verón, IDP (7.4%), Los Manatiales (9.3%), Escuela Primeria de Verón (4.6%), and Dos Jardas (4.6%), and El Colegio de Elizabeth (3.7%). For those enrolled in school, 25% had received some kind of medical treatment or prophylaxis for GI parasites in their school.

Household characteristics. The average number of people living in a household was 5.3 people, with a median of 5. The average household daily income was 506 pesos per day and 184,690 pesos yearly ($14.51 US dollars/day and $5,296 yearly, based on the 2008 rate exchange).

Child's knowledge of parasites. All of the children were asked about their knowledge of parasites. They were asked how a person becomes infected with a gastrointestinal parasite.

Of those asked, 48 were able to speak and give an answer without the assistance of their parent/guardian. For those who gave an answer, 30 gave a correct answer, 7 gave an incorrect answer, and 11 gave an answer that was partially correct and partially incorrect. Some examples of correct answers included: “from contaminated water,” “from not washing your hands,” “from germs and the mouth,” “from trash/waste,” “from food from a bad kitchen.” Incorrect answers frequently included eating candy and sweets. 14 children listed candy or sweets as a cause of GI parasites. Examples of mixed answers included: “from the dirt, caramels, and candy,” “from bottle caps,” and “from candy and latrines.”

Symptoms. Subjects and parents/guardians were asked if the child experienced any health problems in the last 7 days. Complaints included loss of appetite (50.9%), abdominal ache (49%), fever (44%), diarrhea (36.1%), anal itching (28.7%), headache (25%), nausea (25%), dry cough or chronic cough without cold symptoms (23.1%), weight loss (20.4%), vomiting (19.4%), rash (17.6%), abdominal distension (13%), increased appetite (8.3%), visible worms in feces (6.5%), greasy stools (4.6%), weight gain (1.9%), blood in stools (1.9%), and coughing up worms (0.9%).

History of GI infection. 42.6% of subjects had previously been diagnosed with a gastrointestinal parasite, 6.5% were unsure, and 50.9% denied previous infection. For those 46 subjects who reported a previous infection, 4 reported history of ascariasis, 22 amebiasis, 3 giardiasis, and 17 were unsure what they had had.

Annual medical visits. The average number of times in the last 12 months that the subjects had visited a medical clinic or a hospital for any reason was 5.8 times, with the median being 4 times.

Sources of drinking water. Subjects and parents/guardians were asked where they got their drinking water. Multiple sources were often reported. 97.2% consumed bottled water, 20.4% rainwater, 12% used tap water (or other piped public water system), 11.1% well water, and 0.9% river or stream. For those who used non-bottled sources of water, various methods were used to treat the water. 15 subjects reported they did nothing to treat the unbottled water, 9 used boiling, 26 reported using chlorine, 2 used filters (type was unspecified), and 1 subject reported using limes to treat the water.

Toileting. Several survey points addressed toileting. Various toilet types were reported for home and school use. In the home, 63.6% had a private indoor flushable toilet, 16.8% had a shared (with other families) indoor flushable toilet, 7.5% had a public or shared outdoor latrine, 7.5% had a private outdoor latrine, 3.7% used a chamber pot as their indoor toilet, and 0.9% went outside to use nature for toileting. For those subjects attending school, 95.6% had an indoor flushable toilet at school, 2.2% had an outdoor latrine, and 2.2% were unsure.

Hand-washing. Regarding hand-washing after toilet use, 13.0% never washed their hands after using the toilet, 6.5% rarely did, 33.3% sometimes did, and 47.2% reported always washing hands after toilet use. Various things were reported for post-toileting for cleaning after a bowel movement including: toilet paper (93.5%), cloth/towel (5.6%), newspaper (2.8%), stones/rocks (1.9%), leaves (5.6%), nothing (1.9%), water (0.9%), and disposable wipes (0.9%). Regarding hand-washing before eating, 6.5% reported never, 5.6% reported rarely, 31.5% reported sometimes, and 56.5% reported always. WHO states that interventions in hygiene education and instruction in hand-washing can lead to a reduction in diarrheal disease by up to 45% (WHO, 2004).

Animals near the home. The survey also investigated what types of animals lived in or near their homes. 14.8% reported no animals living in or near their homes. 75.9% reported dogs, 49.1% cats, 40.7% chickens, 7.4% cows, 7.4% horses, 5.6% sheep, 4.6% goats, 3.7% donkeys, and 0.9% pigs. Under the "write-in" section, 1.9% reported parakeets, 0.9% reported rats, and 0.9% reported ducks.

Home floor material. Types of floor reported in the home included: cement (80.6%), dirt (0.9%), mosaic tile (9.3%), combined dirt & cement (6.5%), and combined mosaic tile & cement (2.8%).

Poverty and Parasitic Infections in the Dominican Republic

It is interesting to note that 107 of the 108 children examined in this study were positive for one or more gastrointestinal parasites. Children were brought to the Rural Clinic of Verón usually with a health problem, but not necessarily for parasitic related symptoms. The high prevalence of infection reported in this study demonstrates the potential impact of parasitic infections in children in this area of the DR. Hookworm, *T. trichiura* and *H. diminuta* were not reported in this study, although these parasites have been reported in children in the DR by other investigators (Childers et al., 2014; Hotez, 2008; Mackie et al., 1951; Miyata et al., 1995; Vargas et al., 1987; WHO, 1981). A possible explanation is that this study sample consisted of both healthy and sick children, and not always with gastrointestinal complaints. Furthermore, this study was not conducted on children in their rural home environment.

Historically, there is a degree of cyclic closeness between poverty and parasitic diseases on the island of Hispaniola, beginning when slaves were brought to the island from Africa between 1492 and 1870 (Hotez, 2008). Presently, the health of not only young children but also adults, particularly pregnant women, in the DR is impacted directly by acute and chronic parasitic infections (Bank et al., 2011). There is a distinct economic dichotomy existing in the DR made up of tourists who vacation at the resorts of Punta Cana and those who live in the hidden underbelly of poverty in the surrounding areas. The average annual household income of subjects in the study was about $5,300 USD, demonstrating the extreme poverty of those who visit the Rural Clinic. Parasitic protozoa and helminths disproportionately affect the most disadvantaged, often trapping vulnerable individuals n a cycle of poverty and disease (Bank et al., 2011; Gates, 2011; Gyapong et al., 2010). The health consequences of parasitic infections in this area may impact tourists who visit and subsequently become infected (Paez Jimenez et al., 2004). But the more devastating impact in the DR is found where parasitic diseases slow the mental and physical growth of children, complicate pregnancies and birth outcomes, and have long term effects on educational achievement and economic activity (Bank et al., 2011).

Parts of Verón are shantytown, located at the periphery of the city where low-cost dwellings, contaminated water sources, and open pit public toilets are common (Sasidharan & Hall, 2012). Often times, families in these areas do not have enough food for the entire family and every family member must work. Early marriages, large families, and single mothers may contribute to the cycle of poverty. Without fundamental services such as clean water and proper sanitation, communicable diseases continue to have a significant presence in the DR, resulting in morbidity and mortality among children (Carman & Scott, 2004; Grady & Younos, 2010). In the 2011 PAHO report, it was estimated that the death of 30% of infants less than 1 year of age (38% in ages 1-4 and 26% in ages 5-14) can be attributed to communicable diseases (PAHO, 2011). Communicable diseases presenting as diarrhea and respiratory symptoms account for 61% of all mortality in children in the DR (Carman & Scott, 2004; PAHO, 2011).

