The Political Ecology of Intestinal Parasites Among Nicaraguan Immigrants in
Monteverde, Costa Rica

by

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The Political Ecology of Intestinal Parasites Among Nicaraguan Immigrants in Monteverde, Costa Rica

Jason D. Lind

ABSTRACT

Since the mid-1990s Monteverde, Costa Rica has undergone rapid economic, social, political, and environmental change due to a flourishing ecotourism economy. While the effects of ecotourism development in Monteverde are many, two important consequences have been: 1) the immigration of Nicaraguan nationals to the area seeking low-skilled wage labor; and 2) compromised water resources management due to pollution and rapid population growth. The objective of this research is to investigate and identify the inter-relationships between ecotourism development in Monteverde and its affect on infectious diseases outcomes within the context of immigration and water resources management. Specifically, this dissertation uses both anthropological and public health methods within a political ecology of health framework to compare prevalence rates of intestinal parasites between Nicaraguan immigrants and Costa Rican residents living in Monteverde. Results indicate that Nicaraguan immigrants suffer disproportionately from infections with intestinal parasites compared to Costa Rican residents. The results further indicate that community based water resources are not a significant source of infection. Instead, the prevalence of intestinal parasites is most likely the result of fecal-oral transmission at the household level and is related to indicators such as access to health care, underemployment, home ownership, and household sanitation infrastructure.
Chapter One – Introduction

Once thought to be on the verge of eradication, infectious diseases still remain one of the major causes of morbidity and mortality among the world’s population. Both the emergence and re-emergence of infectious diseases has been closely linked and associated with the processes of globalization. While definitions of globalization are often based on academic interests and perspectives, this dissertation is interested in how globalization as a process of interactions and inter-relationships between political-economic, social and environmental systems affects human health by increasing levels of infectious diseases. One of the most conspicuous manifestations of globalization with specific implications for emerging and re-emerging infectious diseases is the unprecedented movement of people, goods and capital (Knobler 2006). As economic, social and environmental disparities grow within and between countries, the number of migrants seeking work and a better quality of life will continue to grow. According to Knobler et al. (2006), “migrant populations are among the most vulnerable to emerging and re-emerging infectious disease and have been implicated as a key causal factor in the spread of such diseases” (2006:21).

In their seminal book “The Anthropology of Infectious Disease” Inhorn and Brown (1997) contend that, because of their expertise in understanding human behavior couched within a mixed methods approach, medical anthropologists are well suited to study infectious diseases by providing critical perspectives that can be used to reduce their burden on human suffering. Inhorn and Brown describe the anthropology of infectious disease as “the broad area which emphasizes the interactions between sociocultural, biological and ecological variables relating to the etiology and prevalence of infectious disease” (1997:14). They later call on anthropologists to conduct research focusing on how infectious diseases are manifest in different cultural, political-economic and ecological settings, especially in terms of identifying individual, community and ultimate risk factors of disease (1997). The authors also express the need for medical
anthropologists to explain how patterns of infectious disease are not only influenced by proximate causes, but how they are also influenced by political-economic processes of globalization. Employing perspectives from anthropology and public health, this dissertation attempts to answer the call from Inhorn and Brown by comparatively studying the prevalence of intestinal parasites among Nicaraguan immigrants and Costa Rican residents living in a rural Costa Rican community that has significantly changed in the past decade as a result of its burgeoning international ecotourism economy and the resulting immigration of Nicaraguan nationals to the area seeking employment and a better quality life.

**Background to the Problem**

The Monteverde Zone is situated in the Tilarán Mountains of Northwest Costa Rica and refers to several communities situated along a rough gravel road extending from the Pan-American Highway up to the Monteverde Cloud Forest Reserve. The communities of Santa Elena, Cerro Plano and Monteverde are currently centers of ecotourism\(^1\) development, local governance, and settlement. Other communities including San Luis, Cañitas and Los Llanos are smaller rural communities where agriculture production and dairy farming are prevalent. Together, it is estimated that the Monteverde Zone has a population between 5,000 and 6,000 permanent inhabitants with Santa Elena being the largest community (AAASE 2003).

The Monteverde Zone was first settled in the early decades of the 1900's by gold miners, settlers, and farmers. Later, in the 1950’s American Members of the Society of Friends (Quakers) established the community known as Monteverde. The Quakers established dairy farming in the region and also set aside about 550 hectares of primary forest to protect their watershed. Today, over 50,180 hectares of forest are under protection in four formal reserves, including the Monteverde Cloud Forest Preserve and

\(^1\) Ecotourism as defined by The International Ecotourism Society is “responsible travel to natural areas that conserves the environment and improves the well-being of local people” (TIES 1990).
other private and public land holdings (Haber 2000; Honey 1999). These forests are home to enormous biodiversity, which has attracted researchers and tourists for several decades and today provide the basis of Monteverde’s ecotourism industry.

The primary threat to the sustainability of the Monteverde Zone has been the recent explosive growth of the ecotourism industry. As an example, in the 1980’s it was estimated that approximately 15,000 tourists visited Monteverde annually while in 2003 the Santa Elena aqueduct estimated that Monteverde receives more that 200,000 tourists a year (AAASE 2003). Tourism has now surpassed dairy farming as the areas primary source of income. More than 80% of the hotels, restaurants, and businesses in the Monteverde zone have been built since 1990. In a recent survey of the areas 93 businesses, 85% are directly related to the tourism and service sector economy and 73% are located either in Santa Elena or Cerro Plano (Amador 2004).

The impact of increased ecotourism development has been mixed. On the positive side there have been benefits in overall employment and improvements in education and health facilities. In a recent survey by the USF-GRC, Amador (2004) reports that respondents overwhelmingly stated the benefits of ecotourism were the availability of work and increased economic growth. Residents also cited the 2001 construction of a well equipped and staffed medical clinic which has increased health services and coverage as another benefit of ecotourism (2004).

On the flip side, ecotourism development is threatening forest resources through the creation of new pasturelands as a result of increased construction to make way for new homes and ecotourism based businesses. The depletion of forest resources is threatening biodiversity which has been exemplified by the disappearance of the golden toad, a species thought to only have existed in Monteverde (Honey 1999; Nadkarni 2000). Another important impact of ecotourism has been the pollution of local rivers and streams as a result of graywater\(^2\) contamination from homes and businesses. In addition,

\(^2\) Graywater is defined as non-industrial domestic wastewater generated from domestic processes such as dish washing, laundry and bathing (The Groundwater Foundation 2009).
the continued growth of the ecotourism sector has increased demands for fresh potable water and has resulted in water shortages for local residents. These threats to local water resources in terms of water quality and quantity have potential human health and environmental consequences.

Another consequence of ecotourism has been the immigration of Nicaraguan nationals to the area seeking employment in seasonal agricultural (the coffee harvest) or the tourism economy; specifically construction and domestic services. Until recently, very little was known about the Nicaraguan population in Monteverde. A pilot study done by students during the USF Globalization and Community Health Summer Field School in 2003 was the first to interview households headed by Nicaraguan immigrants in Monteverde. The preliminary findings of this pilot study indicate that Nicaraguan immigrants living in Monteverde have significantly lower educational levels; tend to live in substandard and/or crowded living conditions; tend to be paid lower wages and suffer from job insecurity; and are more likely not to have health coverage compared with their Costa Rican neighbors.

Although the pilot study lacks external validity, the results are consistent with other national level studies including the annual “State of the Nation Report” (Proyecto Estado de la Nación 2002); the International Organization for Migration’s bi-national study of migration between Nicaraguan and Costa Rica (OIM 2001); the Costa Rican Ministry of Health’s report concerning health care in areas of high migration (Ministerio de Salud de Costa Rica 2002); and an independent report about Nicaraguan immigrants in Costa Rica from Marquette (2006). These reports all cite similar tendencies relating to the health and social status of Nicaraguan immigrants living in Costa Rica; the reports emphasize that: 1) 25% of Nicaraguan headed households live poverty; 2) up to 40% of Nicaraguans live in substandard housing; 3) Nicaraguans are more likely than Costa Ricans to be underemployed; 4) over 50% of Nicaraguans do not have CCSS health insurance coverage; and 5) it is believed that Nicaraguans exhibit a higher prevalence of infectious diseases as a result of these health and social inadequacies.

Of special concern here is the disparity in health insurance coverage and its potential impact on health outcomes. In the 1960’s and 1970’s Costa Rica passed a
National Health Plan that mandated universal health care and recognized the populations’ right to health care and the governments obligation to organize and provide health services (Vargas 1995:62). As a result of this policy, today over 90% of Costa Ricans have health insurance coverage through the Costa Rican Social Security Institute (CCSS) while others are covered through private health insurers (Proyecto Estado de la Nación 2002). However, in Costa Rica the idea of access to health care as a human right is not automatically extended to Nicaraguan immigrants, especially those who are in the country illegally. In fact, a Costa Rican Ministry of Health reports sites that without proper documentation, immigrants do not qualify for any CCSS health benefits (except for emergency care), even if they are dependants of legal immigrants or even if they wished to purchase an individual health insurance policy (Ministerio de Salud de Costa Rica 2002).

The contradictions in health policy to provide access to basic health services for one group but exclude other groups are based on ethnicity and immigration status. These inequalities are based on social, historical, and political processes that amount to what Farmer (2005), describes as “structural violence”, where access to health care, like health outcomes, is never randomly distributed across society, but instead is concentrated among certain groups. As a result, this dissertation is interested in linking the units of analysis between health disparities and health outcomes within the context of health policy and social and political economic processes. By doing this, I hope to identify whether health and other disparities exist between Nicaraguan immigrants and Costa Rican residents living in the same community and whether or not they translate into differential health outcomes.

Another concern is that while Costa Rica has been successful at significantly reducing rates of preventable infectious diseases like intestinal parasites and others (Mata 1998), it raises serious concerns over whether the unequal access to basic health care and public health initiatives among Nicaraguan immigrants has implications for the emergence or re-emergence of preventable infectious diseases that ultimately threaten both the immigrant and host populations (Inhorn and Brown 1997; Knobler 2006).
While the context of national health policy, ecotourism development, and immigration forms the basis of this dissertation research; it was my graduate studies in anthropology and public health in addition to my graduate research fellowship at the University of South Florida – Globalization Research Center that were critical in defining the central thesis of this dissertation.

**The USF-Globalization Research Center**

Established in 2001 as part of a four university Globalization Consortium that included UCLA, The University of Hawaii and George Washington University; the University of South Florida - Globalization Research Center (USF-GRC) was created to study the phenomenon of economic, social, and cultural globalization. The primary academic mission of the USF-GRC was to focus research efforts on the effects of and responses to globalization in the overlapping areas of health, water, and development with a geographic concentration on Latin America and the Caribbean. Within this context and in collaboration with the Monteverde Institute the USF-GRC selected a core research project called *The Triangulation Study* to identify and investigate the inter-relationships between ecotourism development in Monteverde, Costa Rica and its affect on local political, economic, and social institutions; the local environment including water resources; and finally on community health including infectious diseases and nutrition.

At the time of this research, the USF-GRC consisted of a center director, Dr. Mark Amen, and three USF faculty research coordinators responsible for coordinating research for *The Triangulation Study* pertaining to their areas of expertise. In this capacity, Dr. Trevor Purcell was the development coordinator; Dr. Linda Whiteford was the health coordinator; and Dr. Mark Stewart was the water resources coordinator. This dissertation research was carried out as part of a three year graduate fellowship (2001-2004) with the USF-GRC during which time I was assigned to work as a research assistant for Dr. Linda Whiteford, the *Triangulation Study* health coordinator.

In my graduate studies at USF, my education as a dual degree student in the Applied Anthropology Ph.D. program with an emphasis in Medical Anthropology, and the M.P.H program in Tropical Public Health and Communicable Diseases combined the
theoretical and methodological frameworks of anthropology and public health. Coursework in anthropological methods, medical anthropology, infectious disease surveillance, emerging infectious diseases and parasitology; in addition to a mixed methods field course and laboratory training in diagnostic parasitology provided me with the methodological and theoretical foundation to better understand and carry out research focusing on the relationships between political economy, the environment, ecotourism development and infectious diseases. A more in depth discussion of my various field experiences and their specific influence on this dissertation will be discussed next.

**Preliminary Studies**

While a graduate fellow at the USF-GRC three experiences helped shape the development of this dissertation research. First, was the opportunity to participate as a Graduate Assistant for the newly created “Globalization, Nutrition and Infectious Disease Field School” in Monteverde, Costa Rica between June and July 2001. The Globalization and Community Health Field School (as it was later called), was collaboration between the USF-GRC, the USF Department of Applied Anthropology, the Monteverde Institute, and the University of Illinois at Chicago School of Public Health. The experience introduced me to the Monteverde community in addition to providing me with a good background in anthropology and public health field methodology.

The second opportunity was part of my required Public Health field experience which I conducted in diagnostic parasitology at the USF Donald L. Price Parasitology Repository and Training Laboratory between 2002 and 2003. During this laboratory experience I worked closely with Dr. Donald L. Price who taught me the fundamentals of diagnostic parasitology including laboratory and field techniques that I would eventually apply in this dissertation research.

The third experience was my involvement on a pilot study called “The Household Management of Health, Water and Waste Project” which was conducted as part of the USF-GRC Triangulation Study. This project was directed by Dr. Linda Whiteford with funding from the Hewlett-Packard Foundation via Michigan State University and the USF-GRC. The purpose of “The Household Management of Health,
Water and Waste Project” was to use Rapid Assessment Procedures (RAP) to analyze the variation of knowledge, attitudes and behaviors relating to household water management, sanitation and wastewater disposal and the potential for its impact on household and environmental health outcomes including water-borne and water-washed infectious diseases among families in the Monteverde Zone.

The results of “The Household Management of Health, Water and Waste Project” helped, in part formulate the objectives and research hypotheses by identifying four topics for dissertation research: 1) that intestinal parasite infections were a commonly reported health problem among participants of the RAP study; 2) that household hygiene and sanitation behaviors along with graywater pollution are likely sources of water-borne, water-washed, and parasitic diseases; 3) that significant differences in health outcomes may exist among Costa Rican residents and Nicaraguan immigrants; and 4) that the community of Santa Elena provided the best field site to study the relationships between these variables.

It was decided that based on the results of “The Household Management of Health, Water and Waste Project” that this dissertation focus on a common community health problem in order to determine whether disparities in health outcomes differed significantly between Nicaraguan immigrants and Costa Rican residents. Specifically, the use of prevalence rates of intestinal parasites as a comparative health outcome between Nicaraguans and Costa Ricans was the result of conversations with members of my dissertation committee; my laboratory training in diagnostic parasitology; and a Monteverde Clinic report (ASIS 2002) citing that parasitic infections, together with diarrhea and gastrointestinal problems account for 6% of all medical consultations at the Monteverde Clinic (second only to consultations relating to acute respiratory infections).

In addition, key informant interviews with physicians at the Monteverde Clinic during data collection for the “The Household Management of Health, Water and Waste Project” in February, 2003 revealed that while parasites are not considered a severe public health threat, it is likely that parasitic infections are considerably underreported. Furthermore no comprehensive study or inventory of intestinal parasitic species, their prevalence, epidemiology, or etiology had been carried out in the Monteverde Zone.
Finally, it is widely accepted among public health scholars and researchers that parasites are good indicators of basic health, in that their presence are closely associated with conditions of poverty, including poor sanitation and hygiene, a lack of wastewater treatment, low levels of education, a lack of health care access, and economic and social alienation (Esrey 1991; Inhorn and Brown 1997; Levine 1995; Mayer 2000; Vecchiato 1997). It was within this scholarly context that the dissertation research topic was created to gather data to compare intestinal parasite prevalence rates between Nicaraguan immigrants and Costa Rican residents within the context of ecotourism development and immigration in the Monteverde Zone.

**Political Ecology as a Framework for Understanding the Prevalence of Intestinal Parasites**

In order to understand the why some populations suffer disproportionately from intestinal parasites compared to other groups it is necessary to move beyond the traditional epidemiological paradigm of host, vector, and ecology in understanding disease etiology by including social and political-economic inquiries (Whiteford and Cortez-Lara 2005). In their book “Globalization, Water and Health” Linda and Scott Whiteford (2005) note that as a result of the complex interactions between global processes and health, anthropologists must be able to make connections between global and local levels of analysis. This dissertation attempts to connect the complex interactions between disparities in parasite prevalence and the political-economic processes of health policy, immigration and ecotourism at the local and national levels by using a political ecology of health framework.

As a theoretical and methodological model, political ecology has been used to explain the historical and political antecedents of environmental degradation and its effects on human social organization (Stonich 1993; 1998). More recently however, political ecology has become a useful tool to better understand how political and environmental interactions affect human health; including nutrition (DeWalt 2003); HIV/AIDS (Singer 2007); infectious disease (Mayer 1996); and water resources management (Whiteford and Whiteford 2005). The political ecology of health framework
was developed out of a synthesis between medical ecology and critical medical anthropology (Baer 1996a; Baer 1996b; Leatherman 1998; McElroy 2009). The growing interest in the ways in which political economic factors interact with environmental and biological agents within the context of local and global realities that have an impact on health outcomes has been of growing interest to medical anthropologists including (Brown 1996; DeWalt 1998; Goodman 1998; Guest 2005; McElroy 2009; Singer 2007; Stonich 1998; Whiteford and Hill 2005).

However, perhaps the best attempt to use political ecology as a framework for better understanding infectious diseases within a political-economic and environmental context comes from Mayer (1996; 2000) whose approach is based in disease ecology. Mayer’s approach attempts to study infectious disease in terms of the interaction between host, vector and agent within the context of human-environment interaction; specifically, how culture, political-economy and biology, including vector and pathogen ecology interact together in an evolving and interactive system to produce a foci of disease. Mayer calls this approach the political ecology of disease (Mayer 1996).

Another focus of the political ecology of health framework that has implications for this dissertation is its emphasis on microlevel and macrolevel linkages that attempt to understand the interconnections between the proximate causes of disease and the social, political-economic, and environmental relations that are the ultimate causes of disease (Baer 2003; Goodman 1998; Mayer 2000; McElroy 2009; Whiteford and Hill 2005). As Goodman and Leatherman (1998) and Whiteford and Whiteford (2005) suggest, this dissertation “focuses upstream” to the larger “macro” level factors that influence parasite prevalence, not least because the results may provide new strategies to prevent disease transmission and provides anthropologists and public health practitioners a framework with which to better understand health outcomes.

Another component of the political ecology of health framework used in this dissertation is the addition of the household ecology of disease transmission framework proposed by Coreil, Whiteford, and Salazar (1996). This framework suggests that, in terms of intestinal parasites, household ecology provides a link between both macro and micro level phenomena by means of defining household ecology as an intermediate
pathway of disease between larger political economic factors and the proximate
determinants of disease including the actual exposure to intestinal parasites.

In light of a political ecology of health framework, this dissertation contextualizes
how political economic processes are linked to disparities in health outcomes between
Nicaraguan immigrants and Costa Rican residents. Specifically, it look at how micro-
level or proximate causes of intestinal parasites (characterized by fecal-oral transmission)
at the household level can be ultimately linked to and contextualized within the political
economic processes of immigration, immigration status, underemployment, access to
credit, home ownership, living conditions, and access to critical health and social
services.

Research Objectives and Methods

The overall objective of this research is to use the prevalence of intestinal
parasites as a basic health indicator to compare health outcomes between Nicaraguan
immigrants and Costa Rican residents in Monteverde within the context of political-
economic, social, and ecological processes. As a result of previous research and the
scholarly literature, the research objectives that form the basis for this dissertation
research are:

- **O-1** Determine the period prevalence of intestinal parasites among the study
  population
- **O-2** Determine the distribution and the most likely sources of infection and
  modes of transmission of intestinal parasites among the study population
- **O-3** Describe the factors associated to the prevalence of intestinal parasites
  among study participants at the individual and household level.
- **O-4** Provide a general political ecological framework that explains the
  prevalence of intestinal parasites among the study population in
  Monteverde, Costa Rica.

As noted by Whiteford and Whiteford (2005) and Inhorn and Brown (1997), the
complexity of the issues relating to the interactions between globalization and health call
for a diversity of methodological strategies. In order to address these research objectives,
this dissertation employs a mixed methods approach that includes both public health and anthropological methods. Public health methods include the following: 1) the collection of fecal samples from both Costa Rican and Nicaraguan study populations; 2) microscopic diagnostic techniques are used to analyze participant fecal samples in order to evaluate the source of infection and mode of transmission of endemic parasites.

Anthropological methods include participant observation, semi-structured, in-depth, and key informant interviews to better understand the cultural, behavioral, and the political-economic context of parasitic infections. In addition, both laboratory analysis and ethnographic methods are used to evaluate the source of infection and mode of transmission of intestinal parasites with the ultimate goal of providing research participants with relevant health education regarding the prevention of intestinal parasites.

Secondary data from the Monteverde Clinic and the Santa Elena Aqueduct are also collected and analyzed for this research. Specifically, data regarding rates of intestinal parasites from the Monteverde Clinic are gathered and compared with the prevalence rates from this study. Finally, publically available data regarding water quality testing of the Monteverde potable water supply is collected from the Santa Elena Aqueduct in order to help determine whether or not water quality plays an important role in parasite transmission.

**Research Findings**

Based on epidemiological data gathered from this research, intestinal parasite infections were significantly underreported by the Monteverde Clinic when compared with prevalence rates of intestinal parasites gathered by this research during the same time period. Underreporting parasites has serious implications for the implementation of local public health campaigns aimed at reducing parasite transmission. However, perhaps the most significant finding of this research was that among the study population, Nicaraguans were five times as likely to have intestinal parasite infections compared to Costa Ricans; constituting a significant health disparity. This finding contradicts the 1996 National Survey of Intestinal Parasites (Mata 1998), which concluded that parasite
prevalence in Costa Rica is below 3% for the population. As such, the results of this research make a contribution to the growing body of Costa Rican public health literature that indicates parasite prevalence rates remain high among marginalized populations in Costa Rica; including indigenous groups (Hernandez-Chavarria 2005), school children in Limon Province (Abrahams-Sandí 2005), and residents living in urban slums in San Jose, Costa Rica (Hernández 1998).