Parasitic Infections in the Indigenous and the Migrant Populations

Parasitic infections in the DR are widespread resulting from factors that include immigration, cultural beliefs, lack of education, and contaminated food and water sources. Verón's population consists of many Haitians who immigrate to find work in the expansion and development of the Punta Cana tourism. While the exact number of Haitian immigrants in Verón is unknown, the literacy rates in 2012 for Haiti was only 48.7% while the literacy rate for the DR was 90.1% (UNICEF, 2013a, 2013b). Haitians in Verón lowers the total literacy rate for the area; furthermore, many Haitian immigrants speak only Creole. Therefore the development of any educational program for parasite prevention would be considerably hindered by illiteracy and language barriers (Wooding & Moseley-Williams, 2004). The lack of education in some groups in Verón is another factor contributing to controlling parasitic infections. Primary education in the DR is provided free for all children from the ages 7 to 14, and although attendance is compulsory, attendance is rarely enforced, especially in the rural areas (Mundi, 2013; Republic, 2011). Many immigrants and local inhabitants work as child care providers, food handlers and agricultural workers, which positions them in a role which may contribute to the transmission of parasitic diseases (Motarjemi et al., 1993; Sheth & Dwivedi, 2006).

Contaminated Water

The lack of access to clean water contributes to the propagation of disease. In a 2014 study that examined relationships between microbial drinking water quality and the drinking water sources in the Porto Plato region of the DR, it was found that 47% of "improved drinking water sources" were of high to very high risk-water-quality and therefore unsafe to drink (Baum et al., 2014). The study concluded that just because water quality has been deemed "improved," it still may be at high risk for microbial contamination (Baum et al., 2014). Over the past 20 years the percent of the population in the DR with access to improved water sources has decreased slightly from 89% in 1990 to 82% in 2011 (Baum et al., 2014; Rosa & Clasen, 2010). However, this value would likely be greatly reduced due to the microbial contamination of so-called "improved water sources" (Baum et al., 2014). According to the WHO/United Nations Children Fund Joint Monitoring Programme for Water Supply and Sanitation (2012), an "improved drinking water source" is defined as any piped water inside the dwelling or outside in a family plot or yard, any public taps or stand pipes, tube wells or boreholes, protected dug wells, protected springs, or rain-water collection areas. This definition, although identifying improved water sources, fails to account for microbial water quality and therefore overestimates the population with "access to safe drinking water" (WHO, UNICEF, & Sanitation, 2012).

In a study by Lennan (2000), 582 caregivers of children who were less than 5 years of age were systematically sampled from 4 neighborhoods in a poor peri-urban community of Santo Domingo. Lennan reported that 55% of caregivers did not boil drinking water for children, 38% did not always wash hands of the children prior to meals, 87% of children did not always wear shoes outside their house, and 54% were breastfed for less than 1 year (McLennan, 2000a, 2000b); all these being important factors contributing parasite transmission.

Nutritional Factors and Breastmilk Weaning Foods

Contaminated weaning foods account for a substantial portion of parasite-induced diarrheal diseases among infants and young children (Motarjemi et al., 1993). Nutritional deficiency diseases such as protein calorie malnutrition, iron deficiency anemia, and vitamin A deficiency have been reported in connection with food-borne parasitic infections including giardiasis and ascariasis (Motarjemi et al., 1993). The sources of food contamination are numerous and without appropriate food safety measures and hygienic quality control of infant foods including drinking water, parasitic infections will remain high in both infants and children. Health education and food safety procedures for food handlers and caregivers who are responsible for infants and children is imperative if parasitic infections in this age group are to be reduced (WHO: Department of Food Safety, 2006).

According to data from the 2007 Demographic and Health Survey by PAHO, only 8% of infants in the DR were exclusively breastfed at 6 months of age (PAHO, 2012). There is a lack of published data that clearly addresses what constitutes weaning foods for infants and toddlers in the DR or how mothers prepare weaning foods. In a study of infants and children in a Guatemalan Mayan village, prevalence of many infections increased during and following the weaning period, with a particularly high incidence of diarrhea in children between 7 to 18 months old, peaking at 9 months. Other studies have reported the prevalence of diarrhea being highest during the second 6 months of life (Motarjemi et al., 1993). Sources of contamination for weaning foods include pests, domestic animals, waste water, irrigation water, contaminated household water, night soil, infected food animals, food handlers, dirty cookware, cross contamination, and foods contaminated during cultivation. Biological contamination and the role of caregivers in preparing infant foods may have grave consequences for infants and children, ultimately resulting in higher morbidity and mortality (Motarjemi et al., 1993).

Impact of Soil-Transmitted Helminths

During May 2013, a PAHO/WHO regional meeting was held in Bogota, Colombia in order to promote an integrated action to control soil-transmitted helminths (*A. lumbricoides, T. trichiura,* and Hookworm sp.) and to supply guidance for the implementation of integrated deworming actions among the 18 country members in the region of the Americas (Saboya et al., 2013). This report is significant because it gives current information about helminth infections in the DR, a nation that is lacking in recent large scale published peer reviewed reports on the prevalence of gastrointestinal parasitism. PAHO/WHO reported that gastrointestinal parasitic diseases are among the 15 leading causes of morbidity in children in the DR; 55.3% involved STH. Approximately 31% of children ages 1-18 years suffer from anemia, partially because of parasitic infection. Between 50-60% of children in the DR are infected with at least one type of parasite; gastrointestinal parasitism occurs more frequently in children 6-10 years (Saboya et al., 2013).

More than half of these children are infected with more than one species of parasite (J. L. Scarpaci, 2005). Young children are particularly vulnerable during the time when physical and mental developmental growth takes place. A child's development and growth is affected by malabsorption, blood and protein loss, diarrhea, chronic dyspeptic syndrome, appetite suppression, and nutrient diversion, all potentially a result of chronic or recurrent parasitic infection (PAHO, WHO, Worms, Diseases, & International, 2013; Saboya et al., 2013; WHO, 1981). PAHO/WHO have recommended monitoring and evaluating the impact of deworming programs in the DR through the utilization of prevalence and intensity surveys. PAHO/WHO also recommended that deworming programs be integrated in private and public elementary schools as well as with non-enrolled or absentee school-aged children which make up approximately 8% of school-aged children in the DR (Saboya et al., 2013; WHO, 1981). In addition, PAHO/WHO recommended that the DR scale-up deworming activities to include preschool-aged children and to also implement biannual deworming campaigns to cover other at-risk groups such as pregnant women and agricultural workers (PAHO et al., 2013). Intervention programs that combine prevention and control of parasite infections and promote healthier diets will be the most effective in improving growth and development of infants and school aged children in the DR according to PAHO/WHO (PAHO et al., 2013).

Prevention and Treatment of Parasitic Infections in Children in the DR

One of the more effective methods for decreasing the rate of gastrointestinal parasitism in children in the DR would be through an integrated program for the elimination of helminth and protozoan parasites designed at the national level and implemented at the local level. Developing a national policy and plan of action requires the creation of updated strategies to combat parasitic infections in children. Examples of policies include widespread treatment programs and a better prevalence and surveillance mapping system (Bank et al., 2011). Greater attention must be directed towards economic and cultural barriers experienced by caregivers of children (McLennan, 2000b). PAHO, in their 2011 report, estimated the cost to control parasitic worms in the DR over 5 years would average 38 cents per individual per year for a total of 3,585,858 treatments delivered for an estimated cost of $623,155 (Bank et al., 2011). In the current study, with 99% of the participating children found to have at least one parasite regardless of their symptoms, it raises the recommendation to screen all children periodically for GI parasites and to treat them appropriately.

Compliance with medical advice is an important component of medical care but it cannot take place unless patients understand and retain physician's advice. Recall of the physician's advice usually does not diminish with the passage of time once information is internalized by the patient (Ugalde, Homedes, & Urena, 1986). Without this understanding, any new national policy or treatment program will not be fully realized due to lack of patient compliance.

The use of new tools to predict the prevalence of gastrointestinal parasites requires that health workers are trained on using the tools correctly. These workers must be familiar with the software and the equipment so that they may effectively access national, international and private research database. This allows them to make accurate estimates of infections and to direct appropriate methods of treatment (PAHO, 2011). Mapping of the known foci of infections is necessary in order to identify populations most at risk, their location, age groups most at risk, and which authority has the capacity to monitor, evaluate and respond (PAHO, 2011).

Lastly, there must be a concentrated effort to educate health care providers, local medical authorities, schools, agricultural leaders and child caregivers regarding the factors involved in the transmission of gastrointestinal parasites. Authorities must be made aware of the location of medical centers that can provide appropriate evaluation and treatment. There also has to be a concerted effort to eradicate many of the erroneous cultural and religious beliefs about parasite acquisition, prevention and treatment (McLennan, 2000a, 2000b).

Limitations of the Study

The limitations of the study begin with a relatively small sample size of 108 subjects. Increasing the sample size would allow for more descriptive data and further statistical analysis for correlation.

Another limitation was related to the laboratory technique used with thick smear and formalin-ether flotation technique for analysis of the stool samples. Molecular diagnostic techniques, while more expensive, are more sensitive and specific for detection of parasites. Furthermore, the lack of finding Hookworm sp. or *T. trichiura,* both endemic in prior studies to the DR, raises the concern that the laboratory technician was not correctly identifying the organism. Validity and reliability could be improved if multiple stool samples were collected from the same individual for analysis and if organism identification was verified with another laboratory clinician.

In regards to the survey, several of the questions were not specific enough or could be interpreted in different ways and this may have affected the accuracy of data collected from the survey. For example, the term "diarrhea" was not defined and could have a wide range of interpretation from one mushy stool to profuse watery diarrhea. Furthermore, the survey did not specify a chief complaint or a primary reason for why the child came to the clinic. The survey was lacking in reliability testing and validity testing could have been improved.

The study asked about where the subject was born, but it did not ask ethnicity specifically, and with many very poor Haitian immigrants migrating for work to this region, it would be interesting to know if they are at higher risk or more likely to carry specific parasites.

Mapping of the subjects home and schools was attempted, however this was extremely difficult because many subjects did not live in a neighborhood or have a street address. Furthermore, most parents/guardians could not locate the Rural Clinic on a map, let alone their own house, and thus the research objective to attempt to map homes and schools in assessment of geographic risk factors was not able to be completed with confidence in accuracy.

The time of the data collection is a limitation to the study in that Verón has changed quite a bit in the last 6 years. With the increasing development of Punta Cana as a world-class resort and tourist destination, the transient nature of Verón's inhabitants has likely become more secure with job stability. New housing developments continue to be built, with improved access to paved roads, flushable toilets, and sanitation. Piped water systems have expanded, but whether or not this has improved drinking water sanitation is unknown. The Rural Clinic of Verón, in collaboration with VCOM, SESPAS, and the Punta Cana Foundation, has expanded its practice from 1 physician in 2007 to 8 physicians in 2014, which has likely impacted health education and treatment of gastrointestinal parasites.

Chapter 5: Summary and Conclusion

Summary

Gastrointestinal parasites play a significant role in the morbidity and mortality of people on a global level, and many are endemic to the Dominican Republic. Children are particularly vulnerable to these diseases during their physical and mental development and GI parasites can lead to diarrhea, dehydration, nutritional deficiencies, malnutrition, anemia, stunted physical growth, lower IQ, chronic abdominal pain, fatigue, and even death. There is a deficit of published data on the prevalence and intensity of intestinal parasitic infections in the DR, with only a few prevalence studies being published in the last 65 years, although many reports exist for Haiti, the other half of the island of Hispaniola (PAHO, 2011).

This study identified one or more GI parasites in 99% of 108 children, ages 2 to 15 years old, visiting the Rural Clinic of Verón in the Dominican Republic in January to February 2008. Analysis of stool samples revealed a prevalence of 48.2% with *A. lumbricoides,* 24.1% with *E. histolytica,* 22.2% with *G. intestinalis*, and 13.9% with *E. vermicularis.*

Suggestions for Future Research

Recommendations for future research would be to repeat the same study using molecular diagnostic techniques, which are more sensitive and specific. Why did this study not identify *T. trichuriasis*, hookworm, or *H. nana*? It would also be interesting to repeat the study in adults. The same study could be repeated six years later to compare results. The study could also be done in the neighborhoods, going home to home, rather than having subjects come to the clinic, and would better guarantee the freshness of stool samples. Close to Verón there are a few

Haitian immigrant neighborhoods and doing a similar study in these neighborhoods would be an area for research comparison.

Other factors to query would be when does re-infection occur? Is treatment effective? Follow up analysis of stool samples could be revealing for this information. Investigating weaning foods for transition from breast milk to food and when a child is most vulnerable to parasitic infection could be another area of future research. Another important question raised by the study findings is why the presence of *G. intestinalis* was so much higher than in other studies in the Dominican Republic and raises the concern for investigating contaminated water sources. How effectively are people in Verón treating their water? In addition, *E. vermicularis* was also much higher than other studies and investigative studies could look in to this as well.

Conclusion

Children in Verón are at high risk for acquiring gastrointestinal parasitic infections in the DR as demonstrated by the exceptionally high percentage infection rate in this study. This study found that *G. intestinalis* and *E. histolytica* were the most common intestinal protozoans recovered and *A. lumbricoides* and *E. vermicularis* were the most common helminths. Molecular diagnostic techniques should be used in conjunction with standard fecal flotation techniques to more accurately identify parasitic infections. This high prevalence supports the practice of period screening in children in this region, even if they are asymptomatic.

Any plan of action to help reduce gastrointestinal parasitic infections in children in the Punta Cana-Bávaro-Verón-Macao municipal district will require a determined effort between international, national, and local health authorities combined with the education of schools, child care providers, food handlers and agricultural workers. A special effort must be made to reach out to immigrant children, preschool-aged children, and those children who are not part of the public education system. It is important to promote and protect breast-feeding as a method for disease prevention as well as to educate mothers on safe methods for food preparation during the weaning transition to solid foods (Motarjemi et al., 1993). Health education and hygiene programs should be improved and take into consideration lack of literacy, low education levels, and the Haitian immigrant population.

While expansion of piped water systems is to be commended, sources of drinking water contamination should be investigated and identified so that people are aware the water they thought was clean actually needs to be treated prior to consumption. Furthermore, education on water purification techniques should be improved.

If gastrointestinal parasitism is to be reduced or eliminated in children of this region of the DR, future studies should address the variation of GI parasite infections in immigrants, the effectiveness of current methods of health education, modes of parasitic transmission in young children, and contamination and purification of drinking water.

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Appendix A: English Informed Consent

INFORMED CONSENT

TITLE: A Survey of the Gastrointestinal Parasites and Risk Factors in Children in Verón, Dominican Republic

PRINCIPAL INVESTIGATOR: Kristin Geers, D.O.

INVESTIGATOR AFFILIATIONS: Edward Via Virginia College of Osteopathic Medicine; Ph.D. Candidate in International Health Education & Promotion at Virginia Tech

I. INVESTIGATOR'S STATEMENT

I am asking you to be in a research study. The purpose of this consent form is to give you the information you will need to help you decide whether to be in the study or not. Please read the form carefully. You may ask questions about the purpose of the research, the possible risks and benefits, and anything else about the research or this form that is unclear. When I have answered all of your questions, you can decide if you want to be in the study or not. This process is called "Informed Consent."

II. PURPOSE

The purpose of this study is to identify different human gastrointestinal parasites and possible risk factors present in children ages 2 to 15 years old visiting the VCOM Medical Clinic in Verón, Dominican Republic. Information obtained from this study can be used to help doctors at the clinic provide proper medical treatment to patients. Mapping the communities of people infected may point to areas of disease that could then further be investigated for a source. The research can also be used to help develop prevention and eradication programs of gastrointestinal parasites.

III. PROCEDURES

After signing 2 copies of the Informed Consent and Permission Form, you will give one copy of these papers to the researcher and you will keep one copy.

Participation in the study includes providing a stool sample. The child can either provide a stool sample at the clinic or return to the clinic at your convenience with a stool sample that is not greater than 12 hours old. Obtain a stool sample from your child in the cup provided. Screw the lid on tightly. Wash your hands with soap and water. Store the stool in a cool place away from sunlight until you return the specimen cup to the Rural Clinic laboratory. The stool sample cannot be more than 12 hours old when you return it to the laboratory.