In terms of the principal sources of infection and mode of transmission, the data indicate that intestinal protozoa accounted for 87% of all parasitic infections among the study population; whereas infections with intestinal helminths accounted for only 13% of infections. This evidence strongly suggests that solid waste and wastewater management do not play a significant role in parasite transmission. In addition, the low prevalence of common water-borne intestinal protozoa and the high water quality standards of the Santa Elena Aqueduct indicate that the potable water supply does not play a significant role in transmission. The data also show a relatively high prevalence of the pathogenic amoebae *E. histolytica* and similar commensal intestinal protozoa and that individuals living in household with infected family members are at greater risk of being infected with similar parasites. These results are important because they indicate that among the study population, intestinal parasites are not spread via water-borne transmission, but rather through fecal-oral transmission at the household level; most likely the result of a range of poor hygiene behaviors and poor household sanitation infrastructure. These findings are also important because it establishes an association between Nicaraguan households that are more likely to have poor household sanitation infrastructure, and higher parasite prevalence rates compared to Costa Ricans.

Additional findings suggest that household environmental conditions, namely unsanitary bathroom and kitchen conditions were significantly associated with parasitic infections among individuals regardless of nationality. Data from household surveys show that Nicaraguans were significantly more likely to live in poor household conditions compared to Costa Ricans. Interviews with heads of household revealed that ecotourism development was a significant factor in limiting affordable housing options for Nicaraguan immigrants. For example, Nicaraguans who immigrated to Monteverde
looking for work often find themselves underemployed. Both underemployment and immigration status precludes most Nicaraguan household from access to credit or from receiving housing subsidies. Without credit or government support, many Nicaraguan families have no other choice but to rent substandard housing with inadequate sanitation infrastructure. These factors, coupled with the fact that Nicaraguan households tend to be larger, and thus more crowded, than Costa Rican households provides both the social, behavioral and environmental conditions that promote the transmission of intestinal parasites at the household level.

Another important finding of this research was that regardless of nationality, individuals with no health insurance coverage were more likely to be infected with intestinal parasite compared to individuals with health insurance coverage. Reasons for not having access to health care varied from underemployment to immigration status. However, the fact that Nicaraguans had significantly higher prevalence rates of intestinal parasites can be partially explained by the fact that they were almost 5 times as likely to not have access to health care compared to Costa Ricans. According to interviews with heads of households, a lack of access to health care creates barriers to testing and treatment of intestinal parasites. These finding are important on two levels; first because they support the literature suggesting that access to health care is a associated with health disparities (Singer 2007); and second that Costa Rican health policy which excludes illegal immigrants from access to basic health care may play a role in the emergence of intestinal parasites and other preventable infectious diseases among immigrant populations, and thus inadvertently put the host population at risk (Knobler 2006; Ministerio de Salud de Costa Rica 2002).

In summary, the results of this research support the literature in defining parasitic infections as a “disease of poverty” in that the factors associated with parasitoses correlate with underdevelopment and social injustice (Inhorn and Brown 1997; Knobler 2006; Kreier 2002; Mata 1998; Vecchiato 1997). In addition, the medical anthropology literature related to infectious disease, including intestinal parasites tend to stress the importance of culturally determined beliefs, knowledge and behaviors as integral to increased disease transmission (Green 1999; Inhorn and Brown 1997; Nichter 2008).
However, the data from this research demonstrate a departure from the literature in that research participants exhibited an extremely high level of knowledge about parasites, including their prevention and treatment. This finding is significant because it suggests that political ecological factors best explain the intensity and prevalence of intestinal parasites among the study population than do culturally determined beliefs and knowledge.

**Importance of the Study**

This dissertation research is important on a number of levels. First, this research helps to fill a critical gap in the Costa Rican public health literature by comparing rates of infectious disease between Nicaraguan immigrants and Costa Rican residents and demonstrating that intestinal parasites rates continue to be high among marginalized populations in Costa Rica. As a result, the research helps shed light on one of the most controversial issues facing Costa Rican society; the medical and financial impact of Nicaraguan migrants on Costa Rica’s national health care system. Based on this research, this dissertation suggests policy level recommendations that focus on reducing health disparities by bringing Nicaraguan migrants into the health care system rather than continuing their exclusion.

At the local level, this dissertation provides a glimpse into the health and social situation of the Nicaraguan community in Monteverde, providing invaluable information to local primary health care providers. On an individual level, the research provided a viable option for many Monteverde residents, both Nicaraguan and Costa Rican to get tested for intestinal parasites in addition to providing them with relevant health education that was specifically tailored to their level of health literacy.

This dissertation also contributes to the literature of the anthropology of infectious disease; thus answering a call by Inhorn and Brown (1997) to study infectious diseases as they are manifest in different ecological, cultural and political-economic settings. Specifically, this dissertation exemplifies the relevance of using a political ecology of health framework to help contextualize how the proximate causes of parasitic disease are linked to global phenomena related to ecotourism development in Monteverde, Costa
Rica. Thus, this dissertation demonstrates how the political ecology of health framework can become an invaluable theoretical and methodological perspective in the applied medical anthropology tool kit in its potential to go beyond the proximate associations of disease transmission by suggesting health interventions based on macro level phenomena.
Chapter Two – Review of the Literature

Globalization has been extensively studied during recent decades by scholars in the fields of political science, international relations, and economics. However, Lee (2000a) contends that it has only been since the mid-1990s that health researchers and policy makers have begun to explore the extent to which globalization affects health. This sudden interest has been due, in part, to a shift from an international to a global public health agenda spearheaded by the World Health Organization and other UN related groups (Walt 1998). As a result, the globalization and health literature has grown extensively over the past decade and covers diverse issues such as global health policy (Lee 1998; 2000a; Whiteford and Manderson 2000); international and global health (Banta 2001; Howson 1998); the globalization of public health (Yach 1998a; 1998b); health and global trade (Baris 2000); technology and health care delivery (Chandrasekhar 2001); health equity and inequalities (Farmer 1999; Farmer 2004; Navarro 1999); global health law (Fidler 1998); environmental change and health (Guest 2005; McMichael 1999; 2004); chronic diseases (Beaglehole 2003; Lang 1999); the globalization of water resources and health (Whiteford and Whiteford 2005); the effects of global warming on health (Baer 2009); and emerging and reemerging infectious diseases (Knobler 2006; Kombe 2001; Morse 1995). In short, the health field has been globalized.

Globalization and Health

As in other bodies of literature, health scholars differ in the ways they define the relationship between globalization and health. Specifically, many health scholars seem to define globalization in economic terms. David Dollar, a health scholar at the World Bank, defines globalization in terms of “increased integration of different economies and societies as a result of greater flows of goods, capital, people, and ideas” (2001:827). Similarly, Feachem defines globalization as “openness to trade, to ideas, to investment, to people, and to culture” (2001:504). The tendency of contextualizing globalization and
health in economic terms can, as Cornia (2001) notes, be attributed to the fact that many health researchers tend to view health as an independent variable of economic growth, income distribution, and economic stability (2001).

On the other hand, Waters (2001) provides a more holistic view, saying that “globalization refers to the forging of new global economic, financial, social, cultural, and political links by which societies and nations have been brought into increasingly closer contact and interaction” (2001:80). Other discussions have lead to a debate as to whether globalization has “good” or “bad” effects on human health (Cornia 2001; Dollar 2001; Feachem 2001; Waters 2001). However, Lee (2000a; 2000b) aptly notes that globalization affects groups and individuals in different ways and contends that one of the principal challenges is to better understanding how processes of globalization are affecting people and groups differently and how these inequalities can be ameliorated.

Anthropologists, most notably (Cleveland 2000; Hackenberg 1999; Kearney 1995; Lewellen 2002; Mintz 1998; Tsing 2000) have also been interested in globalization. For the most part, these authors tend to view globalization within a theoretical-historical framework related to classic development studies including Wallerstien’s world systems theory (1974), and Eric Wolf’s “Europe and the People without History” (Wolf 1982). However, anthropologists like Hackenberg and Hackenberg (2004), and Cleveland (2000) have encouraged an applied, practical understanding of globalization in order to focus on how it affects people at the local level. This applied approach is based on Giddens’ view that globalization is the “intensification of worldwide social relations which link distant localities in such a way that local happenings are shaped by events occurring many miles away and vice versa” (Giddens 1990:7).

McElroy and Townsend contend that applied anthropologists are especially interested in how the “global” and “local” levels of analysis are affected by and interact with each other and how they come to impact people’s lives (McElroy 2009). This is especially true of medical anthropologists who are specifically interested in how the processes of globalization have local level implication in terms of political-economic, cultural and environmental change, which in turn, can affect human health. This interest
is expressed in the growing medical anthropology literature including Whiteford and Manderson (2000), Whiteford and Whiteford (2005), Goodman and Leatherman (1998), Guest (2005), Baer and Singer (2003; 2009), and McElroy and Townsend (2009).

While health scholars and medical anthropologists are interested in better understanding and analyzing how the processes of globalization are affecting health, perhaps the best attempt to create a working framework for conceptualizing the relationship between globalization and health comes from Lee (2000a; 2000b). First, Lee identifies three key features of globalization that distinguish it from other similar phenomena: 1) that globalization should be understood as a process rather than an object or outcome. In this respect, Lee contends that the processes of globalization are changing the nature of human interaction by eroding boundaries of time and space that separate individuals and societies; emphasizing that these processes are not new, but in fact are part of a much longer historical process; 2) that globalization is a social rather than natural process; that it is actually driven by individual and collective actions and therefore can ultimately be guided and controlled; and 3) that globalization impacts individuals and groups differently; there are both winners and losers. Lee further contends that one of the principal challenges is better understanding how processes of globalization is affecting people and groups differently and how these inequalities can be ameliorated (Lee 2000a; 2000b). From this discussion Lee defines globalization as “a process which is changing the nature of human interaction across a wide range of spheres including the economic, political, social, technological and environmental” (Lee 2000a:19).

In terms of the spheres of globalization, Lee (2000b) explains that the economic sphere concerns the creation of a global economy, characterized by greater trade in goods and increased labor mobility. The political sphere concerns the distribution of power and emerging forms of political representation and authority. The social sphere relates to what some scholars call “global community”, that is, the proliferation of cultural values, beliefs and ideas through channels of mass media. The technological sphere can be understood as the development and application of knowledge in industry, commerce, science and art. Finally the environmental sphere concerns how local environments are
affected by the global. For instance, how economic, social, and technological spheres can positively or adversely affect our physical environment (i.e., climate change and the global environmental movement) (Lee 2000b). With this basic definition and framework of globalization in place it is possible to explore how the processes of globalization can have a potential affect on the determinants of health and, in turn, on crucial areas of public health.

Health researchers and anthropologists have published widely concerning the impact that the processes of globalization have on different health outcomes. For example, a lot of attention has been given to the way globalization affects non-communicable diseases such as cancer, diabetes and cardiovascular disease. Beaglehole (2003), Bettcher (2000) and Lang (1999) have focused on the impact of diets high in saturated fat, sugars and low in complex carbohydrates in addition to reduced physical activity which are associated with an increased rates of obesity; a know risk factor for chronic heart disease and diabetes. Similarly, David Himmergreen et al. (2006) has studied the effects of ecotourism development on food security and nutrition in rural Costa Rica, while Daltabuit and Leatherman (1998) studied the effects of tourism on nutrition among the Maya in Mexico. Finally, Yach (1999) has focused on the effects of the global marketing of tobacco and alcohol, while Loewenson (2001) has focused on environmental carcinogens in relation to cardiovascular disease.

While the implications regarding the effects of globalization on non-communicable diseases are far reaching and complex, this dissertation will focus attention on the impact that globalization has on infectious diseases with particular attention given to intestinal parasites.

**Globalization and Infectious Diseases**

As discussed earlier, globalization affects the processes of human interaction across political, economic, social, technological, and environmental spheres thus making it an important determinant of infectious disease outcomes. Health researchers have become increasingly interested in the direct and indirect links between globalization and infectious disease (Barrett 1998; Cash 2000; CDC 2002; Davis 2001; Knobler 2006;
Kombe 2001; McMichael 2001; Saker 2004). Of particular concern is that globalization is impacting the epidemiology and specific risk factors associated with many infectious diseases in addition to our capacity to prevent, control, and treat those diseases (Saker 2004). The World Health Organization (2004) reports that while morbidity from non-communicable diseases is high, infectious diseases still account for a large proportion of mortality worldwide. For example, infectious diseases remain the most important cause of ill health in developing regions (WHO 2004). Not surprisingly, they have a considerable higher burden on low-income countries compared to high-income countries (Gwatkin 1999). David Satcher (1995), former director of the CDC, comments that in addition to their human burden, infectious diseases deplete scarce economic and social resources, impede development, and contribute to global instability (1995).

Based on Lee’s (2000b) definition, globalization is driven and constrained by a number of factors including political-economic processes, social and cultural factors, technological developments, and environmental changes. According to Woodward et al. (2001), these spheres of globalization have both direct and indirect impacts on health at a number of different levels. For example, Saker (2004) explains that globalization can affect health status through economic changes that are reflected in living conditions and government expenditure on sanitation infrastructure and access to health care. Mayer (2006) adds that environmental changes affect vector ecologies through deforestation, the construction of dams, and rapid urbanization. In turn, these factors can promote the mass migration of people from one region to another and provide an opportunity for pathogens to come into contact with new populations (Mayer 2006; Saker 2004).

In general, experts contend that there are five major aspects of globalization that both directly and indirectly affect infectious diseases: economic, demographic, technological, political economic and environmental change (Guest 2005; Knobler 2006; Saker 2004). However, Saker et al. (2004) cautions that this categorization of the processes of globalization and their affect on health is over simplistic; when in fact globalization is a complex set of interrelated processes. For example, the links between environmental change, immigration and infectious disease have antecedents in, and must be understood within a political economic context. With this in mind, Sacker et al. (2005)
point out that it is useful to consider each sphere or aspect of globalization in terms of risk factors, epidemiology and disease transmission.

Knobler et al. (2006) and Sacker (2005) broadly refer to economic globalization as the increasing linkages of the world’s financial system resulting in the restructuring of a new world economy. This new world economy is characterized by neoliberal free trade agreements and the accessibility of capital through centralized lending banks including the IMF (International Monetary Fund) and the World Bank. While it is outside the scope of this dissertation to discuss the implications of economic globalization on human health, suffice it to say that it has far reaching implications on the other aspects of globalization including demographics, environmental change, and politics. For example, Guest (2005) notes the linkages between economic globalization and political economy stating that the loss of governmental power to multinational corporations, who often ignore labor and environmental laws, pose serious implications for human health. For an in-depth discussion on how economic policies including those of various free trade agreements, the IMF and the World Bank see the book “Dying for Growth: Global Inequality and the Health of the Poor” by Yong Kim et al. (2000).

Of critical importance to the epidemiology of infectious diseases is the environment, precisely because it acts as regulator of interactions between humans and pathogens. The environment in this case not only refers to the natural environment, but also to built and social environments. The implications of environmental change on the epidemiology of infectious diseases are diverse and far reaching. Morse (1995), notes that ecological changes related to economic development, global warming, changes in land use, and changes in water resources management contribute to the emergence and re-emergence of infectious diseases. For example, climate change is likely to expand the geographical distribution of several vector borne diseases including malaria, dengue, and leishmaniasis (Satcher 1995), while dam construction and irrigation projects have increased the prevalence of schistosomiasis (Strickland 1982). Finally, McMichael (2001; 2004) suggests that the worldwide incidence of diarrhea may increase with global warming.
Changes in global environmental conditions can derive from natural disasters that in turn can create health emergencies due to a sudden lack of clean water, sanitation and basic health services. For example, Whiteford and Tobin (2004) studied the increased incidence of acute respiratory infections due to ash fallout of recently activated volcanoes in Ecuador. While these natural disasters are generally dealt with by national governments, they can prompt the mass migrations of people into neighboring countries leading to increased environmental damage and in turn serious health risks such as cholera and dysentery. Such was the case after hurricane Mitch where thousands of Nicaraguan migrants sought relief in Costa Rica (Ministerio de Salud de Costa Rica 2002). For an in-depth discussion on the implications of environmental change on the epidemiology of infectious diseases see Sacker et al. (2004).

One of the most conspicuous manifestations of globalization with specific implications for infectious diseases and this dissertation is population mobility. While humans have always been on the move, migration over the past 50 years has been unprecedented in terms of the volume, speed, and geographical range of travel. It was estimated that in 2000, some 185 million people were living outside of the country of their birth. While the causes and reasons of migration are complex, people most often move in search of a better life and employment opportunities, or to escape an insecure situation (UNFPA 2003).

Knobler et al. (2006) states that migrant populations are among the most vulnerable to emerging and re-emerging infectious disease and are often implicated as a key factor in the spread of infectious diseases around the globe. Indeed, migrant health remains one of the major unresolved public health issues worldwide. According to Knobler et al. (2006) migrant population are more vulnerable to infectious diseases for several reasons: first, because they often lack access to health care and social services in the receiving countries; second, migrant populations are more subject to social instability, poverty, discrimination, and lack legal protections; and third, behavioral changes can also place migrants at higher risk of infectious diseases. In addition, immigration brings people into contact with new microbes and vectors which can increase the risk of spreading infectious to both migrant and host populations (Knobler 2006; Saker 2004).
Intestinal Parasites

Apart from economic, social, demographic and environmental change, the extent to which the processes of globalization affect the epidemiology of infectious diseases also depends on the specific characteristics of the disease pathogen. A variety of pathogens cause human infection including viruses, bacteria, and parasites. This dissertation focuses on one group of pathogens known as intestinal parasites. The following is a discussion that provides the reader with a basic understanding of intestinal parasites and how their transmission is influenced by processes of globalization.

Key Concepts and Definitions

In the field of parasitology, the term symbiosis refers to the relationship or association (primarily for acquiring food) between two animals of a different species. One form of symbiosis is called parasitism in which one animal, the host, is injured as a result of the activities of the other animal (the parasite). Another form of symbiosis is called commensalism, meaning a relationship that is beneficial for one species and at least not harmful for the other species (Markell 1999). In this dissertation, such organisms are referred to as *commensals*. In addition, this dissertation only deals with the intestinal parasites and commensals of humans, of which two phyla are considered: the helminths and the protozoa. The helminths or “worms” are a diverse group of multicellular parasitic animals. There are four phyla of helminths, but only two of these are considered to be important parasites of humans; the *Platyhelminthes*, known as flatworms; and *Nematoda*, known as round worms (Price 1994). In this dissertation, the word helminth or intestinal helminth will be used to describe species of either phylum; whereas individual species will be called by their *Genus species* name (i.e., *Taenia solium* – Common Tapeworm).

Intestinal protozoa are unicellular animals that commonly parasitize humans. The protozoa are represented in four groups: intestinal amoebae, intestinal ciliates, intestinal flagellates, and intestinal coccidia (Price 1994). Based on the results of this dissertation, only two of these groups were present; parasitic and commensal species of intestinal
amoebae and intestinal flagellates. In this dissertation, the word “intestinal protozoa” will be used to generally describe species of either group; whereas individual species will be called by their Genus species name (i.e., *Entamoeba histolytica* – Intestinal amoebae).

**Sources of Infection and Modes of Transmission:**

One of the obvious requirements of parasitism is the continuation of the parasite's life-cycle which includes effectively exiting one host and entering a susceptible host. To do this, the parasite must produce an infective stage that must eventually find its way into a different susceptible host and cause infection. For example, the amoeba *Entamoeba histolytica* produces an infective cyst that is passed in human feces, which, when inadvertently ingested by another susceptible host can produce an infection. Thus, opportunities for contact between parasite and susceptible host and subsequent infection are necessary for the successful continuation of the parasite’s life-cycle. Parasites have evolved both simple and extremely complex mechanisms in order to accomplish this goal (Price 1994; 2003).

In most cases, parasites reach the host through the external environment via a variety of transmission systems. This process can be understood in terms of the “source of infection” and the “mode of transmission” and must be understood within the context of the environment, human behavior and the broad processes of globalization discussed earlier. The mode of transmission influences which factors have an effect on the spread of the parasite to its human host and are essential for understanding the underlying risk factors of parasitic infections and their effective control (Price 2003; Saker 2004). According to Dr. Donald L. Price (Price 1994; 2003), the source of infection refers to the medium (water, soil, food, utensils, etc.) or the host organism (vector, or intermediate host) on which or in which the infective stage of the parasite is found. The mode of transmission refers to the precise circumstances and means by which the infective stage is able to come in contact with, gain entry to, and initiate an infection within the host (Price 1994; 2003).

In general, there are three types of sources of the infective stage of parasites, however, only the first two are relevant to intestinal parasites. First, “contaminated
sources” are those where the infective stage of the parasite is located. Usually this type of source is an inanimate object such as food, water, kitchen surfaces, or eating utensils that have come into contact with human feces carrying the infective stage of the parasite. Subsequently, if the infective stage of the parasite is immediately infective when passed in the feces it is called an immediately infective contaminated source (cysts of *Entamoeba histolytica* and *Giardia lamblia* are such examples). In some cases, the infective stage is not immediately infective when it is passed with the feces. For example, the eggs of the helminth *Ascaris lumbricoides* must develop to the infective stage outside the body of the host (usually in soil). This process can take anywhere from a couple days to several months depending on environmental conditions. This type of source is known as a “delayed infective contaminated source.”

The second type of source is called an “infested source” and refers to those where the infective stage of the parasite is free living and can actively move about; in this case, the infested source is usually water, vegetation or soil. For example, the eggs of the helminth *Necator americanus* (hookworm) that are passed in human feces are not the infective form of the parasite. Instead, the eggs must hatch and develop into an infective third stage filariform juvenile which is the infective stage of the parasite. These juveniles then move about in the soil or grass looking for a suitable host which they then penetrate through the skin, enter the body and continue their development. In this case, the soil or vegetation on which the infective juveniles move about is considered an “infested source of infection” (Price 2003).