After returning the stool sample, you will fill out a questionnaire. The questionnaire asks questions about your child's characteristics, the neighborhood where the child lives, education, family income, household, toiletry habits, previous medical treatment for parasites, current symptoms, and knowledge about gastrointestinal parasites. The questionnaire should take approximately 20 minutes to complete.

The stool test results from the laboratory can take from 1 hour to 4 hours, depending on the business of the lab.

You will be given a paper with the test results. We are referring all subjects positive for a parasite to the Rural Clinic to be treated properly. You may visit another clinic or hospital for treatment or you may refuse treatment. If your test is negative and you are not feeling well, we also recommend you see a physician at the clinic for a full medical evaluation.

IV. RISKS OF THE STUDY

There are few risks from providing a stool example since defecation is a natural life process. Risks during normal defecation include hemorrhoids, anal fissures, or in very rare instances, rectal prolapse. It is possible that in wishing to provide a stool sample more quickly, your child may bear down more strongly, making the above risks more likely. Therefore, we encourage you to provide a stool sample at your convenience.

In attempting to provide a stool sample in a specimen cup, it may be possible to contaminate your hands (if you are helping the child) or your child's hands, if the child has an infection, and then pass this on to others. We strongly recommend thoroughly washing your hands with soap and water after putting the stool sample in the cup to prevent any possible diseases passed through feces.

The risks from completing the survey include emotional consequences, since some questions refer to socioeconomic status, lifestyle, and education. Patients and/or parents/guardians may experience feelings of guilt, depression, anxiety, or inadequacy in answering these questions.

V. BENEFITS OF THE STUDY

A benefit of participating in the study is that the stool test is free. The study is conveniently conducted at VCOM medical clinic and patient may go there free of charge for medical care.

The information you provide in this study will help to determine the number and types of intestinal parasites and risk factors for these parasites for children visiting the clinic. This information can be used to develop an teaching and prevention programs in Verón in the future. Also, in looking at risk factors in this study, local physicians will be able to improve their care for people in Verón. And lastly, mapping neighborhoods of parasite infections may point to a possible source of infection that could be examined.

VI. EXTENT OF ANONYMITY AND CONFIDENTIALITY

When you sign up your child for the study, your child will be given a number. The results of the stool test and the questionnaire will only be identified by a number. The only person who will have access to your name will be researcher to whom you have given the written consent form.

The results of the study will be kept in a file in a locked room at the Rural Clinic in Verón. You may choose to give a doctor at any clinic the results of your child's stool study for proper treatment. You will be given the name and method of contacting the person who is securing your personal information. After the study is completed, the results collected will be taken to the United States where it will be analyzed and then stored in a locked box in a locked room at the Edward Via Virginia College of Osteopathic Medicine. The data will be destroyed by shredding after three years. It is possible that data from this study may be published, however, your name and your child's name will never be used since your information provided in this study has only been coded with a number.

Government staff or the Institutional Review Board sometimes review studies such as this one to make sure they are being done safely and legally. If a review of this study takes place, your child's records may be examined. The reviewers will protect your child's identity. The study records will not be used to put you or your child at legal risk of harm.

You and your child's identity in this study will be treated as confidential. The results of the study, including laboratory or any other data may be published but will not reveal your name or include any identifiable information from public disclosure, except where disclosure is otherwise required by law or a court of competent jurisdiction. These records will be kept private in so far as permitted by law.

VII. COMPENSATION

You and your child will receive no compensation for participating in this program. The study is located at a free medical clinic where you may receive a medical exam and treatment for any gastrointestinal parasite or other medical problem regardless of whether or not you participate in the program. The stool test will be free for you.

VIII. PARTICIPATION AND FREEDOM TO WITHDRAW

Participation in the study is completely voluntary. You and your child are free to withdraw from this program at anytime without prejudice or penalty.

IX. SUBJECT'S RESPONSIBILTY

I voluntarily agree to participate in this research study. I have the following responsibilities:

a. I will return my child's stool sample to clinic in less than 12 hours after producing it.

b. I will be truthful in answering questions in the questionnaire.

X. SUBJECT'S PERMISSION

I have read and understood the Informed Consent and the conditions of this study. I have a full understanding of all my responsibilities. I have had all of my questions answered. I hereby acknowledge the above and give my voluntary consent to participate in the study. I understand that nothing in this consent form is intended to replace any applicable Federal, state, or local laws.

____ ______________

Child's Name Date

____

Parent/Guardian Name

____

Parent/Guardian Signature

Should I have any questions about this project, I may contact:

Kristin Geers, Principal Researcher

U.S.A.

kgeers@vcom.vt.edu

Dr. Norberto Rojas, Rural Clinic Doctor

Verón, Dominican Republic

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Hara Misra, Ph.D.

Internal Review Board Chairman

Virginia College of Osteopathic Medicine,

USA

Phone number: (540)-231-3693

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Appendix B: Spanish Informed Consent

CONSENTIMIENTO INFORMADO

TÍTULO: Un examen de los parásitos gastrointestinales y de los factores de riesgo en los niños en Verón, la República Dominicana

INVESTIGADOR PRINCIPAL: Dra. Kristin Geers

AFILIACIONES DEL INVESTIGADOR: Edward Via Virginia of Osteopathic Medicine; Candidata al doctorado en Educación y Promoción Internacionales de Salud en la universidad de Virginia Tech.

I. Declaración de la Investigadora

Le estoy solicitando que forme parte de mi investigación. El propósito de esta forma del consentimiento es darle la información que usted necesitará para ayudarle a decidir si será parte del estudio o no. Lea por favor la forma cuidadosamente. Usted puede hacer preguntas acerca del propósito de la investigación, los riesgos y las ventajas posibles, y cualquier cosa sobre la investigación o esta forma que le sea confusa. Cuando haya contestado a todas sus preguntas, usted puede decidir si usted desea estar en el estudio o no. Este proceso se llama "Consentimiento Informado."

II. Propósito

El propósito de este estudio es identificar diversos parásitos gastrointestinales humanos y los factores de riesgo posibles presentes en pacientes con edades comprendidas entre 2 a 15 años que visitan la clínica rural de Verón localizada en Verón, República Dominicana. La información obtenida de este estudio se puede utilizar para ayudar a doctores en la clínica a proporcionar el tratamiento médico apropiado a los pacientes. Documentando las personas infectadas en las distintas comunidades podría ayudar a identificar un origen común de determinada patología. La investigación se puede también utilizar para ayudar a desarrollar programas de prevención y erradicación de parásitos gastrointestinales.

III. Procedimientos

Después de firmar 2 copias de la forma informada del consentimiento y del permiso, usted dará una copia de estos papeles al investigador y usted guardará una copia.

Al participar en el estudio le será requerida una muestra de heces fecales. El niño puede proporcionar una muestra de heces fecales en la clínica o volver a la clínica a su conveniencia con una muestra de heces fecales dentro de un periodo de tiempo no mayor de 12 horas. Obtenga una muestra de heces fecales de su niño en el envase proporcionado. Apriete la tapa de dicho envase firmemente. Lávese las manos con jabón y agua. Almacene las heces fecales en un lugar fresco lejos de la luz del sol hasta que usted devuelva el envase con la muestra al laboratorio de la clínica rural de Verón.

Después de entregar la muestra de heces fecales, usted completará un cuestionario. El cuestionario hace preguntas acerca de las características de su niño, de la vecindad en donde vive el niño, de la educación, del ingreso familiar, de las condiciones de la vivienda, lugar de deposición de excretas, hábitos de higiene, así como si ha recibido anteriormente tratamiento contra parásitos, si en el momento actual presenta síntomas, y además, cual es el nivel de conocimiento sobre parásitos gastrointestinales. El cuestionario debe tomar aproximadamente 20 minutos para completarlo.

Los resultados de la prueba de heces fecales del laboratorio pueden tardar de 1 a 4 horas, dependiendo de la cantidad de muestras a procesar.

Le darán un papel con los resultados de la prueba. Se referirán todos los casos positivos de parasitosis a la clínica rural de Verón para recibir el tratamiento apropiado. Usted puede visitar otra clínica u hospital para recibir el tratamiento o usted puede rechazar recibir cualquier tipo de medicación. Si su prueba es negativa y usted no se está sintiendo bien, también le recomendamos ver a un médico en la clínica para una evaluación médica completa.