According to Dr. Donald L. Price (Price 2003) there are two kinds of transmission mechanisms: “passive transmission” and “active transmission”. Passive transmission refers to the fact that neither the infective agent itself nor the host or vector on which the infective stage infection resides plays an active role in transmission, and thus only the actions or behavior of the susceptible individual play a role in infection. Usually this is done when the susceptible individual inadvertently ingests the infective stage of the parasite regardless of whether it resides on an inanimate object or within an intermediate host. Drinking water containing cysts of *Giardia lamblia* would be considered passive transmission of an immediately infective contaminated source. Another example involves
eating food contaminated with cysts of *Entamoeba histolytica*, which would also be considered passive transmission. Finally, ingesting eggs of the helminth *Ascaris lumbricoides* that reside on food or soil would be considered passive transmission of a delayed infective contaminated source since the eggs are not immediately infected but must develop into the infective stage in the soil for a specific period of time (Levine 1995; Olsen 1967; Price 2003).

The transmission of parasites like *Giardia lamblia, Entamoeba histolytica,* and *Ascaris lumbricoides* is often referred to as “fecal-oral transmission” because the infective stage of the parasites are passed in human feces and must be ingested by another susceptible host. In addition, the infective stage of these parasites can also make their way into human water supplies. Thus, a susceptible host can become infected by drinking water contaminated with the infective stage of the parasite; this form of transmission is often referred to as “water-born transmission”. Although fecal-oral transmission and water-born transmission of intestinal parasites are essentially the same, the distinction becomes important in terms of control and prevention efforts.

In contrast to passive transmission, active transmission implies that the infective stage of the parasite actively pursues and enters the susceptible individual. The only example of active transmission in relation to intestinal parasites is that of several helminth species. For example, hookworm juveniles living in the soil actively seek out and penetrate a suitable host through the skin in order to establish infections. This is an example of active transmission of an infested source (Price 2003).

**The Natural Environment and the Distribution of Parasites:**

For several reasons, the distribution of parasites is highly sensitive to their environment. First, their ability to survive and multiply is heavily dependent on climatic conditions; second, the local environmental conditions must also support the survival of both humans and in some cases a secondary host and or vector; third, the environment must support the means for the parasite to come into contact with the host. For example, parasites that require a special type of intermediate host such as a mollusk in the case of Schistosomiasis, or vectors such as the tsetse fly in the case of African Trypanosomiasis
are limited to the particular environmental and geographic distribution of that intermediate host or vector. In contrast, intestinal parasites such as *Entamoeba histolytica* and some helminths that only require an infected and susceptible human host are ubiquitous where human overcrowding is present, where clean potable water, human waste management, and basic sanitation is lacking. As a result, intestinal parasites have the greatest geographical distribution compared to other kinds of parasites (Price 1994; 2003; Saker 2004).

In addition, understanding the source of infection, mode of transmission and the unique environmental factors associated with certain parasites also helps in understanding how infections can be controlled and prevented. For example, eliminating sources of infection and interrupting the transmission of parasites to susceptible hosts will prevent the parasite from spreading. Also, treatment of an infected individual prevents the parasite from being spread to another person.

In many cases, however, it is not the environmental conditions alone that determine an increased or decreased risk of transmission but rather a combination of environment, human ecology, and human behavior, which together create risk factors for parasitic infections.

**Human Ecology and Behavior in the Transmission of Parasites:**

Apart from the source of infection and mode of transmission, human ecology and human behavior are important risk factors in the transmission of intestinal parasites. According to Levine (1995), while sources of infection and modes of transmission remain relatively finite, the processes by which human ecology and behavior influences disease transmission are nearly infinite. Parasites, like other infectious agents do not just infect people randomly; rather, infection is usually the culmination of specific interactions of biology, human ecology, and behavior in time and space. While the etiology of most parasitic diseases are well understood, we are far from being able to understand and deal effectively with the impact human behavior and ecology has on the transmission, incidence and spread of parasites (Levine 1995). The following are factors
related to human ecology and behavior that increase the risk of transmission of parasites among human populations.

**Personal Hygiene and Waste Management:**

Personal hygiene and waste management is perhaps the most important factor contributing to the transmission of intestinal parasites. Touching or handling food or objects such as utensils, plates and doorknobs without proper hand washing and waste disposal can easily place a household at risk for any number of parasites that are transmitted in the feces. The practice of improper disposal of human excrement including open-air defecation and using human waste as a fertilizer also increases the risk of transmission (Byers 2001). In these cases, passive transmission of a contaminated source is commonly observed in crowded living conditions where there is a lack of hand washing, waste disposal, potable water, and general sanitation (Girges 1949; Price 1994; 2003). Some studies have pointed to the fact that water insecurity (not having sufficient water for domestic use on a regular basis) decreases the frequency with which people wash their hands and utensils; thus creating a situation of increased risk for fecal-oral transmission of intestinal parasites (Ennis-McMillan 2001).

**Water – Supply, Distribution & Management:**

For many parasites, water is an excellent source and vehicle of transmission. Parasites such as *Giardia lamblia* (Craun 1978) and *Cryptosporidium parvum* (Schmunis 2002) are primarily spread through water distribution systems and have been implicated with large outbreaks. Infections with *G. lamblia* have been attributed to faulty purification or chlorination systems and untreated water. Another concern is that the cysts of *G. lamblia* and the oocysts of *Cryptosporidium parvum* are said to be resistant to chlorine treatment creating the potential risk for all people in the distribution system (Byers 2001). The case of cryptosporidiosis that affected some 300,000 people in Milwaukee is an excellent example (Mayer 2000). Similarly, in places where leaks in water distribution pipes are common, the distribution systems itself can be a source of infection. It has been shown that main breaks, sudden changes in demand, pump outages,
or power failures create transient pressure events (excessive positive or negative pressure within the water pipe). Negative pressure transients cause suction whereby leaks in the pipeline provide a potential portal of entry of contaminated groundwater into treated drinking water. This situation is especially problematic where open defecation is common (LeChevallier 2003). According to Schmunis (2002) *Cryptosporidium parvum* is often transmitted by contact and subsequent ingestion with surface water run-off contaminated by feces of infective cattle (Schmunis 2002). This is a particular concern in Monteverde, Costa Rica where cattle freely roam the country side near water distribution pipes and holding tanks.

**Travel, Migration, and Transportation:**

The globalization of the world economy has made it possible for goods and people to transverse the world in a remarkably short period of time creating an interdependency of virtually all regions of the world. People traveling from one area to another can introduce a disease to a particular region or become infected and return home to serve as a source of infection to others (Knobler 2006; Saker 2004). Large scale migration from areas of high endemicity to areas of low endemicity can also spread parasitic diseases. Faust (1949) asserts that hookworm and schistosomiasis were introduced to the new world through the slave trade. Similarly, a Costa Rican Ministry of Health report cited that the incidence of malaria increased among Costa Ricans living in a Northern Costa Rica shortly after the area had been inundated by Nicaraguan refugees coming from areas of high malaria endemicity after Hurricane Mitch in 1998 (Ministerio de Salud de Costa Rica 2002).

**Urbanization:**

Migration, as a result of economic insecurity, political instability, or violence from armed conflicts can result in rapid, and in many cases unplanned development of urban and peri-urban areas. In the developing world, local governments are often not able to deal with the influx of people in terms of basic services including health care, infrastructure, and employment. The resulting poverty creates many risk factors for
disease transmission including high population densities and crowding, lack of potable water and waste management, poor nutritional status, and low education levels. All of these factors have been demonstrated to increase disease transmission of intestinal parasites (Esrey 1991; Levine 1995).

**Human Culture and Behavior:**

For many reasons, human culture and behavior has important implications for the spread of infectious disease, including parasitic diseases, in terms of the interactions between infectious agents, their human or reservoir hosts and the environment. Indeed, the links between human behavior and the mode of transmission of infectious agents has been well documented in the literature (Brown 1996; Dunn 1986; Geissler 1998; Inhorn and Brown 1997; Levine 1995; Vecchiato 1997).

The influence that culturally coded patterns of behavior have on the transmission of infectious disease is far reaching and, like culture, constantly changing. Arguably, understanding the cultural practices, beliefs, and values of humans in relation to disease transmission is as important as understanding the specific biological life-cycle and ecology of the parasite itself. Without a comprehensive knowledge of culture and its relation to disease transmission all other measures to control parasitic disease, including vector control and sanitation programs will be of little value. Thus anthropology, with its wide disciplinary boundaries is in a place to provide critical contributions to better understand and prevent infectious diseases of all kinds (Inhorn and Brown 1997).

**Anthropology and Parasitic Diseases**

While anthropologists have been conducting research on infectious diseases, mostly as consultants or cultural brokers on international health teams for some time, it was not until the early 1980’s that the field of anthropology of infectious disease was formalized (Brown 1981; Schwartz 1979). This group defined the anthropology of infectious disease as the broad area that deals with the relationships among sociocultural, biological, and ecological variables and the etiology, prevalence and incidence of infectious disease. Furthermore, the group considered the theoretical and applied aspects
of interdisciplinary issues of anthropologists and health scientists in the fields of epidemiology, environmental health, and parasitology in addition to dealing with health planning, prevention and health education (Schwartz 1979).

Inhorn and Brown (1997) identify three principal domains of anthropological research in infectious disease; biological approaches, ecological approaches, and sociocultural approaches. Biological approaches to infectious diseases include both micro-evolutionary and macro-evolutionary studies. The former focuses on human adaptive or genetic factors that may confer resistance or immunity to infection; the condition known as sickle-cell trait and its role in conferring resistance to Malaria is one example. The latter focuses on understanding epidemiological disease patterns in prehistoric and historic human populations; the impact of disease on indigenous populations through colonization is one example of this kind of research (1997).

Ecological approaches, according to Inhorn and Brown (1997) focus on the interaction between pathogen and host in a given environmental context. Classic disease ecology developed by May (1958) considered both the physical and sociocultural aspects of the environment which, together with disease pathogens, human hosts and the cultural/behavioral aspects of the host interact to form a loci of disease. A classic example of disease ecology was the spread of schistosomiasis around the Nile delta region after the building of the Aswan dam which seriously altered water resource ecology (Heyneman 1984).

Finally, the sociocultural approach to infectious disease focuses on the importance of understanding culturally based behavioral practices and perceptions and their affect on the transmission of disease pathogens (Inhorn and Brown 1997). The early work of Alland (1969) and Dunn (1979) examined and classified health behavior in terms of their effect on the transmission of infectious disease agents. Ethnomedical studies of infectious diseases went beyond that of traditional socio-behavioral studies to ask why people behave the way they do, since any effort to change behavior must be based on such knowledge. Some examples of ethnomedical research related to this dissertation relates to the work done on folk beliefs related to the diagnosis, prevention, and health seeking behavior of diarrheal illnesses (Kendall 1988; Nations and Rebhun 1988; Scrimshaw and
For a comprehensive review of the literature relating to anthropology and infectious diseases see Inhorn and Brown (1997) and Brown et al. (1996). Relevant to this dissertation, it is important to note that while anthropologists have conducted research on the vast majority of infectious disease, relatively few anthropologists have specifically studied intestinal parasites. Some examples include Moffat (2003) who studied the effects of intestinal parasite infections on child growth in Nepal. In terms of ecological approaches Alland (1969), Brown (1987; 1996), and Levine (1995) have discussed intestinal parasites, especially helminth infections, within a disease ecology perspective. Much more common have been sociocultural or ethnomedical studies of intestinal parasites; again, the majority of which deal with intestinal helminths. For example, Dunn’s (1979) classic article identifies behavioral categories that impact the mode of transmission and their relevance for disease prevention along with providing methodological suggestions for studying human behavior. Other researchers Geissler (1998; Green 1999; Vecchiato 1997) have conducted on ethnomedical studies on the perceptions and beliefs of intestinal worms in different cultural contexts. Finally, Logan and colleagues conducted an intestinal parasite prevalence study to determine how well participants implemented health education messages designed to prevent cholera (Faulkner 2003). While the anthropological contributions to the study of intestinal parasites has been minimal compared to that of other infectious disease, the contributions of anthropological research on disease control and prevention have been significant (Manderson 1998).

**Political Ecology as a Framework for Understanding Infectious Diseases**

Understanding the links and interrelations between political-economic, social, and environmental variables that affect human health demands the ability to contextualize these variables among local, regional, national, and international levels. This agenda also necessitates using a multidisciplinary approach which includes the social, health and natural sciences. Subsequently, a theoretical and methodological framework that addresses these concerns must be employed, specifically, one that looks at social, political, environmental, and health phenomena within various levels of analysis. With
this objective, this dissertation employs political ecology as a theoretical and methodological framework. While political ecology has its roots in anthropology and geography, political ecology has mainly been employed within geography to provide an explanatory model of land and environmental degradation within a social and political context (Blaikie 1988; Stonich 1993). Recently however, political ecology has emerged as a useful tool to better understand the political-economic context of environmental changes and subsequent health implications (Turshen 1977; 1984).

As a theoretical framework, political ecology is an integrative approach that intersects a variety of academic disciplines. However, two principal theoretical paradigms have most influenced the development of political ecology. These include political economy and cultural ecology. Political economy focuses on the link between power and production and human/cultural ecology, with its broader focus on bio-environmental relationships (Greenberg 1994). As further explained by Stonich (1993), the political economic model seeks to understand and explain the roles that social and political institutions (at local, regional, national and international levels) play in creating limitations and/or opportunities that influence human agency, which in turn affect those same institutions as well as the natural environment and human health. Similarly, cultural ecology takes into account several factors such as human demographics, environmental concerns, as well as health and nutrition, all factors which affect both social and political institutions (Stonich 1993).

According to Bryant (1998), the political ecology approach developed out of the perceived lack of political analysis and context in environmental research (Bryant 1993; Peet 1996) as well as the fact that political economy gave scant attention to ecological factors that influence social and political organization (Bryant 1992). The integration of ecology and environmental concerns with political economy has been utilized in several studies to provide an explanatory model of how social, economic, and political processes affect the way in which natural resources are used and distributed (Schmink 1987; Sheridan 1988; Stonich 1993), while others have used the model to explain and understand environmental destruction in the third world (Blaikie 1987; Little 1987; Redclift 1984).
The eminent anthropologist Eric Wolf has been credited with coining the term “political ecology” based on a critique of ecological anthropology; citing that local ecological contexts needed to be elucidated within a wider political economy (Wolf 1972). However, Wolf never elaborated on using political ecology within a theoretical or methodological framework. Instead, researchers in geography have been credited with developing a theoretical and methodological model based in political ecology to understand the political and social reasons for environmental destruction and land degradation. Most notably, Blaikie (1985; 1988) and Blaikie and Brookfield (1987) have been credited for developing political ecology as a theory and method for studying land degradation.

Of interest of this dissertation is how the processes of globalization affect rates of parasitic infections within a context of ecotourism development and immigration. While little research has been done on the effects of tourism development on infectious disease and immigration, several studies have used political ecology to examine the environmental and health consequences of tourism within the context of water resources management, most notable from Stonich (1998); Stonich et al. (1998) and Hunter (1995). In addition, numerous studies have been conducted showing that tourism development has affected local water quality due to improper disposal of human waste (Archer 1985; Hunter 1995; Kocasoy 1989; 1995). Tourism has also been cited as a major consumer of scarce water resources and in many places the tourism industry and the local community compete for water resources and water access (Miller 1991). However, these studies stop short of liking issues of water resources management and rates of infectious disease.

**The Political Ecology of Health**

As expressed by Mayer (1996), political ecology has seldom been used as framework to understand patterns of health and disease. However, since political ecology focuses on political interests, social institutions, and human-environment interaction this approach has great potential leading to a greater systematic understanding of health and disease.
While medical anthropology has been instrumental in developing an ecological/evolutionary approach to health on one side, and a political-economy of health approach on the other, rarely have these concepts been synthesized to encompass a theoretical and methodological framework. However, the term political ecology has been used to suggest a revision of the ecological/evolutionary approach that incorporates political-economic forces and social relations into the analysis of health (Baer 1996a; Baer 1996b; McElroy 2009a). Recently, political ecology has become a useful tool to better understand how political and environmental interactions affect human health; including nutrition (DeWalt 2003); HIV/AIDS (Singer 2007); infectious disease (Mayer 1996); and water resources management (Whiteford and Whiteford 2005).

The political ecology of health was developed out of a synthesis between medical ecology and critical medical anthropology (Baer 1996a; Baer 1996b; Leatherman 1998; McElroy 2009). Baer (1996a; 1996b) states that the synthesis developed out of the realization that medical ecology tends to downplay the political-economic factors that affect health and that critical medical anthropology has paid little attention to ecological factors that affect human health (1996a; 1996b). This idea was first championed by Turshen (1977; 1984) who critiqued the ecology of disease framework (which used the classic epidemiological triad of host, pathogen, and environment) as being inadequate because it failed to consider the political-economic factors which she considered the ultimate causes of disease. As such, the growing interest in the ways in which political economic factors interact with environmental and biological agents within the context of local and global realities that have an impact on health outcomes has been of growing interest to medical anthropologists including (Brown 1996; DeWalt 1998; Goodman 1998; Guest 2005; McElroy 2009; Singer 2007; Stonich 1998; Whiteford and Cortez-Lara 2005).

Influenced by Turshen’s work, probably the best attempt to develop a framework of analysis using a political ecology of health model has come out of medical geography (Gatrell 2002; Mayer 1996; 2000; Meade 1988). This approach is based in disease ecology, which attempts to study disease in the context of human-environment interaction. This approach primarily concerns itself with “understanding how humans,
including culture, society and behavior; the physical world, including topography, vegetation, and climate; and biology, including vector and pathogen ecology, interact together in an evolving and interactive system, to produce foci of disease” (Mayer 1996).

**Political Ecology as a Framework for Studying Intestinal Parasites**

In order to understand why some populations suffer disproportionately from intestinal parasites compared to other groups it is necessary to move beyond the traditional epidemiological paradigm of host, vector, and ecology in understanding disease etiology by including social and political-economic inquiries (Whiteford and Cortez-Lara 2005). In their book “*Globalization, Water and Health*” Linda and Scott Whiteford (2005) note that as a result of the complex interactions between global processes and health, anthropologists must be able to make connections between global and local levels of analysis. This dissertation attempts to connect the complex interactions between disparities in parasite prevalence and the political-economic processes of health policy, immigration and ecotourism at the local and national levels by using a political ecology of health framework.

Perhaps the best attempt to use political ecology as a framework for better understanding infectious diseases within a political-economic and environmental context comes from Mayer (1996; 2000) whose approach is based in disease ecology. Mayer’s approach attempts to study infectious disease in terms of the interaction between host, vector and agent within the context of human-environment interaction; specifically, how culture, political-economy and biology, including vector and pathogen ecology interact together in an evolving and interactive system to produce a foci of disease. Mayer calls this approach the political ecology of disease (Mayer 1996).

Another focus of the political ecology of health framework that has implications for this dissertation is its emphasis on microlevel and macrolevel linkages that attempt to understand the interconnections between the proximate causes of disease (fecal-oral transmission) and the social, political-economic, and environmental relations that are the ultimate causes of disease (Baer 2003; Goodman 1998; Mayer 2000; McElroy 2009; Whiteford and Whiteford 2005). As Goodman and Leatherman (1998) and Whiteford and
Whiteford (2005) suggest, this dissertation “focuses upstream” to the larger “macro” level factors that influence parasite prevalence, not least because the results may provide new strategies to prevent disease transmission and provides anthropologists and public health practitioners a framework with which to better understand health outcomes.

Another component of the political ecology of health framework used in this dissertation is the addition of the household ecology of disease transmission framework proposed by Coreil, Whiteford, and Salazar (1996). This framework suggests that, in terms of intestinal parasites, the household ecology model provides a link between both macro and micro level phenomena by means of defining household ecology as an intermediate pathway of disease between larger political economic factors and the proximate determinants of disease including the actual exposure to intestinal parasites.

In light of a political ecology of health framework, this dissertation contextualizes how political economic processes are linked to disparities in health outcomes between Nicaraguan immigrants and Costa Rican residents. Specifically, it look at how micro-level or proximate causes of intestinal parasites characterized by fecal-oral transmission at the household level can be ultimately linked to and contextualized within the political economic processes of immigration, immigration status, underemployment, access to credit, home ownership, living conditions, and access to critical health and social services.
Chapter Three – Description of the Research Site

This chapter provides a brief description of Costa Rica and of the research site of Monteverde. However, because of this dissertation’s interest in issues of health access, environmental health and immigration, the crux of this chapter will focus on the Costa Rican health care system as well as health care issues both on the national and local levels. In that sense, this chapter will provide the reader with a better understanding of Costa Rican health care policy and organization with special attention to issues critical to this dissertation; specifically that of access to health care, water resources management, and the health of Nicaraguan immigrants.

A Brief Look at Costa Rica

The Republic of Costa Rica is a country in Central America that shares borders with Nicaragua to the northwest and Panama to the southeast. Costa Rica enjoys two coastal regions with the Caribbean Sea to the east and the Pacific Ocean to the west (see Figure 3-1). With a total land mass of only 51,000 square kilometers, Costa Rica is slightly smaller that the US State of West Virginia. The estimated population in 2000 was 3.8 million (PAHO 2002) and had an estimated 2009 population of just over 4.2 million (CIA 2009). The country is divided into seven provinces, San Jose, Alajuela, Heredia, Cartago, Puntarenas, Limon and Guanacaste which are further divided into 81 second-level administrative areas called cantons which are further divided into districts (note that the cantons posses local governments called municipalities). For example, the dissertation research site of Santa Elena is located in the province of Puntarenas, Canton Central, District Ten. In terms of health, the Costa Rican Ministry of Health divides the country into 83 health areas, of which Santa Elena and Monteverde are located in the health area number three (ASIS 2002; CIA 2009; PAHO 2002).
Since its independence in 1838, Costa Rica, in stark contrast to its Central American neighbors has enjoyed a deeply rooted democratic tradition with stable political systems in which transparent elections are held every four years (PAHO 2002). Among its unique and well know characteristics, Costa Rica is known as Latin America’s most environmentally friendly country; characterized by 5% of the world’s biodiversity and an increasing pattern of environmental resource protection where over 25% of its land is under protection (The Nature Conservancy 2009). Environmental protection has also had economic dividends; tourism, especially ecotourism has supplants the agriculture sector and now ranks as the country’s primary source of foreign exchange earnings (de Camino 2000). Thanks in part to tourism, foreign technology investment and agriculture, Costa Rica has a relatively stable economy. For example, per capita GDP is roughly $10,800; unemployment between 4.5 and 5.5%; an estimated 64% of the
workforce is employed in the service sector, while 14% still work in agriculture; finally an estimated 16% of the population live below the poverty line (CIA 2009; PAHO 2002).

Another unique characteristic of Costa Rican was the abolition of the military in 1949 in favor of investing those resources in education and health (Mohs 1995). As a result of its dedication to providing universal health care, Costa Rica boasts some of the highest health indicators in Latin America and has served as a model for other countries because it has achieved such status through a democratic process with a relatively low economic budget (Morgan 1987; Morgan 1993; Munoz 1995; PAHO 2002).

Finally, as a result of its political and economic stability Costa Rica has become a primary receptor country of Central American immigration; especially Nicaraguan immigrants seeking employment and better life opportunities. While the estimated 300,000 to 500,000 Nicaraguans, both legal and illegal, provide an important source of unskilled labor in the agricultural and service sector, there are ever growing concerns about the impact Nicaraguan immigration is having on social services including education and health care as well as on society in general (Morales 2002; OIM 2001; Sandoval-Garcia 2004a; 2004b). With specific relevance to this dissertation, Nicaraguan immigrants living in Costa Rica suffer social discrimination characterized by high poverty levels, underemployment, low education levels in addition to facing barriers in health care access and health disparities compared to Costa Ricans (Marquette 2006; OIM 2001). A more in-depth story of the Costa Rican health care systems as it pertains to the objectives of this dissertation will follow.

The Health Care System in Costa Rica

The Costa Rican health care system has received international attention for the dramatic improvements in its basic health indicators during the 1970’s and early 1980’s. The result of this dramatic health transition was the culmination of the government’s rural primary health care program initiated in 1973 that emphasized universal coverage and primary health care (Hill 1986; Morgan 1989; Munoz 1995). By the early 1980’s Costa Rica’s primary health care program had been considered a success and was credited with reducing infant mortality and preventable infectious disease, increasing life
expectancy, and bringing primary health services to rural areas for the first time (Jaramillo Antillón 1984; Munoz 1995; PAHO 1994).

Public health officials, policy makers, and medical anthropologists have been interested in the Costa Rican health experiment. For example, public health officials have touted the fact that despite being a relatively poor, developing country, Costa Rica enjoys a health profile similar to that of other industrialized nations. Others point to the “progressive nature” and “dedication to the health of its citizens” of Costa Rica’s health care system citing the implementation of a rural health program under the rubric of its national primary health care plan several years before the Alma-Ata proclamation of “Health for All by 2000” (Munoz 1995; Sáenz 1995; Vargas 1995). Health policy makers have emphasized that while Costa Rica, Cuba, and Chile enjoy some of the best health indicators in Latin America; Costa Rica is unique in that these goals were achieved within a democratic, capitalist framework (Miranda 1995; Mohs 1983; Mohs 1995; Munoz 1995). Conversely, medical anthropologists and other social scientists have been more critical of Costa Rica’s health success by pointing to failures of community based health care as a result of political partisanship (Barrett 1996; Morgan 1989; Morgan 1993) and continued health disparities among minorities and women (Abrahams-Sandi 2005; Roses 2003).

In this brief overview I will outline the historical health policy factors that led to a rapid epidemiological transition in Costa Rica and will discuss some of the most significant changes in the health profile that took place. Next, I will describe the basic structure of the Costa Rican health care system and some of its most important institutions including the agency responsible for providing potable water and waste water management services. Next I will discuss the health care reforms that took place in the 1990’s and their implication on primary health care in Costa Rica. Next I will discuss the emerging interest and relevant literature regarding the health of Nicaraguan immigrants in Costa Rica. Finally I will briefly discuss the health situation in Monteverde including available services and most prevalent health problems.
Development of the Costa Rican Health System

Clark (2002) explains that prior to the formation of the CCSS “Caja Costarricense del Seguridad Social” (Costa Rican Social Security Institute) in 1942, citizens had to pay for health care out-of-pocket or work for a company that had its own doctors or rely on charity hospitals. The Calderón Guardia administration (1940-1944) played a significant role in initiating the process toward universalized health care when it drafted legislation creating the CCSS in 1942. Health coverage, consisting of curative health care, grew slowly over the next two decades and only included workers that earned below a certain salary cap. It was not until the 1960s that the national constitution was amended and legislation passed that mandated universal health coverage under the CCSS.

Under the new law, health coverage was extended to the families of employees and the self-employed. Still, the CCSS was unable to expand health coverage as it had intended because enrollment was still limited to a salary cap and because the state failed to meet its budget requirements to the institute (Clark 2002). As a result health and pension coverage had only increased from 17% in 1961 to 46% in 1970 (Clark 2002; Miranda 1995; Rosenberg 1983). Although this attempt at extending health coverage did not live up to expectation it was significant on a couple levels. First, it solidified Costa Rica’s political commitment to universalized health care and set the country down the path of attaining a true social security state; and Second, it legitimized the creation of the necessary infrastructure to attain and support such a system; the creation of the medical school and other medical training institutions and the construction of more hospitals and clinics.

Finally, in 1970 the full expression of Costa Rican social security in the form of universal health care took shape as the administration of Jose Figueres (1970-1974) of the PLN “Partido Liberación Nacional” (National Liberation Party) pushed to consolidate the nationalization of the health and pension programs. At his direction, both the Ministry of Health and the CCSS sat down to elaborate a joint “National Health Plan” that would use resources from both institutions resulting in a complete restructuring of the national health care system. In the end, the Ministry of Health would assume responsibility for preventative measures at the individual and population level. The CCSS, on the other
hand, took responsibility for curative care of the population (Clark 2002; Miranda 1995).

In 1971, legislation was passed to place all hospitals and clinics under the authority of the CCSS and to officially remove the salary cap for enrollment into social security to include all wage earners, their dependants, the self employed, and the unemployed. As a result, much of the states portion of social security quotas shifted to employers while the state remained responsible for the unemployed (Miranda 1995). For example, employers pay an additional 9.25% above their employees’ salaries, while employees pay an additional 5.5% from their salaries to the CCSS. Self employed and informal sector workers are encouraged to enroll in the CCSS’s voluntary plans where workers pay between 5.75% and 13.75% of their salaries depending on their income. The government uses about 1.5% of the total salaries paid to the CCSS in order to cover the uninsured (Biesanz 1999; Clark 2002; Mata 1988; Morgan 1993).

The Role of the CCSS and the Ministry of Health

Today, the Costa Rican state dominates the health sector. The Costa Rican Social Security Institute (CCSS), a public institution, virtually monopolizes the health insurance market, administers the national pension system in addition to providing most of the country’s curative health services via a comprehensive system of clinics and hospitals (Clark 2002:3). The CCSS is considered a semi-autonomous institution, meaning that both its budget and decision and policy making powers are completely separate from that of the central government. The CCSS employs over 31,000 people and manages a annual budget equivalent to nearly one-quarter of that of the central government (CCSS 2001). Over the years, the CCSS has gradually incorporated more citizens from different social classes in an attempt to universalize the health care system. Today, the CCSS claims to have 87.7% of the population covered under its services (Estado de la Nación 2002:55). Since the 1970s, virtually all the nation’s hospitals (29) and clinics (240) have been transferred to the administration of the CCSS and as a result, 90% of physicians and other health care workers work under the auspices of the CCSS (Clark 2002; Miranda 1995; Rosenberg 1983).
Though the Ministry of Health lost control of its funding and administration to the CCSS as a result of the passing of the National Health Plan in the early 1970’s, it still retained its primary responsibility for public health. Under this new framework, the Ministry of Health is responsible for formulating public health policy, regulating medical markets, coordinating disease eradication efforts, food and water quality monitoring, and conducting public health campaigns. The Ministry of Health is the primary institution of the National Health System. Although the Ministry of Health only receives on average 7% of the total health budget, its aim is to cover the entire population through programs of infectious disease control and to promote health through community organization based on preventive and curative measures (Clark 2002).

*Primary Health Care Initiatives in Costa Rica*

The most important Ministry of Health programs that had significant impact on improving Costa Rica’s health profile were the “The Rural Health Program” for rural communities; “The Community Health Program” for underprivileged urban populations; and “The Nutrition Program” which targeted children less than 6 years of age, school children and pre and post natal mothers. According to Vargas (1995) these programs were designed and implemented within the framework of the National Health Plan’s vision of the populations’ right to health care and the governments obligation to organize and provide health services (Vargas 1995:62).

One of the Ministry’s major programs and of particular interest to this dissertation was the Rural Health Program (RHP), which was implemented in the early 1970s. The RHP initiative was the result of a meeting of the Ministries of Health of the Americas and the Pan-American Health Organization (PAHO) which solidified the idea that health was a human right and that the state was responsible for insuring that right. Though Costa Rica had been working toward this end, the meeting spearheaded political measures to develop a comprehensive, state-sponsored rural health program, of which the Ministry of Health was responsible (Morgan 1993).

According to Jarimillo (1984) and Mohs (1983) the rural health care program was responsible for building rural health centers and for training community health workers to
provide primary health care and referral services. The primary functions of the rural health program are as follows: 1) census and mapping of the community; 2) immunization; 3) treatment of intestinal parasites; 4) primary diagnosis and referral; 5) family planning; 6) promotion of breast feeding and child nutrition; 7) food distribution; 8) promotion of family health; and 9) community organization (Jaramillo Antillón 1984; Mohs 1983; Vargas 1995). The rural health program is fundamental to the primary and secondary health levels and has been instrumental in improving the health status of Costa Ricans. Mata (1988) argues that there are marked differences in the health status of communities that received the rural health program and those that did not.

The Health Transition in Costa Rica

According to Jaramillo Antillón (1993) the government made good on their commitment of universalizing health services by increasing Ministry of Health budgets for preventive care and nutritional assistance to marginal rural and urban populations (1993). Miranda (1995) insists that it was the redirection of the Ministry of Health and the development of the CCSS that set the stage for a series of changes which included a shift from an individual system of health care coverage to that of the social security model which took into account the rights of citizens (1995). These rights included universal access to health care and well-being, adequate housing, education, nutrition, and clothing (Miranda 1995). Other authors agree that the focus on preventive medicine and nutrition programs, the construction of regional hospitals and rural health posts which extended primary health care into the rural sectors for the first time were principal factors that precipitated the gigantic strides in Costa Rica’s health profile between 1973 and 1984 (Barrett 1996; Clark 2002; Hill 1986; Miranda 1995; Morgan 1993; Vargas 1995).

In little over ten years (1970-1983), as a result of improved health care coverage and organization, Costa Rica underwent a rapid epidemiological transition where diseases characteristic of underdeveloped countries gave way to diseases prevalent in industrialized countries (Sáenz 1995). During this period, for example, the average life expectancy increased from 65 to 73.7 years. Most impressively, infant mortality rates per
1000 live births decreased from 61.5 to 18.6. Likewise, infectious and parasitic disease mortality rates per 10,000 decreased from 13.6 to 1.7. As a result, diseases of the circulatory and respiratory system, including cancer and other degenerative diseases became the top causes of mortality thereby displacing infectious diseases (Jaramillo Antillón 1984). In addition, see Saenz (1995) for a comprehensive review of the health transition in Costa Rica that takes into account the various stages of the disease transition.

Of specific interest for this overview, was the dramatic decrease in diarrheal, parasitic, and other infectious diseases. According to Mata (1988), the significant decrease in rates of infectious morbidity and mortality was directly correlated to health care expenditure and coverage which translated into improvements in nutrition, water supply, education, and preventative and curative public health services; specifically those relating to preventable infectious diseases including intestinal parasites.

The primary health care campaigns implemented in the 1970’s played a major role in significantly reducing rates of intestinal parasites among the general population (Mata 1988). The primary health care campaigns focused on waste disposal, personal hygiene education and intestinal parasites along with an improved laboratory infrastructure (Blanco 2007).

With particular interest to this dissertation, Costa Rica has conducted three national parasite surveys; 1966, 1982, and 1996. In all three, the collection and analysis methods have been the same allowing the results to be compared. Results from the first national survey of intestinal parasites demonstrated a global infection rate of intestinal helminths at over 50% (Mata 1998). The second survey conducted in 1982 saw a dramatic reduction in prevalence rates of intestinal parasites to around 5%. For example, between 1966 and 1982, the prevalence rate of *Ascaris* went from 12.2% to 3.8%; the prevalence of *Tricuris* went from 10.2% to 4.85%; and the prevalence of hookworm (*Nector*) went from 60% to 3.29%. The latest national survey of intestinal parasites saw prevalence rates of intestinal helminths drop even further compared with the 1982 study. For example, in 1996 the prevalence rates of *Ascaris* was 1.35%; Trichuris was 2.79% and hookworm was a mere 0.3% (Mata 1998; Sanchez 1999). See the discussion later in
this chapter concerning recent parasite prevalence studies in Costa Rica that demonstrate much higher rates of intestinal parasites, especially among marginalized populations.

While the Costa Rican health care system has improved health standards for a majority of its residents, some areas of the country have traditionally been ignored and excluded. Hill (1986), for example, describes in her field study how primary health care services were all but absent and uncoordinated in Limon province in the Early 1980's compared to the rest of the country where PHC services were more reliable and accessible. For example, Hill (1986) notes that basic health promotion programs that were commonplace in other parts of the country were virtually absent in Limon. If doctors did exist, there were likely to be no equipment or medicine and thus patients were often referred to the clinic in Puerto Limon. As a result, preventable parasitic infections were a common health problem at the time in Limon due to the lack of primary health care infrastructure (Hill 1986:133).

**Health Care Reform in Costa Rica**

Health reforms during the late 1990’s were common among many Latin American nations. In a general trend, Ministries of Health were advised by donors and international experts including the World Bank and the World Health Organization to make significant health sector changes including decentralization, privatization and regulation (Bossert 1998). Costa Rican health care reforms that were initiated in the 1990’s shared some similarities to other Latin American nations with the exception that the government resisted recommendations from the World Bank to privatize both the CCSS and the Ministry of Health; as a result both institutions remain public (Rodríguez Herrera 2006).

There are many reasons that led to the health care reforms of the 1990’s. Clark (2002) and Rodriguez Herrera (2006) summarize that despite the achievements, by the late 1980’s, the Costa Rican health care system showed signs of problems common among other health care systems in the region: long waiting lists for diagnostic tests, surgery and specialist care; deteriorated hospitals and medical equipment; and demoralized physicians and health care workers. Other problems related to the dramatic rise in health care costs in Costa Rica; such as antiquated and heavily bureaucratic top-down accounting and
management systems which gave hospital and clinic directors little incentive to economize. Another impetus and objective for health care reform were overlapping health services. In the 1970’s the Ministry of Health expanded its Rural Health Program by building rural health posts and mobile health teams. Over time, CCSS clinics came to operate in many of the same areas as the Ministry of Health. Thus, one of the objects of health reform was to eliminate overlapping health services (Clark 2002; Rodríguez Herrera 2006).

### Implementation of Health Care Reforms

In response to these problems, as early as the 1980’s, Costa Rican health officials tested alternative primary health care delivery models in both rural and urban settings. For the most part, these plans consisted of a mixture of private/public partnerships that included physician’s cooperatives, various co-pay systems, and private company doctors. For a description of these models see Clark (2000) and Vargas (1995). In the end, Costa Rican health officials worked out a reform program with the World Bank in 1993. One of the major changes in the Costa Rican health care system as a result of health care reform was the reorganization of the primary care model (Clark 2000).

According to Clark (2000) and Rodriguez (2006), the major issue was the overlapping and random distribution of the CCSS primary care system that was curative, and the Ministry’s preventative health care services. The proposed solution to this dilemma was to replace the old system with integrated basic health care teams known as *Equipos Básicos de Atención Integral de Salud* (EBAIS) which were envisioned to provide integral care that would attend to the physical, social, and physiological health needs of the community. As a result of much political wrangling with congress and workers unions, the first EBAIS was created in 1995. Each EBAIS consists of a medical doctor, nurse, and a technician and is intended to cover a population of approximately 4,000 people. The EBAIS in turn are supported by personnel from nearby CCSS clinics located in the same health area. These clinics usually consist of a family practitioner, nurse, laboratory technician, social worker, dentist, nutritionist, pharmacist, and medical
records specialist. Later on, psychologists were added to some EBAIS on a part time basis (Clark 2002; PAHO 2002; Rodriguez Herrera 2006).

**Impact of Health Care Reforms**

As far as the impact that the Costa Rican health reforms have had on morbidity and mortality, few studies have been published. Most notably, however, are two articles by Rosero-Bixby that demonstrate how improved access to health care has reduced morbidity rates and increased life expectancy rates. In one study Rosero-Bixby (2004b) uses GIS data from the 2000 census to compare supply and demand of health care services. The study reported significant improvements in access to outpatient care between 1994 and 2000 as a result of health care reform implemented in 1995. Rosero-Bixby (2004b) also claims that increased access to health care was achieved by targeting communities that were in greatest need and that this was accomplished through the establishment of the EBAIS in those communities (2004b). A 2002 PAHO report notes that in the areas of the country where it has been implemented the EBAIS strategy has helped reduce health inequity; citing that the population with insufficient and inadequate access to health care services was reduced from 20% to 15% (PAHO 2002). According to Rosero-Bixby (2004a), the increase in access to health care saw a significant reduction of mortality of 8% among children and 2% among adults. Finally, mortality rates due to infectious diseases were reduced by 14% (2004a).

**Water Management in Costa Rica**

In Costa Rica, the Costa Rican Institute of Aqueducts and Sewers (ICAA), commonly known as *Aqueductos y Alcantarillados* or (AyA) was established in 1961 and is responsible for providing potable water supplies and the collection and assessment of sewage and liquid industrial wastes throughout the country (Biesanz 1999; Mata 1988; Mohs 1995).

The AyA, however, is characterized by a different institutional evolution compared to the CCSS and the Ministry of Health. According to Morgan (1992), the development and organization of AyA was heavily influenced by international
development agencies such as the Inter-American Development Bank and the U.S. Agency for International Development (USAID). At the time, these agencies had changed their agenda from health and education to industrial and infrastructure development. Though Costa Rica received only a fraction of available funds from these lending agencies, the government was still able to garner funds from other loans to establish the Institute of Aqueducts and Sewers in 1961. While Costa Rica was able to take advantage of these loans and present them as principal components of the state’s social services (which in this case reduce water related diseases by providing potable water to a greater proportion of the population), the loans heavily influenced the organizational structure of AyA. As a result, AyA was forced to adopt a policy where beneficiaries, not provincial governments would pay for water. Thus, AyA adopted a fee-for-service approach to water management, thereby turning water into a commodity; a policy that continues to this day (Morgan 1993).

Today, AyA has serious problems keeping up with demands of the growing population and water shortages are frequent, especially in the dry season. Still, according to Mora Alvarado (2003), Costa Rica ranks high among other Latin American countries in terms of potable water distribution and waste treatment. For example, 97% of Costa Ricans have access to water, 76% of which is considered potable. Similarly, 98% of Costa Ricans have some sort of waste disposal; however, 77% is through septic tanks and only 4% of human waste is treated with sanitary treatment methods. Similarly, only 4% of graywater receives any treatment at all; the majority drains directly into the environment. While there are shortcomings, especially in terms of wastewater treatment, the general availability of clean drinking water and waste disposal measures has reduced the incidence of water-borne and diarrheal diseases (Mora Alvarado and Portuguez 2000; Mora Alvarado 2003). Costa Rica has also continually increased coverage of potable water for the general population; in 1991 only 50% of the population had access to potable water compared to 78% in 2002 (Mora Alvarado and Portuguez 2003).
Water Management and Intestinal Parasites in Costa Rica

In Costa Rica, research has also been done looking at water quality management and its impact on human health, especially in relation to water-borne diseases including parasites, bacteria and viruses; many of these articles appear in the Costa Rican Journal of Public Health (*Revista Costarricense de Salud Publica*).

Valiente (1999), discusses the development of the sanitary vigilance program for water quality that was implemented in Costa Rica in 1996. In contrast to traditional water quality monitoring programs, the sanitary vigilance program determines the quality of a community’s aqueduct in terms of its health risk to humans as a way to identify priorities for improvement and to avoid water-borne diseases (1999).

Following this methodology, Valiente and Mora (2002) analyzed diarrhea outbreaks in Costa Rica directly related to water quality from 1999 to 2001. Out of 21 documented diarrhea outbreaks, investigators were able to identify the responsible pathogen in 11 cases; in the other cases no pathogen was identified. In the each of the documented diarrhea outbreaks where the pathogen was found, that pathogen was identified as a bacteria or a virus; intestinal parasites such as *Giardia lamblia* or *Cryptosporidium parvum* were not found to be the pathogen in those outbreaks (2002).

According to Gonzalez and Umaña (1996), Costa Rica has been extremely successful in its implementation of control measures to prevent helminth infections such as *Ascaris lumbricoides*, *Trichuris trichiura*, *Necator americanus* and other common species. Still, there are some marginalized populations in Costa Rica that still experience high prevalence rates of helminth infections. In contrast, not the same is true with parasitic infections of intestinal protozoa, especially *Giardia lamblia* and *Entamoeba histolytica* which, according to Monge et al. (1996) are much more common than helminth infections based on laboratory tests throughout the country.