IV. Riesgos del Estudio

Al proporcionar la muestra de heces usted se expone a pocos riesgos, ya que la defecación es un proceso natural de la vida. Los riesgos durante la defecación normal incluyen: hemorroides, fisuras anales, o en los casos muy raros, prolapso rectal. Es posible que al niño desear proporcionar una muestra de heces fecales más rápidamente, este pueda pujar más fuertemente, haciendo los riesgos antedichos más probables. Por lo tanto, le animamos a que proporcione una muestra de heces fecales a su conveniencia.

Al proporcionar la muestra de heces en el envase, es posible que se contamine sus manos (si usted está ayudando al niño) o las de su niño, si el niño tiene una infección, y luego la transmite a otras personas. Recomendamos que se lave sus manos profundamente con agua y jabón luego de entregar la muestra para prevenir la transmisión de cualquier tipo de enfermedad a través de las heces.

Los riesgos de participar en este estudio incluyen consecuencias emocionales, puesto que algunas preguntas se refieren al estatus socioeconómico, estilo de vida, y nivel educativo. Los pacientes y/o padres/tutores pueden experimentar sentimientos de culpabilidad, depresión, ansiedad, o incapacidad al responder estas preguntas.

V. Ventajas del Estudio

Una ventaja de participar en el estudio es que la prueba de heces fecales es gratis. El estudio es conducido convenientemente en la clínica rural de Verón y el paciente puede ir allí gratuitamente para la asistencia médica.

La información que usted proporciona en este estudio ayudará a determinar el número y los tipos de parásitos intestinales y los factores de riesgo para adquirir estos parásitos en los niños que visitan la clínica. Esta información se puede utilizar para desarrollar una enseñanza y programas de prevención en Verón en el futuro. También, al analizar los factores de riesgo en este estudio, los médicos locales serán capaces de mejorar el nivel de la atención para las personas de la comunidad en Verón. Y finalmente, identificando las áreas con mayor incidencia de parasitosis intestinal nos podría guiar a un posible origen común que podría ser examinado.

VI. Grado del Anonimato y del Secreto

Al incorporar al niño al estudio, a este le será dado un número. Los resultados de la prueba del heces fecales y del cuestionario serán identificados solamente por el número. La única persona que tendrá acceso a su nombre será el investigador a quien usted ha dado en la forma escrita del consentimiento. Los resultados del estudio serán mantenidos un archivo en un cuarto cerrado con llave en la clínica rural de Verón. Usted puede elegir dar los resultados a un doctor de cualquier clínica para recibir el tratamiento apropiado. Le darán el nombre y el método de entrar en contacto con la persona que está asegurando su información personal. Después de que se termine el estudio, los resultados recogidos serán llevados los Estados Unidos, donde serán analizados y luego almacenados en una caja de seguridad en un cuarto cerrado con llave en el la Universidad de Virginia de Medicina Osteopática. Los datos serán destruidos después de tres años (utilizando una maquina especial para tal fin). Es posible que los datos de este estudio puedan ser publicados. Sin embargo, su nombre y el de su niño nunca serán utilizados, puesto que su información proporcionada en este estudio solamente se ha codificado con un número.

El personal del gobierno o la revisión institucional del comité examinador estudia a veces estudios como este, para asegurarse de que se esta haciendo con seguridad y legalmente. Si ocurre una revisión de este estudio, los expedientes de su niño pueden ser examinados. Los revisores protegerán la identidad de su niño. Los expedientes del estudio no serán utilizados para ponerlo a usted o a su niño en riesgo.

Su identidad y la de su niño serán tratadas confidencialmente en este estudio. Los resultados del estudio, incluyendo laboratorio o cualquier otro dato se pueden publicar pero no revelarán su nombre ni incluirán cualquier información identificable para acceso público, excepto donde el acceso es requerido de otra manera por la ley o una corte de la jurisdicción competente. Estos expedientes serán mantenidos privados hasta donde lo permita la ley.

VII. Remuneración

Usted y su niño no recibirán ninguna remuneración para participar en este programa. El estudio se establece en una clínica médica gratuita donde usted puede recibir el examen y tratamiento médicos para cualquier parásito gastrointestinal u otro problema médico sin importar si participa o no en el programa. El examen de heces será gratuito para usted.

VIII. Participación y libertad de retirarse

La participación en el estudio es totalmente voluntaria. Usted y su niño están libres retirarse de este programa en cualquier momento sin recibir ningún tipo de amonestación o prejuicio.

IX. Responsabilidad del participante

Participo voluntariamente en este estudio. Tengo las siguientes responsabilidades:

1. Entregaré la muestra de heces del niño dentro de un periodo de tiempo no mayor de 12 horas
2. Seré veraz al contestar las preguntas del cuestionario.

X. Autorización del participante

He leído y entendido el consentimiento informado y las condiciones de este estudio. Tengo una comprensión completa de todas mis responsabilidades. He tenido todas mis preguntas contestadas. Reconozco por este medio lo anteriormente escrito y doy mi consentimiento voluntario para participar en el estudio. Entiendo que nada de lo que se encuentra en esta consentimiento informado podrá sustituir cualquier ley federal, estatal o local.

____ __________________

El nombre del Niño Fecha

____

Nombre del padre o tutor

____

Firma del padre o tutor

Si tengo cualquier pregunta sobre este proyecto, puedo contactar a:

Dra. Kristin Geers, Investigadora Principal

Los Estados Unidos

kgeers@vcom.vt.edu

Dr. Norberto Rojas, Doctor de la Clínica de VCOM

Verón, la Republica Dominica

Examinador

Numero de teléfono: 809-917-6363

Hara Misra, Ph.D.

Presidente Interno Del Comité

Numero de Teléfono: (540)-231-3693

Email: hmisra@vcom.vt.edu

Appendix C: Creole Informed Consent

Rapò de konsantman

TIT: Egzamen sou parazit ak faktè risk yo nan Veron, Repiblik Dominikèn

Moun ki fè travay rechèch sa a se: Doktè Kristin Geers

Moun oubyen enstitisyon ki asosye nan zafè rechè la se: Edward Via Virginia College of Ostheopathic Medicine, Kandida pou tit Doktè nan zafè Edikasyon Entènasyonal sou Lasante ak Promosyon nan Virginia Tech.

I. Pawòl moun k´ap fè travay rechèch la:

M´ap mande ou pou patisipe nan yon travay rechèch. Objektif fòmilè sa a se pou mwen kapab ba ou tout enfòmasyon ou pral bezwen pou ede ou pran desizyon pou ou kapab patisipe nan projè etid sa a. Tanpri souple, li fòmilè a ak anpil atansyon. Ou kapab poze kesyon sou projè rechèch la, risk posib ak benefis; oubyen nenpòt lòt bagay sou rechèch la oubyen sou fòmilè a ki ta va pa klè pou ou. Lè mwen fin reponn tout kesyon ou yo ou va deside si ou vle pran pa ou non nan projè rechèch la. Pati sa a rele : « Informed Consent ».

II. Objektif

Objektif rechèch sa a se pou nou kapab rive idantifye tout kalite parazit oubyen lòt faktè lakay pasyan yo nan laj 2 a 15 zan ki konn ale nan sant sante Vcom ki nan Veron nan, nan la Dominikani.

Enfòmasyon sa yo kapab ede doktè yo bay bon jan medikaman a moun ki nan trètman. Lè nou rive idantifye zòn kote ki gen moun malad ak viris la yo, sa va pi fasil pou nou chèche solisyon pou problèm nan. Etid sa a kapab sèvi tou pou plizyè program de prevansyon ak eradikasyon parazit ak maladi ki konn akonpaye yo.

III. Fason kouman sa va fèt

Aprè moun yo fin siyen 2 kopi fomilè a, ou pral bay yon kopi a moun ki fe rechèch la, e w'ap kenbe avèk ou yon lòt kopi.