According to Peinador and Murillo (2000) the fact that infections with intestinal protozoa are much more common than helminth infections coincides with his research of water quality monitoring that demonstrated the high prevalence of protozoa cysts found in some water treatment systems (2000). In a similar study, Peinador and Quirós (2000) found that many water treatment plants that provided water for human consumption had
very poor rates of eliminating these parasites during treatment. These results demonstrate that potable water from treatment facilities, in some cases, can serve as a source of infection of intestinal protozoa (2000).

**Nicaraguan Immigrants in Costa Rica**

During the past 30 years the surge of migratory movements in Central America has been characterized by armed conflict, natural disasters, and resulting economic instability. Many immigrants in Central America have sought refuge in the United States and to a lesser extent Mexico and Canada. For example, as a result of a 12 year civil war, it is estimated that 2.4 million or 28% of El Salvadorians reside outside the country (OIM 2001). In contrast, migratory movements within Central America are increasingly significant; most notably between Nicaragua and Costa Rica.

According to the 2000 census, Nicaraguans comprised 6% of the population in Costa Rica and it is estimated that some 350,000 Nicaraguans live in Costa Rica; approximately half of which may be considered illegal immigrants (OIM 2001). However, the CIA reports that anywhere between 300,000 and 500,000 Nicaraguans live in Costa Rica (CIA 2009). Ultimately, it is unclear as to how many Nicaraguans reside in Costa Rica at any one time.

According to a study of Nicaraguan immigration to Costa Rica by the International Organization for Migration (2001), while many Nicaraguan immigrants have come to Costa Rica for political and environmental reasons (Hurricane Mitch), the majority of Nicaraguans have decided to immigrate and reside in Costa Rica because of the continued stagnation of Nicaragua’s economy characterized by high rates of unemployment, underemployment, and the lack of social services. The pull of migration is also related to Costa Rica’s sustained demand for unskilled labor in its agriculture, construction, and service sectors. It is estimated that some 25% of Nicaraguan immigrants work in the agricultural sector (pineapple, coffee, sugar, and bananas); 18% work in the service sector (hotels and restaurants); and 17% work in construction. It is also estimated that 62% of Nicaraguan women work in the service sector. Nicaraguan immigrants have much lower levels of education compared to their Costa Rican cohorts;
are more likely to live in poverty (25% of Nicaraguan households) and in substandard housing (35 – 40%); and are paid less than their Costa Rican counterparts who engage in the same line of work (Marquette 2006; OIM 2001).

While it is clear that Nicaraguan immigrants tend to be economically and socially marginalized, it is unclear how these phenomena are manifest in terms of health status. This is primarily due to the fact that census data collected in Costa Rica did not start to register individual nationality until the year 2000. In addition, health statistics in Costa Rica do not gather data concerning patient nationality. This has made it difficult to comparatively study health outcomes between Nicaraguan immigrants and Costa Rican residents.

Marquette (2006) estimates that more than half of all Nicaraguan immigrants living in Costa Rican do not have access to CCSS health care, and notes that the percentage of uninsured may be much higher among illegal Nicaraguan immigrants. In comparison, almost 90% of Costa Ricans are currently insured through the CCSS, not counting those who have private health insurance. Marquette (2006) notes that while many Nicaraguans may have access to health services in Costa Rica regardless of their insurance or legal status, the quality of care they receive may be lower. This is evidenced by the fact that Nicaraguans have lower levels of health care use than Costa Ricans in terms of the number of annual clinic consultations (Marquette 2006).

While access to health care for legal immigrants is garnered through the same pathways as for normal residents, a Costa Rican Ministry of Health report notes that illegal immigrants have no viable way to acquire health insurance through the CCSS because affiliation requires legal documentation. Even preventative and referral services offered by the integrated basic health care teams (EBAIS) require CCSS affiliation. As a result, illegal immigrants only have access to emergency services since immigration status is not required. The only other option in terms of access to health care available to many illegal immigrants is to pay up-front and out-of-pocket for health services; a situation made difficult considering the fact that over a quarter of Nicaraguans live below the poverty line (Ministerio de Salud de Costa Rica 2002).
Among Nicaraguan immigrants, women and children and individuals employed in seasonal labor and the informal service sector are more likely to not to have access to health care. Furthermore, while the Costa Rican state absorbs costs for those citizens who cannot afford health coverage, the non-legal status of many Nicaraguan immigrants prevents them from accessing these forms of health coverage. Other health issues facing Nicaraguan immigrants include access to family planning services, pediatric services, preventative screening procedures and occupational health services (CCSS 2002). Furthermore, Marquette (2006) and the OIM (2002) report suggests that there is a higher prevalence of infectious diseases associated to poor living conditions among Nicaraguans and points out that Nicaraguan immigrants tend to suffer from diseases that were common among the Costa Rican population during the 1960’s (i.e., diarrheal, parasitic, and viral infections). As a result, both the OIM (2002) and Marquette (2006) suggest the need of researchers to compare disease outcomes between Nicaraguans and Costa Ricans.

**Intestinal Parasites in Costa Rica**

Apart from the three national intestinal parasite surveys, researchers have continued to conduct research on parasite prevalence rates in Costa Rica among marginal and special populations. Many of these articles were published (in the Costa Rican Journal of Medical Sciences and the Costa Rican Journal of Public Health) after the 1996 National Parasite Survey. These studies emphasize the continued high prevalence rates of intestinal parasites in marginal communities in Costa Rica, pointing to significant health disparities among Costa Ricans.

In a recent study of intestinal parasite prevalence, Blanco and Calderon (2007) studied the marginalized urban communities of La Barva, Heredia. The global period prevalence of intestinal parasites between January and November, 2004 was 41.2%; though the vast majority of positive cases of infection were with commensal species, the most common being *Blastocystis hominis* (27.4%), *Endolimax nana* (16.5%), and *Entamoeba coli* (7.4%). Infection with pathogenic intestinal parasites was much lower; *Giardia lamblia* (2.1%) and *Entamoeba histolytica* (1.7%). In this study, there were only a few cases of intestinal helminths.
Blanco and Calderon (2007) state that while intestinal parasites are often spread by fecal-oral transmission, it is possible that water plays a significant role as a source of infection. The authors noted that the water supply in the study community did not have adequate safeguards to prevent intestinal parasites from being transmitted through the water supply. In addition, the study points to continued health disparities of marginalized urban communities in Costa Rica (Blanco 2007).

In another parasite prevalence study among school age children in five rural communities of Limon province, Abrahams et al. (2005), discovered very high rates of infection with parasitic commensals; 47.6% on average. Also, infections with helminths were very high; *Ascaris lumbricoides* (16.6%) *Trichuris trichiura* (18.6%). Infection with the pathogenic intestinal parasite *Giardia lamblia* was (7%). The highest rates of infection were among children in third and fifth grades (20%). The 1996 National Survey of Intestinal Parasites reported global prevalence rates of intestinal helminths well below 3%. This study demonstrates that dramatic disparities in intestinal helminth rates exist in marginal areas of Costa Rica. The authors point out that Limon province still lacks proper sanitary and hygienic infrastructure, access to prevention programs, and suffers from high rates of poverty and unemployment. The authors call upon Costa Rican health officials to take notice of the health needs in these and other marginalized areas of the country (Abrahams-Sandí 2005).

Hernandez et.al (1998) collected stool samples from 76 inhabitants of a squatter settlement near San Jose, Costa Rica. Results showed that 45% of the study population was infected with at least one kind of intestinal parasite. The most common parasites found were *Entamoeba coli* (27%), and the helminths *Trichuris trichiura* (18%) and *Ascaris lumbricoides* (15%). Again, the data show very high rates of intestinal helminths compared to rates reported in the National Parasites Survey and thus reiterate that the problem of intestinal parasites is ongoing. The authors note that the continued high prevalence rates of intestinal parasites in marginalized communities in Costa Rica have been masked by national surveys that show fictitiously low rates of infection (Hernández 1998).
In a larger study of an urban health clinic near Hatillo, Costa Rica, Pardo and Hernandez (1997) analyzed 3,506 samples for intestinal parasites between 1995 and 1996. Results showed relatively high rates of *Ascaris lumbricoides* (8.2%), *Trichuris trichiura* (4.1%) and *Giardia lamblia* (9.3%). Rates of commensal parasites *Entamoeba coli* and *Endolimax nana* were higher at 17.4% and 14.7% respectively. The authors note that the rates are similar to those found in the area 10 years earlier, attesting to the continued lack of poor sanitary infrastructure, insufficient potable water and a lack of prevention programs Pardo and Hernandez (1997).

The authors go on to discuss the fact that the study of intestinal parasites in Costa Rica has been perceived as irrelevant and relegated to a lower professional status in many clinical laboratories. For example, clinical technicians are often times not properly trained in the handling and diagnostics of intestinal parasites. This situation could result in significant underreporting of prevalence rates in certain areas that lack properly trained staff and equipment Pardo and Hernandez (1997).

Sanchez et.al (1999) analyzed 151 elderly patients (60 years and over) from an outpatient hospital near San Jose and found a global prevalence rate of 26.5%. Rates of *G. lamblia* and *C. parvum* were both 5.3% respectively. The study also found a 2% prevalence rate of *Strongyloides stercoralis*, an intestinal helminth not reported on in the last National Parasite Survey. *Strongyloides stercoralis* is significant for the elderly because it often accompanies long term chronic infections common among the geriatric population. In Costa Rica, the majority of intestinal parasite survey studies focus on pediatric and or general populations. This study demonstrates that the elderly are also at risk for parasitic diseases. Infection with *Strongyloides stercoralis* is significant for the elderly because of its association with immune-suppressed patients (Sanchez 1999).

Cerdas et.al (2003) analyzed 320 samples from school aged children in Curridabat, a suburb outside of San Jose, Costa Rica. Results found an alarming prevalence rate of 45% for all parasites; a prevalence of 28% with pathogenic species and 16.9% with commensal species. The most frequent helminth was *Trichuris trichiura* (12.2%), followed by *Ascaris lumbricoides* (6.9%). The most frequent protozoan pathogen was *Giardia lamblia* with a prevalence of 7.8%. The study demonstrates
continued high prevalence rates contrary to results from national surveys. In addition the authors attribute the high prevalence rates with poor hygienic practices; washing hands and fruits and vegetables (Cerdas 2003).

Finally Hernandez-Chavarria (2005) analyzed the prevalence of intestinal parasites among an indigenous community in the South of Costa Rica. The researchers gathered 45 fecal samples from children under 15 years of age. The results show that 38 of the 45 samples (84%) were positive for at least one parasite. The prevalence for helminths was as follows: *Ascaris lumbricoides* (36%), *Necator americanus* (22%) and *Trichiura trichiura* (2%). For intestinal protozoa, prevalence rates were as follows: *Endolimax nana* (33%), *Entamoeba coli* (27%), and *Entamoeba histolytica* (11%). The authors point to lack of potable water, the lack of latrines, high household density, and the fact that many children do not use shoes (Hernandez-Chavarria 2005).

These studies clearly demonstrate that the problem of intestinal parasites is far from over, especially among marginalized and poor communities. These articles suggest that researchers are becoming more aware of health disparities among diverse and marginalized populations in Costa Rica. However, until this time, no formal research has been done to analyze prevalence rates intestinal parasites among Nicaraguan immigrants living in Costa Rica; this study pretends to be the first to provide data on that population.

This chapter will now turn to focus attention on the health conditions in Monteverde, Costa Rica with specific attention to the study site of Santa Elena.

**The Monteverde Zone**

The Monteverde Zone is situated in the Tilarán Mountains of Northwest Costa Rica in the department of Puntarenas and refers to several human communities including Monteverde, San Luis, Cerro Plano, Santa Elena, Cañitas, Los Llanos and others (see Figure 3-2). The Monteverde area was first settled by Costa Ricans in the 1920’s and 1930’s by gold miners, settlers, and farmers. However it was not until the 1950’s, with the arrival of a group of 12 North American Quaker families, that it became known by the name of Monteverde, with schools and the characteristics of a community. The
Quakers established a cheese factory supported by a network dairy farms located among neighboring communities.

**Figure 3-2. Map of the Monteverde Zone**

![Map of Monteverde Zone](image)

Map Courtesy of the Monteverde Institute (2001)

Later, in an effort to protect the community water supply from threats of deforestation, the Quakers set aside about 550 hectares of cloud forest. Today, over 50,180 hectares of forest are under protection in four formal reserves, including the Monteverde Cloud Forest Preserve and other private and public land holdings (Haber 2000; Honey 1999). These forests are home to enormous biodiversity, for example, more that 3,000 plant species, several hundred avian species, and 500 butterfly species are
found in the Monteverde area alone, many of which are unique to this area (Haber 2000; Nadkarni 2000).

The presence of these pristine forests with their biological diversity has created a vibrant and growing ecotourism industry in the Monteverde region. As a result, the region began to experience rapid growth (starting in the mid 1990’s and continuing through the mid 2000’s) in the tourist sector, concentrated principally in the communities of Santa Elena, Cerro Plano and Monteverde, which border on the three most important biological reserves. As a result, the local economy has significantly shifted from agriculture to ecotourism. For example, in the early 1990s an estimated 50,000 people visited Monteverde; in the late 1990’s Honey (1999) estimated that over 70,000 tourists visited Monteverde; and in 2003, the Santa Elena aqueduct reported that over 200,000 tourists visit the Monteverde zone every year (ICEA 1998). Tourism has now surpassed dairy farming as the areas primary source of income. More than 80% of the hotels, restaurants, and businesses in the Monteverde zone have been built since the mid 1990’s. In a recent survey of the areas 93 businesses, 85% are directly related to the tourism and service sector economy and 73% are located either in Santa Elena or Cerro Plano. See Amador (2005) for a comprehensive review of the impact of ecotourism development on area households and businesses. In addition, see Nadkarni and Wheelwright (2000) for a comprehensive discussion concerning the biological and ecological impact of ecotourism development in Monteverde.

The Study Site: Santa Elena de Monteverde

The research site for this dissertation took place in and around the community of Santa Elena de Monteverde. Santa Elena is the political and economic center in addition to being the largest community in the Monteverde Zone. Santa Elena is located approximately thirty-five kilometers east of the Inter-American Highway and 160 kilometers northwest of the capitol, San José. At the time of this research it was composed of approximately 311 households and had a population of roughly 3,100 people (Amador 2004).
Santa Elena is the seat of the new Municipal Government. It houses the offices of the governmental agencies AyA (Aqueducts and Sewers), MAG (Ministry of Agriculture), ICE (Electricity Institute), the Banco Nacional (National Bank), the post office and a CCSS (Social Security) clinic. It has an elementary school and a professional and technical high school. There is private dentist, physician and pharmacy, several restaurants and internet cafes, a supermarket, a book and stationery store, a bakery, bus station, hardware stores and other stores and businesses related to tourism. In the center of Santa Elena there is nearly constant movement of vehicles, people, dogs, and an occasional horse.

The other community included in this research is Los Llanos, a small rural settlement just a few kilometers southeast of the center of Santa Elena. Several families started settling Los Llanos in the 1990’s as an alternative to living in Santa Elena because land and housing is much cheaper. According to the Monteverde Institute there are 59 households and an estimated population of 231 people in Los Llanos which include the recently constructed low income housing neighborhood called La Colina (Amador 2004). Los Llanos has only one small store that sells basic supplies and a small primary school. For this reason, the majority of the inhabitants of Los Llanos go to Santa Elena or Cerro Plano for school, work and to buy food and supplies. In spite of the lack of economic activity, Los Llanos is on the same electric, water and telecommunications grid as Santa Elena.

**Health and Health Services in Monteverde**

Due to its relative isolation and inaccessibility, the Monteverde Zone lacked basic health services for most of its history. Only until recently have health services improved in terms of coverage and ambulatory care. For example, while a small clinic was built in 1971, Monteverde did not receive a full time physician and nurse from the CCSS until 1983; before that, the community relied on mobile health teams who visited the community only a few times a year. Gradually, more health services were added to the clinic including a dentist and a pharmacist. In 1995, Monteverde received an integrated basic health care team (EBAIS #9) that provided primary health care and referral services
to Santa Elena, Cerro Plano and Monteverde in addition to the services already provided by the clinic. In 1997, the EBAIS #8 was stationed to the Monteverde Clinic to provide health services to the communities of Guacimal, San Luis and Santa Rosa (located between Monteverde and the Inter-American Highway).

As a result of the rapid growth in the ecotourism sector and an increase in population, the demand for more health services grew. Finally, a new, larger and modern CCSS clinic opened in the spring of 2002. Located in Santa Elena, the new Monteverde Clinic has substantially increased health care access and the variety of services available to the local population. Apart from housing the EBAIS #8 and #9, the Monteverde Clinic is considered a primary health care facility whose function is to provide health promotion, prevention, treatment and referral services to higher levels of health care. At the time of this research the Monteverde Clinic provided the following services: 1) a basic pharmacy with general medicines in stock; 2) dentistry services offered twice a week based on referral; 3) gynecological services offered once every two weeks; 4) social services focusing on various social issues including domestic violence, drug and alcohol addiction, teen pregnancy, and general counseling; 5) laboratory services, lab samples are taken to Puntarenas once a week for analysis; and 6) emergency services, however, medical emergencies are generally referred to Puntarenas. In addition, the CCSS maintains one ambulance that is in good condition as well as a second ambulance that is property of the Red Cross. On an interesting note, the Monteverde Clinic does not have a pediatrician and therefore expecting mothers are expected to travel to Puntarenas to give birth.

At the time of this research, the 2002 local health profile (ASIS) reported that the principal health problems of the community (based on the volume of clinic consultations) included respiratory infections, back problems and diarrheal diseases (see Table 3-1). The report states that these morbidity statistics are most likely attributed to environmental factors as in the case of respiratory illnesses which are associated with extreme climate changes, high humidity and frequent rain. Back problems may be related to road and work conditions which typically involve manual labor. Finally, diarrheal illnesses, including intestinal parasites accounted for over 6% of clinic consultations in 2002.
making gastrointestinal diseases the second most prevalent health condition in the community. The ASIS report suggests that gastrointestinal diseases may be linked to environmental conditions including climate, sanitation, and possible contamination of local water supplies. Other health concerns of the community that are recognized by the ASIS include drug and alcohol abuse, domestic violence, and teen pregnancy (ASIS 2002).

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>No. of Consultations</th>
<th>Percent of Consultations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Respiratory Infections</td>
<td>617</td>
<td>13.89%</td>
</tr>
<tr>
<td>Back Problems</td>
<td>183</td>
<td>4.11%</td>
</tr>
<tr>
<td>Diarrheal Diseases</td>
<td>159</td>
<td>3.57%</td>
</tr>
<tr>
<td>Accidents</td>
<td>113</td>
<td>2.54%</td>
</tr>
<tr>
<td>Acute Ear Infections</td>
<td>111</td>
<td>2.49%</td>
</tr>
<tr>
<td>Intestinal Parasites</td>
<td>110</td>
<td>2.47%</td>
</tr>
<tr>
<td>Viral Infections</td>
<td>104</td>
<td>2.34%</td>
</tr>
<tr>
<td>Urinary Tract Infections</td>
<td>100</td>
<td>2.18%</td>
</tr>
<tr>
<td>Asthma</td>
<td>97</td>
<td>2.1%</td>
</tr>
<tr>
<td>Hemorrhoids</td>
<td>93</td>
<td>2.09%</td>
</tr>
</tbody>
</table>

Another important health statistic in relation to this dissertation is the percent of the population with access to health care (i.e., having health care coverage through the CCSS). According to the 2002 ASIS report, 93% of the residents living in Santa Elena, Cerro Plano, Monteverde, Los Llanos and Cañitas have health care coverage through the CCSS. The majority of the insured are dependants (children, family and spouses) of primary policy holders. In addition, approximately 8% of residents receive their health coverage through a state subsidy based on their low income status (ASIS 2002). For a more comprehensive discussion of Monteverde health profile see the 2002 ASIS report.

**Water Resources Management in Santa Elena**

Santa Elena first organized a water committee in 1980 with the goal of providing water to Santa Elena, Cerro Plano and Cañitas. The committee was officially recognized as an administrative entity of The Costa Rican Institute of Aqueducts and Sewers (AyA) in 1998 when three distinct water distribution systems were consolidated into a single aqueduct named The Santa Elena Aqueduct Administration (Asociación Administradora
del Acueducto de Santa Elena). Currently, the Santa Elena aqueduct consists of three integrative water distribution systems that serve the communities of Santa Elena, Cerro Plano, Cañitas and Los Llanos providing services to approximately 4,655 permanent residents and more than two hundred thousand annual tourists (AAASE 2003). All households that participated in this research received water from the Santa Elena aqueduct.

The Santa Elena aqueduct captures and distributes water from 17 naturally occurring springs that are located in the mountains above and around Santa Elena and Cerro Plano. The springs themselves produce high quality drinking water that is safe for human consumption without the need of secondary treatment. The 17 springs comprise three principal distribution systems that supply water to different parts of the community; System #1 consists of 10 natural springs and two holding tanks and provides water to residents of Cañitas and North Santa Elena; System #2 consists of 2 natural springs and one holding tank and provides water to central Santa Elena and neighborhoods to the east near the cemetery; System #3 consists of 5 natural springs and three holding tanks and distributes water to Cerro Plano, South Santa Elena and Los Llanos. Although the spring water is safe for human consumption, in order to reduce the risk of possible contamination, the Santa Elena Aqueduct applies chlorine to the water at its point of distribution via automated chlorination machines (AAASE 2003; ICEA 1998).

Upon the initiation of this research in 2003, the Santa Elena Aqueduct received the prestigious “Sello de Calidad Sanitaria” (Seal of [Water] Quality Sanitation) as a result of an external evaluation by AyA technicians (AAASE 2003). According to Feoli Boraschi (2007), the AyA initiated the Sello de Calidad Sanitaria program in 2001 as an incentive to local aqueduct operators in Costa Rica to provide high quality water to local populations in a sustainable and environmental friendly manner. The program consists of 6 parameters that local aqueduct operators must follow in order to receive recognition as having a Sello de Calidad Sanitaria; they are as follows: 1) An active program that protects local water sources, including maintenance in and around springs, reforestation, spring flow measurement and periodic spring inspection; 2) A program that periodically cleans water storage tanks and distribution tubing; 3) A system to chlorinate all water and
at the same time monitor residual chlorination levels; 4) A plan to implement environmental education programs in the local community and to disseminate information about the aqueduct publically; 5) A program to periodically measure water quality at different points throughout the entire aqueduct and to maintain specific water quality standards at all times; 6) A comprehensive risk assessment and water mediation program in addition to futures planning (Feoli Boraschi 2007).