Patisipasyon yon timoun nan etid la vle di moun sa a dakò pou li bay nou poupou li pou pèmèt travay la rive reyalize. Timoun nan kapab bay poupou li nan klinik lan dirèkteman oubyen li kapab fè li lakay li epi aprè li pote li ale nan klinik lan, nan ka sa a fòk poupou an pa pase douzè (12) de tan. Fe timoun nan poupou epi pran yon ti moso ladan li, fèmen li nan yon ti poban oubyen yon ti bokal byen fèmen. Lave men ou nan dlo ak savon. Sere poupou a yon kote ki fre, lwen limyè ak chalè solèy jiskaske ou pote li ale nan laboratwa klinik VCOM lan nan Veron. Poupou an pa dwe gen plis pase douzè de tan nan lespas ou te fin fè li ak lè pou li rive nan klinik lan.

Lè ou fin remèt poupou an, w'ap genyen pou ranpli yon fòmilè ak kèk kesyon ladan li. Gen kèk kesyon sou ki jan pitit ou an ye, vwazinaj kote timoun nan rete a, zafè edikasyon, mwayen de vi fanmiy lan, kantite moun k`ap viv nan kay la, koutim lijyèn, kèk trètman nan tan pase kont parazit timoun nan te fè deja, sentòm ki souvan prezante, konesans sou zafè maladi parazit yo. Fomilè ak kesyon yo kapab pran 20 minit sizanka mwens pou yon moun ka ranpli yo.

Rezilta egzamen poupou an kapab pran 1 a 4 è de tan selon okipasyon laboratwa a.

Y'ap ba ou yon papye ak rezilta egzamen an aprè sa. Tout ka maladi parazit nou ta rive dekouvri, n'ap voye yo nan klinik VCOM nan pou bon jan trètman. Gen posibilite pou kèk moun ta kab ale nan yon lòt klinik oubyen lopital pou trètman an tou selon ka a. Konsa tou nenpòt moun ka refize trètman an si li pa vle. Nan ka moun ki pa ta genyen maladi parazit dapre sa egzamen an di, men moun sa yo ta santi yo pa byen, n´a rekomande yo ale wè yon doktè pou yon etid pi konplè.

IV. Zafè risk etid lan.

Pa gen tròp risk lè yon moun bay poupou li pou fè etid, paske poupou an se yon bagay ki natirèl nan tout moun. Risk ki toutafè nòmal lè yon moun ap fè poupou se emoroyid, kèk ti blese nan dèyè li, oubyen nan kèk ka ki trè ra, se dèyè moun nan ki ka soti. Li posib tou, nan anvi fè poupou vit pou bay pou egzamen an, timoun nan kapab fòse fè poupou, sa kapab fè risk nou sot pale a yo kapab pi posib toujou. Nou konseye tout moun bay poupou pou etid lè yo kapab.

Lè yon moun ap eseye fe pitit li poupou nan yon ti bokal pa egzanp, li posib tou pou moun nan kapab kontamine men li yo (si l'ap ede timoun nan) oubyen men timoun nan kapab kontamine si li ta genyen kèk maladi enfeksyon lòt moun ka pran. Nou rekomande ak tout fòs nou, tout moun dwe lave men yo byen lave avèk savon ak dlo lè yo fin prepare poupou an, fèmen li byen fèmen nan yon ti bokal, pou nou ka evite problèm maladi moun ka pran nan poupou an.

Risk nan zafè ranpli fòmilè a ta genyen pou wè ak kèk ti problèm santiman, paske ladan li, n'ap jwenn kèk kesyon sou zafè lajan ki toutafè pèsonèl nan lavi yon moun, fason moun nan viv, nivo edikasyon. Pasyan yo, paran ou byen moun ki responsab timoun nan kapab santi yo koupab; yon santiman dekourajman ka anvayi yo pandan yon ti moman oubyen tou, yo pa ta byen reponn kesyon yo ak tout senserite.

V. Benefis etid la.

Yonn nan benefis yon moun ka genyen lè li patisipe nan etid lan sè ke li p'ap peye anyen pou sa. Etid lan va fèt nan klinik VCOM nan epitou moun yo ka ale san yo pa mete nan têt yo zafè depanse lajan.

Gras a enfòmasyon nou jwenn pa mwayen etid lan, sa ka pèmèt nou rive rann nou kont de kantite epitou ki kalite maladi parazit ak faktè de risk yo genyen nan lavi timoun yo ki konn ale nan klinik lan. Enfòmasyon sa a kapab sèvi tou pou nou devlope epi montre ak prevni lòt maladi pa mwayen de program nou kapab mete sou pye nan Veron. Gras a faktè de risk yo, doktè yo nan zòn nan kapab amelyore fason yo bay moun swen nan Veron. Konsa tou, lè nou rive lokalize parazit yo nan diferan zòn vwazinay, sa ka ede nou dekouvri sous maladi enfeksyon yo epi chèche trètman pou yo tou.

VI. Zafè konsèvasyon non moun ki pa ta renmen yo site non yo ak konfidansyalite tou

Le ou siyen pou pitit ou kapab patisipe nan etid la, y´a bay timoun nan yon nimero. Rezilta egzamen an ak tout fòmilè kesyon yo, se selman pa mwayen nimero sa yon moun ka rive idantifye yo. Se sèlman moun k'ap fè etid lan ke ou te konfye enfòmasyon ou yo k'ap gen aksè sou non ou. Rezilta etid la pral sere anba kle byen sere nan klinik Veron lan. Nenpòt granmoun ka chwazi bay nenpòt doktè nan nenpòt klinik oubyen lopital rezilta etid pitit li an pou yon bon jan trètman. Nan ka sa a, yo va ba ou non ak ki fason ou kapab antre an kontak ak moun ki pral sere enfomayon timoun nan. Lè etid lan fini, y'ap voye rezilta yo nan peyi Etazini, kote yo pral analize yo pi byen epitou sere yo anba kle nan yon tirwa nan yon chanm nan local Edgard Via Virginia Collage of Osteopathic Medicine. Y'ap gen pou detrwi enfòmasyon yo nét ale apre twa zan. Li posib pou yo ta pibliye kèk enfomasyon sou rezilta etid la tou. Sizanka sa ta rive fèt, nou asire ou ke ni non pa ou ni non pitit ou pap janm rive mansyone ditou sitou paske nan moman etid lan, se selman nimewo yo ki te konsève, se pat non pyès moun.

Gen kèk fwa, kèk enstans nan gouvènman peyi Etazini oubyen komite dirijan kèk gro jounal enpòtan konn revize kalite etid sa yo pou sètifye yo byen fèt dapre prensip lalwa ki deja etabli sou sa. Si yon bagay konsa ta rive fèt, yo ka rive analize rezilta pitit ou an, ou pa janm konnen. Nenpòt kòman, y'ap toujou proteje idantite pitit ou an. Etid sa a p'ap janm mete ni oumenm ni pitit ou an danje devan lajistis oubyen devan nenpòt lòt enstitisyon leta ou prive.

Oumenm ak tout idantite pitit ou ap genyen yon trètman toutafè konfidansyèl. Rezilta etid lan oubyen kèk lòt enfòmasyon laboratwa ka rive pibliye, men yo p'ap janm kite moun konnen sou ki mounn etid la te fèt, sof nan kèk sitiyasyon kote lalwa ta rive egzije sa. Enfòmasyon sa yo pral rete prive epitou konfidansyèl dan la mezi ke lalwa pèmèt sa.

VII. Rekompans

Paran yo avèk timoun yo pa pral resevwa pyès rekompans poutèt yo patisipe nan program sa a. Program sa ap fèt nan yonn klinik kote ou pa genyen pou peye anyen, tout egzamen avèk trètman pou problèm vè nan vant ap fèt gratis. Pou tout moun, sak vle patisipe oubyen sak pa vle patisipe pèsòn p´ap gen pou peye anyen.

VIII. Patisipasyon nan etid la ak libète yon moun pou li kontinye ou non

Patisipasyon nan program sa se sèlman si ou vle. Paran yo avèk timoun yo gen dwa pou soti nan etid la menm lè yo ta déjà kòmanse. Pèsòn pap genyen problèm avèk lalwa si li deside pa kontinye.

IX. Responsablite moun nan

Mwen aksepte patisipe nan etid sa a san pyès lòt moun pa fòse mwen. Mwen genyen responsablite sa yo devan mwen:

1. Mwen genyen pou mwen voye poupou pitit mwen an nan klinik lan avan douzè depi li fin fèt la pran lè li rive nan klinik Veron nan
2. Mwen promèt senserite lè m'ap reponn kesyon yo nan fòmilè a.

X. Pèmisyon moun nan genyen

Mwen te li epitou mwen konprann fomilè a ak tout kondisyon etid la. Mwen byen konprann responsablite mwen nan etid la. Mwen te reponn tout kesyon yo. Mwen rekonèt tout sa ki di yo la a epi mwen aksepte patisipe nan etid lan. Mwen konprann tou, anyen nan fomilè sa a mwen ranpli a pa pral chanje ni modifye pyès lwa federal, lwa leta oubyen lwa local nan peyi Etazini.

____ __________________________

Kouman timoun nan rele Dat

____

Moun ki responsab timoun nan

____

Siyati moun ki responsab timoun nan

Si mwen ta genyen kèk kesyon sou etid la, mwen kapab kontakte :

Kristin Geers, se moun ki fè travay rechèch sa a : USA

kgeers@vcom.vt.edu

Dr. Norberto Rojas, Doktè Klinik VCOM

Verón, Repiblik Dominikèn

809-917-6363

Hara Misra, Ph.D.

Presidente Interno Del Comité Examinador

Virginia College of Osteopathic Medicine, USA

540-231-3693

Email: hmisra@vcom.vt.edu

Appendix D : English Survey

Survey of Gastrointestinal Parasites & Risks Patient #__________

Date: __________________

1. Has the parent/ guardian signed the Informed Consent?
    a. Yes
    b. No
2. Age of child: ___________________________
3. Gender of child:
    a. Male
    b. Female
4. City of Residence:____
5. Community/ Neighborhood:
   ____
6. If the child lives in Barrio Nuevo, did someone come to your house in May 2007 and give you medicine for Scabies and parasites?
    a. Yes
    b. No
    c. Unsure
7. Name of School: ____
8. School grade: ____
9. City of Birth____

10. Country of Birth: ____

11. Number of years living in Verón:___________________

12. Other cities or countries where the child has lived before

Verón?___________________________________

____

13. What is the total number of people living in your household?__________________

14. What is your household's total income per day?___________________________

15. Question to child: Where do gastrointestinal parasites come from?________________

____

16. If the child/ teen is female, has she started her menses?

a. Yes
b. No

17. If female, is the child/teen pregnant?

a. Yes
b. No
c. Unsure

18. Circle any of the following symptoms that the child has had in the last 7 days:

a. Diarrhea	j. Blood in stools
b. Abdominal pain	k. Nausea
c. Worms in stools	l. Anal itching
d. Fever	m. Vomiting
e. Abdominal distention	n. Loss of appetite

f. Increased appetite
g. Weight gain
h. Rash
i. Coughing up worms
o. Weight loss
p. Headache
q. Dry cough without a cold or chronic cough
r. Greasy stools

19. Has the child ever been diagnosed in a clinic or hospital with a parasite or worm of the intestines or stomach?
    a. Yes…if so,
        i. When? ____
        ii. What kind?____
    b. No
    c. Unsure
20. Has the child recently been given medicine in school for parasites?
    a. Yes….if so,
        i. When?____
    b. No
    c. Unsure
    d. The child does not attend school
21. How many times a year does the child visit a clinic or hospital?

    ____

22. Where do you get your drinking water?
    a. Purchase bottled water
    b. Community well
    c. Tap water

d. River or stream

e. Rain water collected

f. Other____

23. If you do NOT buy bottled water, what do you treat your water with before drinking?

a. Nothing

b. Boil

c. Iodine

d. Chlorine

e. Filter…if so,

i. What kind?____

f. Other____

g. Unsure

24. What type of toilet do you use at home or where do you use the bathroom?

a. Indoor flushable toilet

b. Public or shared outdoor latrine

c. Private outdoor latrine

d. Outside/ Nature

e. Other____

25. What type of toilet does the child use at school?

a. Indoor flushable toilet

b. Outdoor latrine

c. Other____

d. Unsure

26. How often does the child wash his/her hands with soap and water after using the toilet?

a. Never	c. Sometimes
b. Rarely	d. Always

27. Does the child use any of the following after a bowel movement to clean himself/herself?

a. Toilet paper

b. Cloth

c. Paper

d. Stones

e. Leaves

f. Nothing

g. Other____

28. How often does the child wash his/her hands with soap and water before eating?

a. Never	c. Sometimes
b. Rarely	d. Always

29. What kinds of animals live in or around your house?

a. Dog	d. Cat	g. Pig	j. None
b. Cow	e. Horse	h. Chicken	
c. Goat	f. Sheep	i. Donkey	k. Other_________________

30. What type of floor is in your home?

a. Dirt	d. Tile
b. Cement	e. Other______________________________________
c. Wood	f. Unsure

Appendix E: Spanish Survey

Examen de parásitos gastrointestinales y de riesgos Paciente # _______________

Fecha: __________________

1. ¿Han firmado el consentimiento informado los padres o tutores?
   a. Sí
   b. No
2. Edad del niño: ________________________________
3. Género del niño:
   a. Masculino
   b. Femenina
4. Ciudad de residencia:____
5. Comunidad/ Barrio: ____
6. Si el niño vive en Barrio Nuevo, ¿alguien le visito a su casa en mayo de 2007 y le dio medicinas para escabiosis y parásitos?
   a. Sí
   b. No
   c. Inseguro
7. Nombre de la escuela: ____
8. Grado de escolaridad: ____
9. Ciudad de nacimiento:____
10. País de nacimiento: ____
11. ¿Hace cuanto tiempo vive el niño en Verón?__________________________________
12. ¿Ha vivido el niño en otros lugares antes del Verón? ¿Dónde?_____________________

____

13. ¿Cuántas personas viven en la casa?___________________________________

14. ¿Cuánto es el ingreso diario de todas las personas que viven en la casa?_____________

15. Pregunta al niño: ¿De dónde vienen los parásitos gastrointestinales?_______________

____

16. ¿Si es una niña, ella ha comenzado el ciclo menstrual?

    a. Sí

    b. No

17. ¿Si es una niña, está la niña embarazada?

    a. Sí

    b. No

    c. Inseguro

18. Encierre cualesquiera de los síntomas siguientes que el niño ha tenido en los 7 últimos días:

    a. Diarrea
    b. Dolor de estómago
    c. Gusanos en heces fecales
    d. Fiebre
    e. Distensión abdominal
    f. Aumento de apetito
    g. Aumento de peso
    h. Erupción cutánea
    i. Parásitos en catarro
    j. Sangre en heces fecales
    k. Náusea
    l. Picazón en el ano
    m. Vomito
    n. Pérdida de apetito
    o. Pérdida de peso
    p. Dolor de cabeza
    q. Tos seca sin gripe o tos crónica
    r. Heces fecales grasientas

19. ¿Han diagnosticado al niño alguna vez en una clínica o un hospital con un parásito o un gusano de los intestinos o del estómago?
    a. Sí
        i. Cuándo? ____
        ii. Qué tipo?____
    b. No
    c. Inseguro
20. ¿Ha recibido el niño recientemente medicina contra los parásitos en la escuela?
    a. Sí
        i. Cuándo?____
    b. No
    c. Inseguro
    d. El niño no asiste a la escuela
21. ¿Cuántas veces al año el niño visita una clínica o un hospital?______________________
22. ¿Dónde usted obtiene su agua potable?
    a. Compra botellón de agua
    b. Pozo de la comunidad
    c. Agua de la llave
    d. Río o arroyo
    e. Agua de lluvia
    f. Otro
    ____
23. Si usted no compra agua en botella, ¿con qué usted trata el agua antes de consumirla?