At the time of this research, the Sana Elena Aqueduct was one of only 13 local aqueducts in the entire country to receive this distinction; demonstrating that the aqueduct provides high quality water to the local population and maintains a high standard of quality control and assessment measures to ensure the consistency of services. Results from independent laboratory testing from January to June 2004 demonstrated that potable water from the Santa Elena aqueduct met water quality standards and residual chlorine levels for human consumption.

**Nicaraguan Immigrants in Monteverde**

In Monteverde, Nicaraguan immigrants have come to the area seeking seasonal agricultural work (the coffee harvest) and low-skill wage labor jobs (hotels, restaurants, and construction). However, it is unclear exactly how many Nicaraguan immigrants reside in and around Monteverde and how many are employed in seasonal work. In addition, data on the health status of Nicaraguan immigrants living in Monteverde is not available because the Monteverde Clinic does not collect data on patient nationality.

A recent pilot study done by students of the 2003 USF-GRC/Monteverde Institute Globalization and Community Health Field School interviewed 19 households (a total of 71 individuals) headed by Nicaraguan immigrants in Monteverde. However, their research cited that due to time constraints, they were unable to make contact with all Nicaraguan households and much less with those who were engaged in seasonal employment. In any case, their report is consistent with other national studies, including (Marquette 2006; Ministerio de Salud de Costa Rica 2002; OIM 2001), that Nicaraguan immigrants living in Monteverde have significantly lower educational levels (18% had no schooling while 41% had not finished primary school); tend to live in substandard and/or
crowded living conditions; tend to be paid lower wages and suffer from job insecurity; and are more likely not to have health coverage compared with their Costa Rican neighbors (over half of the individuals interviewed had no health insurance). Furthermore, interviews with Nicaraguan residents raised concerns relating to a lack of information about immigrant rights, health care, and a general mistrust in accessing social services as a result of their immigration status.

This research is the first known attempt to compare health outcomes between Nicaraguan immigrants and Costa Rican residents in Monteverde. It is hoped that the research will contribute to the knowledge of immigrant health status in Monteverde by determining whether Nicaraguan immigrants have a higher prevalence of parasitic infections and to better understand the political economic, environmental and cultural conditions in which they are manifest.
Chapter Four - Research Objectives and Methods

This chapter outlines the four primary research objectives of this dissertation including specific research questions and hypotheses. Following this will be a discussion of the research methodology that is organized in terms of the public health/laboratory methods and procedures used to determine parasite prevalence, and the anthropological methods used to inform the political ecology framework. Included is an in-depth discussion of data collection techniques and instruments used to conduct the research as well as a discussion of the research timeline, the research team, selection criteria, sampling, and informed consent.

Research Objectives

The overall objective of this research is to determine how interactions and inter-relationships between political-economic, social and environmental variables affects disease outcomes by increasing levels of intestinal parasites Nicaraguan immigrants and Costa Rican residents in Monteverde. The following is an outline of the four primary research objectives in addition to their specific research question and hypotheses.

Research Objective (O-1): Determine the period prevalence of intestinal parasites among the study population

Research Question (RQ-1): Are infections with intestinal parasites significantly underreported by the Monteverde Clinic?

Alternative Hypothesis (H-1): Infections with intestinal parasites are significantly underreported by the Monteverde Clinic.

Research Question (RQ-2): Within the study population, do Nicaraguan immigrants have higher prevalence rates of intestinal parasites compared to Costa Ricans?
Null Hypothesis (H-2): There is no difference in the period prevalence of intestinal parasites between Nicaraguan and Costa Rican participants.

Research Objective (O-2): Determine the distribution and the most likely sources of infection and modes of transmission of intestinal parasites among the study population.

Research Question (RQ-3): Among the study population, are infections with intestinal protozoa more common than infections with intestinal helminths?

Null Hypothesis (H-3): There is no significant difference in the prevalence of intestinal protozoa and intestinal helminths among the study population.

Research Question (RQ-4): Are parasites primarily transmitted as water-borne infections, or through the fecal-oral route of transmission?

Null Hypothesis (H-4): There is no difference in parasite transmission; that is, intestinal parasites are just as likely to be transmitted via water as they are via the fecal-oral route of transmission.

Research Objective (O-3): Determine the significant socio-demographic, economic and cultural factors associated with the prevalence of intestinal parasites among the study population at the individual and household level.

Research Question (RQ-5): Are infections with intestinal parasites more common among study participants with no access to health care?

Alternative Hypothesis (H-5): A lack of access to health care among study participants is associated with a higher prevalence of intestinal parasites.

Research Question (RQ-6): Is the household hygiene environment associated with the prevalence of intestinal parasites?

Alternative Hypothesis (H-6): Inadequacies in household hygiene infrastructure are associated with a higher prevalence of intestinal parasites among study participants.

Research Question (RQ-7): Is knowledge of intestinal parasites and prevention strategies associated with lower household rates of infection?
**Alternative Hypothesis (H-7):** Significant knowledge of parasite etiology and prevention will be associated with lower prevalence rates at the household level.

**Research Objective (O-4):** Provide a general political ecological framework that explains the prevalence of intestinal parasites among the study population in Monteverde, Costa Rica

**Overview of Research Methods**

This research combined public health and anthropological methods. First, a cross-sectional study design to determine the period prevalence of intestinal parasites among a study population of Nicaraguan and Costa Rican study participants was developed. In addition, anthropological methods such as semi-structured interviews, observation, and key informant interviews were conducted to further explore and understand the cultural, behavioral, and political-economic context of parasitic infections and the relevant risk factors attributed to each study population. Table 4-1 summarizes the main elements of both the public health and anthropological methods.

**Table 4-1. Summary of Research Methods**

<table>
<thead>
<tr>
<th>Public Health/Laboratory Methods</th>
<th>Anthropological Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objective:</strong></td>
<td><strong>Objective:</strong></td>
</tr>
<tr>
<td>To determine the period prevalence of intestinal parasites among a study population of Nicaraguans and Costa Ricans.</td>
<td>To better understand the demographic, cultural, behavioral, and the political-economic context of parasitic infections and the relevant risk factors attributed to each study population.</td>
</tr>
<tr>
<td><strong>Methods:</strong></td>
<td><strong>Methods:</strong></td>
</tr>
<tr>
<td>Collection of Fecal Samples</td>
<td>Household Demographic Interviews</td>
</tr>
<tr>
<td>Analysis on Fecal Samples using Microscopic Diagnostic Techniques</td>
<td>Semi-Structured Interviews</td>
</tr>
<tr>
<td>Diagnosis of Intestinal Parasites in Participant Fecal Samples</td>
<td>Key Informant Interviews</td>
</tr>
<tr>
<td><strong>Participants:</strong></td>
<td><strong>Participants:</strong></td>
</tr>
<tr>
<td>Volunteer Participants (Nicaraguan and Costa Rican) from Santa Elena and Los Llanos.</td>
<td>Volunteer Participants (Nicaraguan and Costa Rican) from Santa Elena and Los Llanos</td>
</tr>
</tbody>
</table>
**Public Health and Laboratory Methods**

This research uses the prevalence of intestinal parasites as a basic health indicator to compare Nicaraguan and Costa Rican study participants in Monteverde within a political-economic and social context. The principal objective of this aspect of the research was to contribute to the knowledge of immigrant health status in Monteverde by determining whether Nicaraguan immigrants suffer disproportionately from parasitic infections compared to Costa Ricans and to better understand the social and economic conditions in which they are manifest.

**Research Timeline**

Research for this dissertation was conducted from November, 2003 to July, 2004. Table 4-2 depicts the research tasks and the timeframe according to the sequence in which they were carried out.

**Table 4-2. Research Tasks and Timeframe of the Parasite Prevalence Study**

<table>
<thead>
<tr>
<th>Research Task Description</th>
<th>Timeframe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site Visits, Gaining</td>
<td>November 2003 – January 2004</td>
</tr>
<tr>
<td>Permission and Informed</td>
<td></td>
</tr>
<tr>
<td>Consent</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Participant Selection,</td>
<td>February 2004 – June 2004</td>
</tr>
<tr>
<td>Collection and Analysis</td>
<td></td>
</tr>
<tr>
<td>of Biological Samples</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Education and Dissemination</td>
<td>May 2004 – July 2004</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Research Team**

This research was financially supported by the USF Globalization Research Center through a graduate research assistantship. However, there were insufficient funds with which to hire a research assistant to help with data collection or laboratory procedures. As a result, I took on all research responsibilities involved in this research. In
retrospect, the lack being able to hire at least one research assistant was a major limiting factor on two aspects of the study: site selection and sample size.

**Selection of the Research Community**

The community of Santa Elena de Monteverde was chosen as the primary research site. This decision was based on the following characteristics: 1) Santa Elena is the focal point of poor waste water management, water insecurity, water pollution, urbanization, and tourism; and 2) in the Monteverde Zone, Santa Elena is the community where the majority of the Nicaraguan immigrant population resides. Thus, the research site made it possible to compare prevalence rates of intestinal parasites among a group of Nicaraguans and a group of Costa Ricans living in the same community.

Since the selection of study participants had to be chosen from Santa Elena, it became necessary to define community boundaries because it was often difficult to determine where one community ends and another begins. As a result, household were selected from neighborhoods that were politically defined as part of Santa Elena. The other criterion was that the household receive water from the Santa Elena Aqueduct. Under this rubric it was ensured that all participants selected for the study received their water from the same central source. The standardization of the household water source was an important consideration for household selection since the study sought to determine the prevalence of water-borne parasites. Santa Elena has a centralized water distribution system which is managed by the Costa Rican Institute of Aqueducts and Sewers (AyA). As explained in chapter three, the community’s potable water originates from several mountain springs located in and around the community. The Santa Elena Aqueduct is responsible for water allocation, distribution, quality control, chlorination, and metering of the communities water supply.

Due to the difficulty of locating Nicaraguan households, the Monteverde Institute recommended including the nearby communities of Los Llanos and Cañitas in addition to Santa Elena. Due to the fact that the Nicaraguan population living in Cañitas was mostly made up of temporary laborers, Cañitas was not chosen as a research site from which to choose the study participants. Los Llanos, on the other hand was eventually included as a
research site because the Nicaraguan population living there were more sedentary and because the community was serviced by the Santa Elena Aqueduct.

**Recruitment of Participants**

Study participants were chosen based on the following criteria: 1) the Participant must be of either Costa Rican or Nicaraguan national origin; 2) that participants live in households representing a variety of neighborhoods throughout Santa Elena; 3) that participants’ households be at risk for parasite transmission (i.e., proximity to gray water pollution, poor sanitary conditions, water insecurity, poverty, crowded housing conditions etc.); 4) that residents have lived in Monteverde for at least a year prior to the study and that they remain in the community for the duration of the study; 5) that both an adult and a child under 17 years of age living in the same household participate in the study; and 6) that each household receive their potable water from the Santa Elena Aqueduct Association.

One of the most important criteria for selection was the participants’ national origin. For this reason, only Nicaraguans and Costa Ricans were asked to participate in the study. The definition of a Nicaraguan or Costa Rican was defined as having been born in their respective countries and self identifying as either Nicaraguan or Costa Rican. In this study, children of Nicaraguan born parents who were born in Costa Rica, (making them legal Costa Rican citizens) were considered to be Nicaraguan because the family self identified as being culturally Nicaraguan.

Another criterion for selection was that the study participants lived in household’s located in a variety of different neighborhoods throughout Santa Elena and Los Llanos (see Figure 4-1). The geography of settlement in Santa Elena does not revolve around a central area, but rather is spread out along a main road. As a result of increased urbanization, settlement patterns in and around Santa Elena are unorganized and often do not follow zoning standards. New neighborhoods and settlements are continuously being developed around the Monteverde Clinic, the cemetery, and along the main road. Thus, in Santa Elena, it was attempted to choose participants living in households located in the upper, middle and lower parts of the community. In Los Llanos, participants were chosen
from that community’s central settlement as well as from a new low-income housing neighborhood called “La Colina”. Identifying households in different sectors of Santa Elena and Los Llanos was facilitated by community maps from the Monteverde Institute.

Figure 4-1. Map of the Study Communities and Selected Households

In addition, to selecting participants living in households located throughout Santa Elena and Los Llanos, it was attempted to select households with characteristics that put
them at risk for intestinal parasites. Factors of increased risk for intestinal parasites included the following: a close proximity to wastewater pollution, past experience of water insecurity, poor sanitary conditions, crowded living conditions, and limited financial resources.

Another criterion for selection was that participants had been a resident of Monteverde for the past year and that they planned to stay in Monteverde for the duration of the study. This was important because people who had recently arrived in Monteverde could be hosting parasitic infections they contracted in other locations.

Finally, it was important that children under 17 years of age participate in the study since they are more susceptible to and adversely affected by parasitic infections compared to adults. In this case, it was attempted to select at least one adult and one child under 17 living in the same household to participate in the study.

**Sampling**

The study enrolled two study populations, one Nicaraguan and the other Costa Rican. The goal was to recruit 50 participants for each respective study population. Participants were identified and asked to participate in the study by using separate snowball samples for each group (one for Nicaraguan households and one for Costa Rican households). The researcher continued to identify and enroll participants from each group to the study until 50 participants for each study population had been selected. Identifying and enrolling participants through the snowball samples were done on a continual basis between February and June, 2004 as the researcher processed the fecal samples.

The snowball method of sampling was used because it was the only way to locate Nicaraguan households. Thus, one snowball sample was started with a Nicaraguan key informant and continued until enough participants had been selected. For the Costa Rican population, three snowball samples were started in three neighborhoods along the main road; one from the North part of town, one from the South end, and one from Los Llanos. Each snowball sample was started with a Costa Rican contact and was done in order to
identify households from different areas of Santa Elena. See table 4-3 for a description of the number of participants in each sample.

Key informants used to start each snowball sample were identified using the researchers own contacts or based on suggestions from the Monteverde Institute. All interviews were administered to the male and/or female head of household, though preference was given to the female head of household whenever possible because they are most involved in household water handling and health care. Finally, all household members were be invited to participate in the study, though the final decision as to which household members participate in the prevalence study was up to the head of household.

<table>
<thead>
<tr>
<th>Study Group</th>
<th>Participants Recruited (N=126)</th>
<th>No. of Participants in Prevalence Study (n=84)</th>
<th>No. of Refusals</th>
<th># lost to follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Costa Rican</td>
<td>76</td>
<td>49</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Nicaraguan</td>
<td>50</td>
<td>35</td>
<td>10</td>
<td>7</td>
</tr>
</tbody>
</table>

As mentioned earlier, due to the difficulty of locating Nicaraguan Households, researchers from the Monteverde Institute suggested focusing on two small settlements, one in the community of Cañitas and the other in the community of Los Llanos. It turned out that there was a significant population of Nicaraguans living in Cañitas employed as temporary agricultural workers, mostly for the coffee harvest. While this population would have been interesting to study it turned out to be impossible due to their migratory nature. Since the Nicaraguan population in Cañitas was constantly moving, and was mostly made up of men, it was decided not to include this population. On the other hand, there were several Nicaraguan families living in Los Llanos who were long term residents. It was decided to ask these families to participate in the study. For comparative reasons, several Costa Rican families from Los Llanos were also asked to participate.

One of the biggest challenges of working with the Nicaraguan population in terms of sampling was the refusal rate to participate in the study and loss to follow-up. Due to IRB standards, written informed consent was required for participation in the study. For the Costa Rican families, this was not a problem as no individuals rejected participation.
In contrast, ten Nicaraguan individuals refused to participate in the study specifically because of the requirement of written informed consent. These individuals and families expressed a desire to participate in the study, saying that they were interested to know whether their children had parasites, but that they would not participate if they had to sign “a piece of paper.” In all cases, these individuals and families were extremely poor; were of low literacy; had dubious legal status in the country, and cited having gotten into “problems” in the past for signing papers that they did not fully understand. This researcher thus perceived the written informed consent process as a limitation when working with the Nicaraguan community because the families who refused to participate in the study expressed a desire to do so. Another issue in the sampling was loss to follow-up. While some participants agreed to partake in the study, many participants did not end up providing a fecal sample.

**Informed Consent, Confidentiality and Study Permission**

A protocol for this research was submitted to and approved by the University of South Florida’s Institutional Review Boards (IRB) division of biomedical research involving human subjects. For this research, a biomedical research IRB had to be submitted because the study involved collecting, handling and analyzing infectious agents. A waiver of informed consent was submitted because the researcher believed that the Nicaraguan community would be skeptical of signing consent forms. However, the request for a waiver of informed consent was eventually denied because the study was biomedical in nature. Thus, a combined informed consent document requiring the signature of both adult participants and the guardian of child participants, and the researcher was created and used for the study (See Appendix A for a copy of the Combined Written Informed Consent Form).

In addition to the USF-IRB process, the research proposal was also submitted to an informal ethical review board at the Monteverde Institute. Upon review, the MVI ethical review board suggested that the proposal be submitted and approved by an in-country scientific ethical review board before the MVI gave permission to carry out the study. At the time of this study, Costa Rica did not have an official IRB process or policy.
for independent researchers carrying out research in Costa Rica. Permission to carry out biomedical research is usually obtained by official international research groups in conjunction with the Ministry of Health. Instead, it was suggested that this research proposal be submitted for IRB approval from an ad-hoc ethical committee housed at the National University of Costa Rican in Heredia. As a result, this research proposal was submitted to the “Comité Ético Científico Del Instituto Regional de Estudios en Sustancias Tóxicas” (CEC-IRET). Finally, the proposal to carry out the study was approved and permission to conduct the study was granted in November, 2003 by the Monteverde Institute.

**Field and Laboratory Procedures for the Diagnosis of Intestinal Parasites**

Determining the period prevalence of intestinal parasites among the study population incorporated collection and handling procedures of biological samples in addition to laboratory procedures to identify and diagnose intestinal parasites. Both collection and laboratory procedures and methods were based on Dr. Donald L. Price’s book called “Procedure Manual for the Diagnosis of Intestinal Parasites” (1994). Table 4-4 outlines the field and laboratory procedures used to collect and analyze fecal samples.

**Table 4-4. Field and Laboratory Procedures**

<table>
<thead>
<tr>
<th>Field/Laboratory Procedure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collection of Fecal Samples</td>
<td>Specimen vials were provided to all study participants to collect fecal samples for analysis of intestinal parasites.</td>
</tr>
<tr>
<td>Handling and Organization of Fecal Specimens</td>
<td>The specimen vials were collected by the researcher and later coded and stored in the MVI laboratory until analysis.</td>
</tr>
<tr>
<td>Sample Preparation</td>
<td>Samples were prepared for analysis using concentration and staining methods.</td>
</tr>
<tr>
<td>Examination and Diagnosis of the Specimen</td>
<td>Samples were analyzed and diagnosed using microscopic techniques. Positive samples, along with a percentage of negative samples were taken to a private laboratory for confirmation.</td>
</tr>
<tr>
<td>Dissemination of Results</td>
<td>Participants were later given the official laboratory results and its implication was discussed.</td>
</tr>
</tbody>
</table>
Collection of Fecal Samples

In traditional laboratory settings, including the ones used in Costa Rica, unpreserved fecal specimens are collected and submitted for examination of intestinal parasites. Unpreserved fecal specimens refer to those that are collected directly and which have not been placed in a preservation solution to prevent premature desiccation of parasite cysts, trophozoites, eggs, and larvae. According to Price (1994), the cysts and trophozoites of intestinal parasites start to break down in unpreserved specimens within 30 minutes of being passed and after several hours, unpreserved specimens in field conditions can completely break down and become unidentifiable. Thus, field circumstances where fecal specimens are unpreserved can significantly reduce the probability of finding and identifying parasites in collected specimens. The practice of collecting unpreserved fecal specimens has therefore been criticized as contributing to the underreporting of parasitic infections (1994).

Several methods exist to preserve fecal specimens in field settings. According to Price (1994), specimens that are immediately placed in a fixation/preservation solution significantly increase the chance of identifying positive samples compared with those samples that are unpreserved. This study used “PIF” solution to collect and preserve all fecal samples collected in the field. PIF solution contains formalin, glycerin, alcohol, and formaldehyde and is mercury free, unlike other commonly used collection/preservation solutions. The PIF solution is effective for collecting, fixing, preserving, and staining trophozoites, and cysts of protozoa; eggs of trematodes, cestodes, nematodes; and juveniles of nematodes in bulk feces. Organisms are killed and preserved once they come into direct contact with the chemical solution. Mixed specimens can be examined an hour after they have been collected. Another advantage is that specimens retain indefinitely the diagnostic features present at the time of fixation and thus can be analyzed at the convenience of the researcher. This researcher used a commercially available PIF collection and preservation system called ProtoFix® that is manufactured and distributed by Alpha-Tec Systems, Inc. The ProtoFix system consists of a 20ml plastic vial with a screw on cap that contains 13ml of the PIF solution.
In traditional laboratory settings that test for parasites, including those in Monteverde, it is the responsibility of the patient to bring the fecal sample to the clinic for testing. Because time is an important element in the identification of parasites in unpreserved specimens, patients are usually told to arrive at the clinic early in the morning, while fasting, and provide a fecal sample on the spot that is then transferred to the lab for analysis. If the patient is unable to provide a fecal sample on the spot, they are given a container with which they are supposed to collect the sample at home and bring it in right away the next morning. This process is time consuming for the adult and can be stressful for the child. At the Monteverde Clinic, laboratory specimens must be sent to the Puntarenas hospital for analysis, increasing the time between passing the specimen and analysis; therefore reducing the probability of encountering parasites in the sample.

The procedure used in this study enabled participants to collect fecal samples in the comfort of their own home and at their own convenience; samples could be collected any time of the day and did not require the individual to fast before producing the specimen. Thus, the procedure used by this researcher eliminated the inconvenience of the parent of having to go to the clinic, and stress on the child to produce a specimen on the spot. This procedure also eliminated the urgency with which the sample had to be returned to the laboratory for analysis since preserved samples can be analyzed at any time without risking the quality of the sample.

The procedure used to collect fecal samples was as follows: After a household agreed to participate in the study and after consent forms had been signed, the head of household was provided with a ProtoFix kit for each family member who wished to participate. Each kit consisted of a plastic zip-lock baggie that contained one ProtoFix vial and three wooden sticks. I was extremely careful to provide a detailed explanation to participants on how to collect the fecal samples. Written instructions that included drawings on how to collect the sample were also provided to participants (See Appendix B for a copy of the written instructions that were given to participants).

To ensure that participants fully understood the procedure, I asked the head of household in charge of collecting the samples to explain the procedure. In addition, I also stressed that the preservation solution in the vial was poisonous and that it was to be kept
under strict parental supervision at all times to prevent small children from inadvertently playing with or drinking the solution. Instructions and contact numbers were given to the head of household with instructions in case of accidental ingestion.

At the outset of this research there was doubt as to how participants would respond to the research and the process of collecting fecal samples. I was relieved to hear positive feedback from heads of household who had successfully collected fecal samples for themselves and their children. Many participants commented that the ProtoFix collection system was easy and much more convenient compared with going to the clinic since samples could be collected in the home under natural circumstances. This was especially the case with small children who would stress at the clinic and fail to produce a sample. One mother stated that this was the first time that her son had been tested for parasites explaining that all previous attempts had been thwarted by clinic related stress. In general, the study participants were not put out by the process of collecting fecal samples because the majority of them had been exposed to the procedure in the past; most of them equated providing a fecal sample with testing for parasites and perceived the procedure itself as commonplace.

Due to time constraints, each participant was asked to provide one fecal sample. In some cases I asked that the participant collect an additional sample. This was only done in the following circumstances: 1) when the initial sample provided was of poor quality (i.e., when the sample was inadequately mixed; when there was too much sample or too little sample collected in the vial); 2) when the initial sample tested negative for parasites while the participant had symptoms that could be related to parasitic infections; and 3) when the sample tested positive for parasitic commensals (non-pathogenic species) including *Entamoeba coli* and *Endolimax nana*. This was done to ensure that no pathogenic species were missed upon the first analysis since pathogenic parasites like *Entamoeba histolytica* often coexist with commensal species.

**Handling and Organization of Fecal Specimens**

Once the specimen vials had been given to the head of household, I discussed an appropriate time frame to return to the home to collect the samples. In most cases, I
would call the head of household to see if the samples were ready to be picked up. In other cases where the household had no phone service, I agreed to return on a certain day to collect the samples. Once collected, the sample vials were transported to the Monteverde Lab for storage and organization.

This method of collecting the sample vials turned out to have its advantages and disadvantages. The disadvantage was that not all household members produced samples at the same time often requiring multiple visits to the household to collect all of the samples. As was the case in many households, all the participants produced a sample on time, save for one or two individuals who would take up to several weeks to produce a sample. In a few cases, participants failed to provide a sample altogether and were thus considered lost to follow-up.

Reasons varied for the extreme delay in producing a viable sample. In some cases it was due to an un-cooperating child and in other cases, a forgetful adult. Some households produced all samples in a matter of days, while others delayed more than a month to provide all of the household samples to the researcher.

While the delay in producing samples was a disadvantage in terms of time. The advantage was that this gave me an excuse to make continued visits to the household to check on the status of the samples and allowed me to spend time within the household and to get to know the participants better. I also took advantage of this time to conduct observations and to conduct interviews with participants.

When participants finally did provide the researcher with a sample it was taken back to the laboratory at the Monteverde Institute. Back at the laboratory, the sample was assigned a code number that identified it with both to the household and the sample population. To ensure patient confidentiality, the names that were written on the sample vials were blocked out and replaced by code numbers. The code numbers were then entered into a computer data base. Before and after the samples were processed for analysis they were placed in a box and were locked in cabinet to ensure that they would not be tampered with.
Sample Preparation

Once at least 6 specimens had been collected they were prepared together for microscopic analysis. All samples underwent a concentration process from which wet-mount preparations were made to be analyzed under the microscope. In addition, a small specimen left over from the concentration procedure was applied to a separate microscope slide and stained for *cryptosporidium parvum*.

Concentration Procedures and Wet-Mount Slide Preparations

In most laboratory settings, concentration methods are used to increase the probability of finding eggs, cysts, trophozoites, and larvae of parasites in preserved and unpreserved specimens. Concentration methods are essential for locating parasites when the parasitic load in an individual is low. For this study, the CONSED® system was the concentration method used to facilitate the identification of parasites. The CONSED system is a relatively new procedure that was designed specifically to concentrate fecal specimens that have been collected and preserved in ProtoFix solution. Like ProtoFix, the CONSED solution is commercially available from Alpha-Tec Systems, Inc.

The CONSED system uses the principals of sedimentation (as opposed to flotation) and is often referred to as gravity sedimentation because the specific gravity of parasite eggs, cysts, and trophozoites play a role and because the process requires the use of a centrifuge. The system uses a unique sediment solution, straining funnel, and centrifuge.

After each sample had been concentrated using the CONSED procedure, wet-mount slides were prepared and later analyzed with a microscope. The wet-mount procedure used in this research was as follows: After the concentration procedure had been performed, a small specimen was taken from the centrifuge test tube and placed onto a microscope slide. Cover glass was then placed over the specimen and excess liquid or material was wiped off. The edges of the cover glass were then sealed using vaspar, a heated mixture of 50% Vaseline and 50% paraffin wax. Sealing the edges of the cover glass preserved the specimen for up to a week making it possible to examine the slide at a later date when it was convenient.
**Staining Procedures for the Identification of Cryptosporidium parvum**

In addition to preparing wet-mount slides for the examination of common intestinal parasites, a special staining procedure to examine all specimens for *Cryptosporidium parvum*, (an intestinal coccidian parasite that is of increasing public health importance) was performed. It was decided to test specimens for *C. parvum* because it is considered to be an important water-borne parasite that is able to persist in chlorinated water systems. For example, *C. parvum* was implicated as the pathogen that infected more than 300,000 residents of Milwaukee, Wisconsin in 1996 due to contaminated drinking water (Mayer 2000). Since *C. parvum* is too small to be identified using traditional microscopic techniques, a staining procedure has been invented to facilitate its identification. A small part of the concentrated specimen was taken and spread over a microscope slide, thereafter, each slide underwent a simple two part staining process to test for *C. parvum*. The staining kit used in this research is available from Alpha-Tec Systems, Inc. to be used with specimens that have been collected and preserved in ProtoFix solution.

**Analysis of Fecal Samples**

The microscopic analysis procedures used to determine the presence of intestinal parasites as well as the quality assurance measures employed to ensure proper diagnosis is discussed in the following chapter.

**Dissemination of Results**

The results of all samples were given to participants as soon as possible after they had been properly examined. In the case of positive samples, the results were given to them as soon as they had been verified by the private laboratory. In all cases, a results sheet was given to the head of household with the name of each participant, the date, and the results of the laboratory examination along with the researcher’s signature. When the results dealt with positive samples, the original result sheet from the private laboratory in Puntarenas was presented and given to the head of household.
In the case of positive samples I was careful to provide the participant or head of household with comprehensive information as to the meaning of the results and whether or not the species tended to be pathogenic or non-pathogenic. With all participants, regardless of whether the results from their sample were positive or negative, I took as much time as necessary to explain the nature of the parasites and their infections. I was also careful to explain concepts such as sources of infection, modes of transmission and prevention strategies particular to different species of parasites.

**Anthropological Methods**

In addition to the public health field and laboratory procedures, I also relied heavily on anthropological methods including semi-structured interviewing and participant observation to better understand the cultural, behavioral, and the political-economic context of parasitic infections (see Table 4-5 for an overview). For this study, anthropological methods were an invaluable tool to evaluate the source of infection and mode of transmission of parasitic infections within the household setting.

**Table 4-5. Anthropological Methods**

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Archival Data Collection</td>
<td>Documents containing local and national health statistics, local water quality reports, and newsletters were collected to provide background information for the study.</td>
</tr>
<tr>
<td>Semi-Structured Household Demographic Interviews for Costa Ricans and Nicaraguans</td>
<td>This interview was conducted with all Costa Rican and Nicaraguan households to gather information regarding household structure, income, employment, education, migration/immigration, and remittances.</td>
</tr>
<tr>
<td>Semi-Structured Health Interviews</td>
<td>This interview was conducted with all households in order to elucidate knowledge, attitudes, and behaviors relating to intestinal parasite.</td>
</tr>
<tr>
<td>Semi-Structured Water Security Interviews</td>
<td>This interview was conducted with all households to gain information concerning household water use, access, cost, water quality, water security, sanitation, wastewater management and perceptions about water services.</td>
</tr>
<tr>
<td>Participant Observation</td>
<td>Observations were conducted during household visits to identify household conditions relating to potential sources of infections and modes of transmission of parasites.</td>
</tr>
</tbody>
</table>
Key Informant Interviews

Community leaders, water managers, and clinic staff were interviewed to better understand community water security and local health issues.

Health Education

All households that participated in the study received basic information about how to prevent parasitic infection including common modes of transmission and sources of infection.

Archival Data

The majority of Archival data for this phase of the research had already been collected during “The Household Management of Health, Water and Waste Project.” However, more secondary and archival data was gathered and used to compare and place local reality within national and historical context. Documents such as national health statistics, studies of immigrant health, newsletters, newspaper articles, historical documents and records were used to provide background and historical information for the parasite prevalence study. In addition, local health statistics, most importantly, the period prevalence of intestinal parasites from the Monteverde Clinic was collected. This data provided a point of comparison between my data and the clinic data regarding parasite prevalence at the time of this research. Records of water quality analysis of the Santa Elena Aqueduct were also collected in order to determine potable water quality standards at the time of this research.

Semi-Structured Interviews

Because this research was not only interested in parasite prevalence rates between Costa Ricans and Nicaraguans, but also the political, economic, cultural and historical factors that influence risk factors for infection; a series of 3 semi-structured interviews aimed at better understanding these factors were administered to each participating household. Each of the three semi-structured interviews focused on a different theme that coincided with the research objectives such as: household demographics, household water management, and knowledge, attitudes and behaviors relating to parasites.

The interview guides, while structured, allowed me to pursue relevant leads from the participant. In addition, all of the interview guides were developed based on past research carried out in the community including the GRC development survey and “The
Household Management of Health, Water and Waste Project.” All of the semi-structured interviews were briefly piloted for content and language and changes were made where necessary during the research as well.

The interviews were administered during household visits that were scheduled around the collection, retrieval, and dissemination of results of the fecal specimens. This method of administering the interviews was both convenient for me and for the participant since it spread the interviews out over the period of a couple weeks. In this way, the participants felt that each interview was part of each household visit relating to the handling of the fecal specimens. In addition, the researcher made an attempt to maintain the time needed to conduct each interview to a minimum so that participants would not feel that each household visit was so time consuming. In general, all three of the semi-structured interviews took approximately between 30 to 45 minutes to administer.

It should also be noted that two separate demographic interviews were designed for both Costa Rican and Nicaraguan households. The researcher decided that household histories and structures differed greatly between the two groups and that administering the same instrument to both populations would risk being irrelevant to one group. However, the interview maintained continuity by asking relevant questions to both groups. For example, virtually all questions that were asked of Costa Rican Households were also asked of Nicaraguan households. The interviews only diverged in topics that are relevant to Nicaraguan households, for example, immigration to Costa Rica, access to community services, and finally perceptions and experiences of social acceptance within the Costa Rican community.

Semi-Structured Demographic Interviews for Costa Rican Households

This was the first of the three semi-structured interviews administered to Costa Rican families. In most cases it was conducted on either the first or second visit to the household. The interview was designed to be simple and straightforward and in general took approximately 30 minutes to administer. Demographic interviews were administered to each of the 18 Costa Rican households in the study. This interview asked participants
about their place of origin and their current household structure including the number of people who inhabit the home during the entire year. Information relating to current employment/income and past unemployment for all household members was collected. In addition, several questions were aimed at community participation and their perceptions of tourism in the area including whether the household perceived itself as benefiting directly from tourism. Finally, participants were asked to express their opinions of the community’s health services and were asked to share both good and bad experiences and whether all household members had health insurance (See Appendix C for a copy of the actual interview).

**Semi-Structured Demographic Interviews for Nicaraguan Households**

As discussed above, the same questions asked to Costa Rican households including household structure, employment, perceptions of tourism, and health services were also asked to Nicaraguan households. In addition, a series of questions aimed at better understanding the reality and uniqueness of Nicaraguan households were added to this semi-structured interview. As a result, this interview took a bit longer to administer; usually about 45 minutes. This was the first of the three semi-structured interviews administered to Nicaraguan families. In most cases it was conducted on either the first or second visit to the household. Demographic interviews were administered to all 11 Nicaraguan families in the study.

The additional questions included topics of the household’s first migration to Costa Rica and continued movement between the two countries. In addition to asking their opinions about local health services, Nicaraguan residents were asked about the level of access they had to community services in general. The interview also included questions concerning remittances sent to family and friends in Nicaragua. Finally, questions relating to perceptions and experiences of social acceptance within the Costa Rican community were asked (See Appendix D for a copy of the actual interview). The ideas for additional questions came in part from a questionnaire that was used for a transnational study on the immigration situation between Costa Rican and Nicaragua. The
research for that study was carried out in 2000 by the International Organization for Migration (OIM 2001).

_Semi-Structured Interviews: Parasite Perceptions and Knowledge_

This was the second semi-structured interview administered to study participants. In general it was administered on the second or third visit to the participants’ household. The household health interview was specifically developed and administered to heads of household in order to elucidate individual knowledge, perceptions, and behaviors relating to parasites etiology, symptoms, and treatment pathways. In addition, participants were asked to provide a detailed household parasite infection history and participant’s history of taking anti-parasitic medication. Out of the three semi-structured interviews administered, this one tended to last the longest, taking on average 45 minutes. In total, 18 health interviews were administered to Costa Rican families and 10 were administered to Nicaraguan families (See Appendix F for a copy of the actual interview).

Specifically, heads of household were asked to talk freely about their understandings of what parasites are, the different species they knew of, where they come from, how they are transmitted, and how one can prevent getting them. Participants were also asked to talk about past experiences with parasites, how they identify persons infected, and what they do to get rid of them; paying special attention to both western and folk medicine. Participants were also asked to talk about parasites in the community, if seasonality or weather plays a role, and whether they perceive parasites as a public health problem. The interview ended by asking a series of yes/no questions that were designed to test specific knowledge concerning common parasite etiology and to verify whether these answers coincided with statements they had made at the beginning of the interview. This activity proved to be helpful in clarifying ideas and in getting participants to offer more information.

The main purpose of this interview was to create and better understand how participants construct parasite related domains and to see whether these domains differed significantly between Costa Rican and Nicaraguan households. The researcher felt that this information was relevant since participant knowledge, perceptions and behaviors
related to parasites were completely unknown. The researcher was also interested in this information because all participants would be provided with education materials relating to parasites at the end of the study, and in order to provide participants with relevant information regarding parasites, domains of knowledge and perceptions had to be understood.

**Semi-Structured Interviews: Household Water Management**

This was the last of the three semi-structured interviews administered to study participants. In most cases it was administered on the third or fourth visit to the household. This interview tended to be the shortest of the three semi-structured interviews; taking on average 15 minutes to complete. In total, 18 water interviews were administered to Costa Rican families and 10 water interviews were administered to Nicaraguan families.

Since this research was interested in whether there was an association between local water management and the prevalence of intestinal parasites, interviews were conducted with all heads of household in order to ascertain information about household water use, water supply, access, cost, perceptions of water quality, water security, sanitation, wastewater management and the quality of water services (See Appendix E for a copy of the actual interview). These interviews were extremely similar to the ones conducted in “The Household Management of Health, Water and Waste Project.” For example, observations regarding household water infrastructure both in and outside the household were conducted during the interview. The decision to follow the format of the interview guide used in previous study was twofold. First, the questions asked in the interview efficiently cover a wide spectrum of issues related to household water use and perceptions. Second, the researcher wished to know whether there was a difference between water use, access and handling between Nicaraguan and Costa Rican households.
**Participant Observation**

Although participant observation was not planned as being a major method of data collection of this research, observations conducted during household visits provided valuable information. Apart from the formal observations conducted during the household water interview, informal observations were conducted during most other household visits. These informal observations related to sanitary conditions and behaviors, possible sources of infection, and potential modes of transmission in addition to household structure and family dynamics.

**Key Informant Interviews**

Key informants including community leaders, water managers, and clinic staff were interviewed to better understand these issues within the community context. The researcher was also lucky to count on a key informant from the Nicaraguan community who helped place the community into political, economic, and cultural perspective as well as introduce the researcher to other members of the community. Key informants were chosen based on their ability to provide information that reflects broad consensus or official policy in their field of expertise.

One of the important key informants interviewed was a community health specialist from the Monteverde EBAIS who was familiar with the Nicaraguan community and the health issues that affect them. This particular key informant shed light on many issues important to the research and was also helpful in providing me with parasite prevalence data from the Monteverde Clinic. Other key informants included the director of the Santa Elena Aqueduct, water researchers from the Monteverde Institute and a local water committee member. These key informants provided me with a better understanding of community water issues and also provided me with community based water quality data.
**Health Education**

Based on interviews with participants concerning knowledge, perceptions, and behaviors of parasite etiology, an information brochure was designed, prepared, and explained to participants in the form of an educational discussion (See Appendix G for a copy of the educational brochure). In most cases the discussion was conducted during the last household visit. The brochure and discussion touched on and explained all of the topics of the health interview. It was discovered that the majority of participants had a relatively high level of sophistication when it comes to knowledge about parasite. The education discussion served to correct common misconceptions about parasites and focused on sources of infection, modes of transmission, and prevention.

**Data Analysis**

A discussion of laboratory analysis procedures and both qualitative and quantitative data analysis procedures is presented in the following chapter.
Chapter Five – Data Analysis

This chapter will briefly describe the process of data analysis of both the public health based research methods and the anthropology based research methods. This discussion of the research analysis will be organized in three sections: 1) analysis of biological samples to determine the presence of intestinal parasites among study participants; 2) analysis of ethnographic data collected from semi-structured interviews concerning participants’ perceptions and knowledge of intestinal parasites; and 3) statistical analysis of demographic and epidemiological data from household surveys and laboratory results of fecal samples.

Analysis of Biological Samples to Determine the Prevalence of Intestinal Parasites

For this part of the research, an American Optical, Model 110, compound clinical microscope was used to examine the prepared fecal specimens. The microscope was set up for Köhler illumination in order to examine all wet-mount samples under bright-field illumination (Price 1994). Setting up the microscope for Köhler illumination facilitates locating potential cysts and trophozoites of intestinal protozoa through their refractive index. This was achieved by scanning each wet mount specimen under the 10x ocular objective while quickly moving the fine focus of the microscope in and out of focus to look for objects to “flash” in the field. When a suspicious object was observed, the researcher switched to the 40x or 100x objectives to better observe the object. In most cases, species identification was determined using the 100x objective and by using the microscope’s eyepiece micrometer for the precise measurement and identification of parasite cysts, trophozoites, and eggs. Identification of parasite species was based on morphological characteristics including size and internal cell structure.

When parasites species identification was questionable, the researcher used the CDC parasite bench aids and Prices’ key for differentiating species of intestinal amoebae and helminth eggs found in feces preserved in PIF solution. Parasite identification was
made directly from the wet-mount concentrated slides. While it is suggested that slides should be stained with Polychrome IV or Trichrome-PLUS to ensure species identification, I found that identifications from wet-mounts were more than sufficient and much less time consuming.

One of the major conditions imposed by the CEC-IRET (the Costa Rican IBR Committee) to the parasite prevalence study was that all fecal samples that tested positive for parasites, and a random selection of samples that tested negative for parasites, be verified by a licensed microbiologist in Costa Rica. This condition was imposed, in part, because the researcher was not a microbiologist by training and was therefore not licensed to provide laboratory results to Costa Rican citizens. As a result, all positive lab results obtained by the researcher had to be confirmed by a licensed Costa Rican microbiologist.

In order to accommodate the confirmation of positive lab results, the researcher adhered to the following protocol: 1) once the researcher identified a positive sample all of the details were noted in a laboratory diary and logged into a computer spreadsheet and digital photographs were taken for additional documentation; 2) once several positive samples were identified, the original sample vials were taken to a licensed microbiology laboratory in Puntarenas for secondary confirmation; 3) for every three positive samples submitted for confirmation, the researcher included a random negative sample to be confirmed as a quality control measure. Secondary laboratory confirmation of for intestinal parasites was carried out by the Laboratorio Quimico Clinico, Dra. Zoila Torres located in Puntarenas. This private laboratory was chosen because the turnaround time for sample confirmation was much faster (just a few hours) compared to a CCSS clinical laboratory where the turnaround time was several days at best. Once laboratory confirmations were completed, the microbiologist provided the researcher a signed document stating the official diagnosis with the name of the corresponding patient. Copies of these documents were made and the researcher later disseminated the original form to the patients.
Qualitative Data Analysis of Semi-Structured Interviews

Analysis of semi-structured interviews of participants’ perceptions of intestinal parasites was done entirely using a grounded theory approach with the qualitative data analysis software ATLAS.ti 5.0. In total, 28 interview transcripts were assigned into the ATLAS.ti primary document manager and a hermeneutic unit (project document) was created. Later, each transcript, or primary document was further assigned into primary document families; appropriately named Costa Rican households and Nicaraguan households using the primary document family manager. Each primary document was assigned a family in order to facilitate queries that later reveal differences and similarities both among and between groups.