a. Nada

b. La hierve

c. Yodo

d. Cloro

e. Filtro

i. ¿Qué tipo?____

f. Otro____

g. Inseguro

24. ¿Qué tipo de inodoro usted utiliza en su hogar?

a. Inodoro intradomiciliario

b. Letrina extradomiciliaria (afuera de la casa) compartida

c. Letrina extradomiciliaria privada

d. Monte/ tierra

e. Otro____

25. Deposición de excretas en la escuela:

a. Inodoro

b. Letrina

c. Otro____

d. Inseguro

26. ¿Cuan a menudo el niño se lava las manos con jabón y agua después de usar el inodoro?

a. Nunca

b. Raramente

c. A veces

d. Siempre

27. ¿Qué usa el niño para limpiarse después de ir al baño?

a. Papel de inodoro

b. Paño

c. Periódicos

d. Piedra

e. Hojas

f. Nada

g. Otro ____

28. ¿Cuántos veces el niño se lava las manos con jabón y agua antes de comer?

a. Nunca
c. A veces

b. Raramente
d. Siempre

29. ¿Qué clase de animales viven alrededor de su casa?

a. Perro	d. Gato	g. Cerdo	j. Ningunos
b. Vaca	e. Caballo	h. Gallo	
c. Cabra	f. Ovejas	i. Burro	k. Otro_________________

30. ¿Qué tipo de piso tiene en su hogar?

a. Tierra
d. Mosaico

b. Cemento
e. Otro _________________________________

c. Madera
f. Inseguro

Appendix F: Creole Survey

Egzamen Sou Parazit Yo Paciente #_________

Dat______________

1. Èske paran yo ou byen moun ki responsab yo te siyen rapò a?
   a. Wi
   b. Non
2. L'aj timoun nan: _________________________________
3. Ki sèks timoun nan?
   a. Gason
   b. Fiy
4. Vil kote li rete:____
5. Zòn nan: ____
6. Si timoun nana p viv Barrio Nuevo, èske kèk moun te ale lakay o unan mwa me 2007 la pou ba ou medikaman kont escabias ak parazit?
   a. Wi
   b. Non
   c. Mwen pa konnen
7. Kouman lekòl la rele: ____
8. Nan ki nivo lekòl la rive: ____
9. Vil kote li fèt: ____
10. Peyi kote li fèt: ____

11. Ki kantite tan li genyen depi l'ap viv nan Veron? ______________________________

12. Kèk lòt vil oubyen peyi kote timoun nan te viv avan Veron?

____

13. Konbyen moun k'ap viv nan kay la?

____

14. Ki kantite lajan nou depanse chak jou pou nou manje ak bwè nan fanmiy lan?

____

15. Kesyon pou timoun: Ki kote problèm parazit la sòti?

____

16. Èske timoun nan ou jenn nan se yon fiy, eske li deja genyen peryòd li?

a. Wi

b. Non

17. Si se yon ti fiy ou byen demwazèl, èske li ansent?

a. Wi

b. Non

c. Mwen pa konnen

18. Make yonn nan sentòm sa yo ke timoun nan genyen pandan sèt (7) dènye jou sa yo:

a. Dyare

b. Vant fè mal

c. Vè lan poupou

d. La fyèv

e. Vant gro

f. Manje apil

j. San nan pou pou

k. Anvi vomi

l. Dèyè grate

m. Vomi

n. Paka manje

o. Pèdi pwa

g. Vin pi gro

h. Li gen bouton soup o li

i. Crache vè

p. Tèt fè mal

q. Tous sèch

r. Lwil nan poupou

19. Èske yon doktè nan yonn la lopital oubyen nan yon klinik te deja di ke timoun nan gyen problèm vè?

a. Wi

i. Kilè?____

ii. Ki kalite?____

b. Non

c. Mwen pa konnen

20. Èske nan lekòl li, yo konn bay timoun nan medikaman pou vè?

a. Wi

i. Kilè?____

b. Non

c. Mwen pa konnen

d. Timoun nan pa ale le kòl

21. Konbyen fwa timoun nan vizite yon sant santé oubyen yon lopital?_______________

22. Ki kote ou pran dlo pou bwè?

a. Dlo trete

b. Dlo nan pi

c. Dlo nan tiyo

d. Dlo nan rivyè

e. Dlo lapli

f. Oubyen lòt kalite dlo____

23. Si ou pa achte boutèy dlo trete, ki sa ou fè pou trete dlo avan ou bwè?

a. Anyen

b. Dlo bouyi

c. Yòd

d. Cloròs

e. Dlo filtre

i. Ki kalite dlo filtre?____

f. Ou byen ki lòt kalite____

g. Mwen pa konnen

24. Ki kalite twalèt ou itilize lakay ou?

a. Watè ijyenik

b. Latrin piblik

c. Nan latrin prive

d. Fe bezwen nan raje

e. Ou byen ki lòt kalite____

25. Ki kalite twalèt timoun nan itilize nan lekòl li?

a. Watè ijyenik

b. Latrin

c. Oubyen ki lòt kalite ankò ____

d. Mwen pa konnen

26. Kombyen fwa timoun nan lave men li ak savon twalèt, le li soti nan twalèt?

a. Jamè

c. Pa trò souvan

b. Kèk fwa d. Toujou

27. Ki sa timoun nan itilize pou li siye fès li lè li fini fè poupou?

a. Papye ijyenik

b. Moso twal

c. Papye

d. Moso wòch

e. Fèy bwa

f. Anyen ditou

g. Oubyen lòt bagay ____

28. Ak ki frekansite timoun nan lave men li avèk savon avan li manje?

a. Jamè c. Pa trò souvan

b. Kèk fwa d. Toujou

29. Ki jan de bèt ougenyen kaviv la kay ou?

a. Chyen d. Chat g. Cochon j. Ni yonn ni lò

b. Bèf e. Cheval h. Poul

c. Kabrit f. Mouton i. Bourik k. Lòt___________

30. Kouman plafon lakay la ye:

a. Tè d. Mosaik

b. Siman e. Lòt____

c. Bwa f. Mwen pa konnen

Appendix G: IRB Approval

Edward Via
Virginia College of Osteopathic Medicine
Physicians & Research for the 21st Century

Institutional Review Board
Dr. Hara Misra
Chairman
540.231.3693
misra@vcom.vt.edu

VCOM Institutional Review Board
Notice of Review

December 27, 2007

Kristin Geers, DO
PhD Candidate

RE: IRB#2007/045, A Survey of the Prevalence of Gastrointestinal Parasites and Risk Factors in Human Populations in a Rural City in the Dominican Republic

Dear Dr. Geers:

The proposed research is eligible for expedited review according to the specifications authorized by 45CFR 46.110 and 21 CFR 56.110. Your protocol has been reviewed via expedited procedure by two members of the VCOM IRB. Three minor reviewer questions were addressed to you via email. Your responses and revised protocol have been reviewed and accepted by the reviewers and your project has been **approved.**

Federal guidelines dictate that IRB-approved research must be reviewed no less than once a year. Note that your continuation review will be December 27, 2008. Approximately 30 days before this date, you will receive a Progress Report Form from the IRB Coordinator. Please fill out this report and submit it to the IRB Coordinator at least two weeks prior to your review date.

Please remember that as the PI, you are responsible for promptly reporting to the IRB any proposed changes in the research activity prior to being implemented. You are also responsible for promptly reporting any injuries or adverse events or unanticipated risks to subjects.

Please be advised that the VCOM IRB will be conducting routine audits as a means of ensuring compliance with VCOM and federal policies in an effort to assure the protection of human subjects. Your project may, at any time throughout the approval period, be subject to this type of monitoring.

Thank you for your cooperation. If you have any questions or concerns, please do not hesitate to contact the IRB Coordinator, Sharon Kauffman at skauffman@vcom.vt.edu or 231-4512.

Sincerely,

Hara P. Misra, DVM, PhD
Chairman, VCOM Institutional Review Board

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