The next analytical step was to code the primary documents. Codes, in this case were understood as names for pieces of data (quotations) that have specific meaning and can that can be organized into thematic groups. In order to facilitate data analysis, primary documents were coded and organized within the specific parameters of the interview objectives: 1) how participants describe what parasites are in general; 2) how participants understand the source of infection and mode of transmission of parasites; 3) how participants identify common symptoms and illnesses relating to parasites; 4) to know what illnesses or diseases are caused by parasites; 5) what participants do to treat parasites; 6) what participants do to prevent parasites; and finally 7) to explore community perceptions of parasites and areas of folk knowledge.

While the process of coding primary documents followed the structure of the research objectives, the actual codes themselves were based on careful reading of each document. In this sense, it was the intent of the researcher to “ground” the codes as close as possible to the data. Also, when possible, codes were given procedural labels. As explained by Charmaz (2006), procedural coding uses the gerund to label codes (i.e., walking with bare feet) in order to elucidate structures of process in the data, not just explanations. This method of coding proved to be relevant because the interviews sought to understand what mothers do, would do, or should do in hypothetical situations. In the end, the researcher created approximately 174 codes from the 28 primary documents.
Another important aspect of coding and of data integration in general, is creating families of codes. In ATLAS.ti, code families represent related codes that when combined, form thematic groups; sometimes referred to in ethnography as cultural domains (Spradley 1980). In this research, code families were developed as a result of analysis of the codes themselves and from the interview objectives. As part of the analysis, code families were constructed, modified and used as a tool to further code interview transcripts. In total, 25 code families were constructed; 7 of which were considered primary code families that represented the interview objectives and served as a guide to writing up the data.

The researcher also implemented the use of writing tools in ATLAS.ti such as comments and free memos; the cornerstones of data analysis. In ATLAS.ti, each analytical object (primary documents, quotations, codes, and network views etc.) is accompanied with an optional comment box. The researcher used comment boxes to write field notes of specific interviews relating to the corresponding primary document (notes relating to household conditions or about the interview itself). Comments were also used by the researcher to define and justify codes, to comment on the importance of specific quotations, and as reminders to pursue different methodological and analytical phenomena.

Memos are similar to comments, but differ in the fact that they can be linked and integrated to multiple analytical objects such as quotations, codes and other memos. Memos represent a space where the researcher writes observational, analytical, theoretical, and methodological ideas about the data. For example, a single memo linked to three quotations provides a space to discuss the relationship between those quotations. In this research, memos were employed as the primary means of data analysis, data integration, and write up. The researcher used memos as a space to construct ideas and theory while working with the data. For example, reading a certain passage or quote from an informant would jar the memory of similar or different quotes from other informants; memos provided the space for this researcher to think about and question similarities and differences in the data which in turn lead to theory construction. In this research, memos were also linked to codes as a way to theorize about their inclusion or exclusion into
certain code families. As a result, this researcher wrote memos throughout the coding process as a means to analyze the data. The researcher even created memo families that consisted of comment memos, analysis memos, methodological memos and write-up memos to organize and facilitate this process.

Another important process of the qualitative analysis in this research was to link codes with other codes using the relation manager. In ATLAS.ti, the relation manager is used to define the semantic relationship between codes. For example, the two codes “padra” and “lombrices” were linked with the semantic linear designation “is treatment for”. Another example, “grinding teeth” and “lombrices” was linked with the semantic relation “is symptom of”. In this research, semantic relations were applied by asking questions of the data, for example, “how do mothers know when their children have parasites?” These questions were answered by going back to the data and analyzing existing relationships between quotations, codes and memos relating to specific research questions and by applying the appropriate semantic links to those codes.

Another analytical tool used for data analysis was the use of Network views. Quite simply, network views provide a visual look at the data and can be the result of linked elements such as a code family or constructed manually. Graph 6-1 provides an example of a network view taken from the research. This network shows a graphic representation of the code family “description of parasites” and shows the 11 codes that are inclusive to that code family. This network view shows that the code “eat food in intestine and blood” has 17 related quotations attached to it (two of which can be seen in the network view), while the code “larva” has only one quotation attached to it. Thus, the network view demonstrates that informants overwhelmingly tend to describe parasites as “things that eat food in the intestine and blood” compared to describing parasites as “larva”.

Memo “distinguishing parasites” - 12/06/07 12:34:13 PM
Participants often differentiate parasites primarily through morphology. For example, people note that "amoebas" are so small that one can't see them. "Lombrices" on the other hand are bigger to where one can see them and resemble common earth worms.
The memo “distinguishing parasites” in this network view is linked to several codes and provides insights about their relationships. This particular memo was written during the coding process. The previous excerpt was taken from the actual memo in Figure 5-1. As a result, the network view in ATLAS.ti was used by the researcher as a way to visually represent code families and as a way to determine the relevance of each code relative to other codes in the family, and finally as a way to easily view the researchers comments about certain aspects of the network.

Figure 5-1. Network View of Qualitative Data Analysis

Another important analytical tool in used in this research was the “query tool.” The query tool in ATLAS.ti is a powerful search engine that can accommodate both simple and complex search procedures. For this research, the query tool was used primarily to compare and contrast the knowledge, beliefs and behaviors of Costa Rican and Nicaraguan mothers who participated in the survey. In ATLAS.ti, filters can be applied to virtually any analytical object including primary documents and codes, as well
as document families and code families. For example, the researcher used filters to only show the primary documents of Nicaraguan mothers and then asked the query tool to show all quotations related to the code “ataque de lombrice”. This would provide all of the quotations where Nicaraguan mothers talked about worm attack. These results were then copied into a memo named “comparing beliefs about ataque de lombrice”. Next, the filter was changed to only show the primary documents of Costa Rican mothers and the query tool was asked the same question whereby producing quotations relating to worm attack from Costa Rican mothers. These results were copied into the same memo. This information allowed the researcher to compare differences and similarities between Nicaraguan and Costa Rican mothers’ knowledge and beliefs and behaviors of intestinal parasites; the conclusions of which were written in the same memo.

**Data Analysis of Demographic and Epidemiological Data**

Analysis of quantitative data from household demographic interviews, household water interviews and epidemiological data relating to the period prevalence of intestinal parasites were done using the statistical software package SPSS 13.0. Data and notes collected from interviews were taken on paper and then transferred into an SPSS database. Originally, four databases were created: 1) basic demographic data of all household residents (including name, age, sex, education); 2) household demographic data (household income, individual health care coverage); 3) household water data; and 4) epidemiological data of participants who provided fecal samples for testing.

Later, these four databases were modified into three main databases that were used as the basis for statistical analysis: 1) basic demographic and household data for all study participants; 2) basic demographic, household, water, and epidemiological data of participants who provided a fecal sample; and 3) household level demographic, water, and epidemiological data. In addition, some data from the Monteverde Clinic (ASIS 2002) were converted into an SPSS database and used to create comparative statistics such as age distributions.

The first step in data analysis was to examine the basic demographic and household data for all study participants. To facilitate analysis, many variables in the
database were converted into nominal categories including age, education, household size and home ownership. Using SPSS, simple statistical procedures such as frequency outputs and cross tabulations were performed in order to calculate the frequency, percent, mean, median, and range of all relevant variables.

Later, statistical tests of association were performed on the data. This research assumes that the Costa Rican and Nicaraguan study populations constitute two independent samples that were collected at two different locations in the same community. For this reason, unpaired independent sample $t$ tests were used to test for any significant difference in the mean age of Nicaraguan and Costa Rican participants and to test for any significant difference in the mean age of male and female participants from within nationality groups and between nationality groups. In addition, $t$-tests were also used to test for any significant difference in mean years of education obtained, mean household size, and mean household income between Costa Rican and Nicaraguan households. The following standard formula to conduct the independent sample $t$ test was calculated using SPSS (Kinnear 2006):

$$
t = \frac{M_1 - M_2}{\sqrt{s^2 \left( \frac{1}{n_1} + \frac{1}{n_2} \right)}}
$$

For $t$ tests, the level of significance ($\alpha$) was set at $\leq 0.05$. The null hypothesis stated that there is no difference in the mean scores between the two groups ($H_0: \mu_1 = \mu_2$). Thus, when the probability associated with a certain $t$ score was less than or equal to 0.05, the scores difference from the mean will be declared statistically significant and the null hypothesis rejected.

Because the majority of variables analyzed for this research consisted of nominal or categorical data, Pearson’s chi-square ($\chi^2$) tests were used to test the statistical association of parasitic infection with other nominal and discrete variables (e.g., nationality, gender, household size category, the presence of infected family members, health care coverage, unemployment status, education category, household conditions,
home ownership, and household income category). The following standard formula was used to conduct chi-square test for association using SPSS (Kinnear 2006):

$$x^2 = \sum \frac{(O - E)^2}{E}$$

For chi-square tests, the null hypothesis stated that there is no association between the two variables and the level of significance ($\alpha$) was set at $\leq 0.05$. That is, if the $x^2$ value indicated a $p$ value of $\leq 0.05$ the null hypothesis was rejected and a significant association assumed. In cases where the expected frequencies of the $x^2$ test were less than 5, the statistic was corrected (Madrigal 1998). For this research, Fisher’s Exact Test was used as the standard $x^2$ correction because it was automatically generated when calculating 2x2 contingency tables in SPSS.

Epidemiological statistics such as prevalence and prevalence odds ratios were also used to explain rates of parasitic infections and risk. For this study, period prevalence was calculated in order to know the prevalence of intestinal parasitic infections present in the population from January 1$^{st}$, 2004 to June 30$^{th}$, 2004. Period prevalence was calculated with the following formula:

$$prevalence = \frac{All \ new \ and \ pre-existing \ cases \ during \ the \ time \ period}{Sample \ population \ during \ the \ time \ period} \times 100$$

Because this research is considered a case/control study, odds ratios were calculated to determine the odds of having tested positive for intestinal parasites and having certain characteristics (e.g., education categories, home ownership, household conditions, health insurance, household size, and presence of infected family members) between Costa Ricans and Nicaraguans. Odds ratios were calculated using the same 2x2 contingency table as the Pearson’s chi-square test for association. The formula to calculate the odds ratio is the following:

$$OR = \frac{(A \times D)}{(B \times C)}$$
For the Odds Ratio, a 95% Confidence Interval was used to determine significance. Since an odd ratio value of 1.0 means that each group has the same odds of having disease, or whatever characteristic, the odds ratio calculation was considered significant if the 95% confidence level did not include the number 1.0.

Chapter six will focus on the results of the qualitative data regarding participants’ perceptions and knowledge of intestinal parasites while Chapter seven will discuss the results of the quantitative data; specifically the epidemiological data and the household survey data.
In addition to epidemiological data regarding the period prevalence of intestinal parasites, semi-structured interviews were conducted with each head of household to gather qualitative data regarding Nicaraguan and Costa Rican participants’ knowledge, perceptions, and behaviors relating to intestinal parasites. The semi-structured interview was specifically developed and administered to heads of household in order to elucidate individual knowledge, perceptions, and behaviors relating to the following interview objectives: 1) how participants describe what parasites are in general; 2) how participants understand the source of infection and mode of transmission of parasites; 3) how participants identify common symptoms and illnesses relating to parasites; 4) to know what illnesses or diseases are caused by parasites; 5) what participants do to treat parasites, 6) what participants do to prevent parasites; and finally 7) explore community perceptions of parasites and areas of folk knowledge. In addition, participants were asked to provide a detailed household parasite infection history and participant’s history of taking anti-parasitic medication.

Specifically, heads of household were asked to talk freely about their understandings of what parasites are, the different species they knew of, where they come from, how they are transmitted, and how one can prevent getting them. Participants were also asked to talk about past experiences with parasites, how they identify persons infected, and what they do to get rid of them; paying special attention to both western and folk medicine. Participants were also asked to talk about parasites in the community in terms of which people are most likely infected, if seasonality or weather plays a role, and whether they perceive parasites as a public health problem. The interview ended by asking a series of yes/no questions that were designed to test specific knowledge concerning common parasite etiology and to verify whether these answers coincided with statements they had made at the beginning of the interview. These yes/no questions
proved to be helpful in clarifying ideas and in getting participants to offer more information. The following network view depicts the principal domains of qualitative analysis used in this part of the research.

**Figure 6-1. Network View of Model of Qualitative Analysis**

Finally, the main purpose of this interview was to better understand how participants construct parasite related domains and to see whether these domains differed significantly between Costa Rican and Nicaraguan households that would ultimately help to inform and ground the epidemiological data within the context of cultural and household level realities. The researcher felt that this information was relevant since participant knowledge, perceptions and behaviors related to parasites were completely unknown. The researcher was also interested in this information because all participants would be provided with education materials relating to parasites at the end of the study. A total of 28 interviews were conducted with heads of household; 18 interviews were administered to Costa Rican families and 10 were administered to Nicaraguan families.

**Defining Parasites**

When participants were asked to "describe what parasites are?" two primary domains appeared that were similar among both Nicaraguan and Costa Rican participants. The first domain was related to where parasites reside and what they do within the human organism; the second domain was related to specific morphology, or a
physical description of parasites. In addition, several participants were able to list a good number of parasite species by name indicating that knowledge of particular parasites have been passed down from past generations as well as learned as a result of local primary health promotion/education. A view of this network can be seen in the following graphic. The network depicts the domain “description of parasites” that is connected with relating codes elicited from interviews. The graphic is followed by a more in-depth description of the domain along with quotes that illustrate codes and domain structure.

Figure 6-2. Network View Defining Parasites

First, participants tended to define parasites in terms of where parasites reside and what they do within the human organism. The most common example of this appears when participants state that parasites are "things" or "bichos" (bugs) that reside in ones stomach or intestine. Take the following quotes as an example; the first from a Costa Rican woman and the second from a Nicaraguan woman:

“They are little bichos in your stomach." (8:1 - 13)

“Well, I know that they live in your stomach, and that there are lots of different kinds, I mean species.” (19:1 - 17)
While these simple definitions of parasites were commonplace, the most common way used by participants to define parasites was to describe both where they live and what they do within the human organism. Participants stated that parasites either eat one's food in the intestine before the body can use or process it or that parasites eat blood and suck nutrients from a person’s intestine or stomach. This was a common theme described in 17 of the 28 participant interviews. These views are expressed in the following participant quotes:

“They are little bichos that live in ones intestine and live off the food that one eats.”
(6:2 - 13)

“Well they say that the parasites or whatever eats the food that you eat; they also eat vitamins from the food you eat.” (10:8 - 39)

In addition, participants often related that parasites eating food and nutrients in ones stomach or intestine was directly related to both symptoms or illnesses such as stomach aches, diarrhea, not gaining weight, being listless, and malnutrition. These ideas are well illustrated in the following quotes from both Nicaraguan and Costa Rican participants.

“They are bichos that live inside you and live off the food that one eats. They cause stomach aches, vomiting, and malnutrition in kids, especially the lombrices (worms).” (12:2 - 13)

“I guess that the parasites, since they live in people’s stomachs that they eat all the food or nutrients that the person eats, so that’s why they don’t gain any weight.” (19:6 - 33)

Several participants were even able to identify parasites by name and link it with where they live and what kind of symptoms and illnesses they cause. For example:

“I know that this one parasite Giardia clings to your intestine and eats the food that a person eats before they can digest it. They also cause vomiting and dizziness.” (2:6 - 25)

“Then there is the La Solitaria which is very long, like meters long and it eats your food and you can’t gain any weight; you get skinny.” (23:7 - 15)
The second way participants described parasites was to distinguish specific morphology or physical description of parasites. For example, informants recognize that there are "microscopic" parasites that you can't see and that there are parasites that are "bigger" that you can see. This knowledge most likely comes from both folk knowledge based on experience with lombrices and biomedical knowledge from primary health campaigns that describe parasites as "microscopic." Virtually all of the participants made the distinction that "amoebas" are small or "microscopic" and that one can't see them while lombrices or worms are bigger to where one can see them and resemble common earth worms. These descriptive domains were constant between both Nicaraguan and Costa Rican residents as illustrated in the following quotes.

“I know that they are really small and that you need a microscope to see them. The lombrices however are bigger.” (2:2 - 13)

“I know that they [lombrices] are big, they are like the worms that live in the ground. I remember that when I was a kid my mother would give me a purgante in the morning and all of them would come out.” (21:1 - 37)

“Well, amoebas are small and they eat away at your intestine and blood and stuff like that. Let’s see, and lombrices are bigger and they sometimes rise up from the stomach and get into your lungs. You need to treat them with medicine otherwise you can choke on them.” (20:3 - 23)

In addition to describing parasites in terms of where they reside and their morphology, several participants were able to identify parasites by name, often including specific details relating to size, symptoms, source and mode of transmission and ways to treat them. In total, participants were able to name eight different species of parasites; the most common parasites named, as in the number (N) of interviews the code appeared were “La Solitara” (N=9) or tape worm; followed by “Giardia” (N=6); “Pin Worm” (N=2); “Hookworm” (N=1); and “E. nana” (N=1) a common commensal parasite. The following quotes demonstrate the detailed knowledge that some participants had obtained about specific parasite species.

"I know that this one parasite, Giardia clings to your intestine and eats the food that a person eats before they can digest it. They also cause vomiting and dizziness."
There is also one called *E. nana* but I don’t remember what it does. I know that the amoebas, when there are a lot of them they give you a stomach aches and your feces can have blood in them.” (2:6 - 25)

"There is one that I know of, pinworm [*E. vermicularis*] that makes your anus itch really bad.” (6:2 - 13)

"When people eat lots but are still really skinny. That is caused by *La Solitaria*, my brother had it and he went to the doctor and they gave him medicine and then it came out of him and it was huge.” (4:3 - 30)

These statements taken on a whole indicate that while participants have constructed detailed descriptions of parasites their knowledge was based primarily on word of mouth, from primary health campaigns and in the case of *lombrices*, from experience. However, none of the participants was able to provide a solid biomedical definition of a parasite apart from noting that *lombrices* are worm like and amoebas are "microscopic". Interestingly, knowledge and descriptions regarding parasites between Nicaraguan and Costa Rican participants were very similar.

**Source of Infection and Mode of Transmission**

Both Nicaraguan and Costa Rican participants portrayed a deep and broad range of knowledge and perceptions regarding the source of infection and mode of transmission of intestinal parasites. To reiterate, the source of infection refers to the medium (water, soil, utensils, etc.) or the host organism (vector, or intermediate host) on which or in which the infective stage of the parasite is found. The mode of transmission refers to the precise circumstances and means by which the infective stage is able to come in contact with, gain entry to, and initiate an infection within the host (Price 2003). In order to understand how participants conceptualized and constructed ideas regarding the source of infection and mode of transmission the researcher asked simple questions including "where do parasites come from?" and "how does one get or contract parasites?"

Based on qualitative analysis using ATLAS.ti, a total of 26 codes emerged relating to the source of infection. The most common source of infection, as in the number (N) of interviews the code appeared were "Flies" (N=18); "Poor Hygiene" (N=16); "Water" (N=13); "Animals" (N=10); "Insects" (N=8); "Feces" (N=7); and "Dirtiness" (N=5). An analysis of the mode of transmission revealed 17 different codes,
the most common being "Eating Contaminated Food" (N=20); "Eating with Dirty Hands" (N=14); "Walking Barefoot or Walking on the Ground" (N=12); "Drinking Contaminated Water" (N=11); and "Putting Dirty Objects in Mouth" (N=9).

After further analysis in ATLAS.ti, six principal domains emerged from grounded codes that exemplified the scope of knowledge and perceptions regarding the source of infection and mode of transmission. The six domains include the following: 1) “Animals and Insects; 2) Food; 3) The Ground and/or Dirt; 4) General Hygiene; 5) Hand Washing; and 6) Water. A view of this network can be seen in the following figure followed by a short description of each domain.

**Figure 6-3. Network View of Source of Infection and Mode of Transmission**

**Domain: Animals and Insects**

The emergent domain "Animals and Insects" in reference to the source of infection and mode of transmission relates to the common perception that insects, including flies and cockroaches, can cause a wide range of illnesses and can transmit parasites. Among participants, "flies" constituted the most common culprit. In addition, many participants demonstrated a complex understanding of how one can contract parasites from flies; stating that flies often carry feces on their feet and then land on food.
which is later ingested causing infection. This understanding can be observed in the following quotes:

“Yes, from flies, they can transmit parasites on their feet and then land on your food and you can get parasites like that. You can also get parasites from cockroaches the same way.” (3:28 - 89)

“Well, flies usually land on excrement and then if they walk all over your food and if you eat it you can get parasites and get sick.” (14:34 - 85)

Another common theme was that one can get parasites from animals, most often from domestic animals and rats. Some participants explained that one can get parasites from animals that are dirty and that are not well taken care of, while other participants explained how one can get parasites from the feces and urine of common animals. The following quotes demonstrate these perceptions.

“Yes, especially street animals because they are dirty. Animals like cats, dogs, rats, cows; you can get parasites from their feces and urine.” (2:19 - 71)

“Yes, especially from domestic animals like cats and dogs.” (19:24 - 111)

“From animals I guess, like when rats crawl over your plates and silverware. I am always careful about that...Or like, you know how when dogs roll around on the ground; you can get parasites like that.” (24:3 - 29)

These common perceptions held by both Nicaraguan and Costa Rican households are exemplified in the fact that even household pets such as dogs and cats are rarely handled and are most often kept outside and are not allowed inside the living quarters.

**Domain: Food**

The emergent domain "Food" as source of infection and mode of transmission was the most common and best understood by participants. In fact, all of the 28 interviews mention at least some aspect of "food" as a source of infections or mode of transmission. The most common code that emerged from the data as in the number (N) of interviews the code appeared was "Eating Contaminated Food" (N=20); followed by "Improper Food Handling" (N=7); and "From not Washing Food" (N=5). Again, many
participants exhibited a high degree of understanding of specific modes of transmission regarding food, hinting at the various ways food can become contaminated and thereby transmitting parasites when ingested. These concepts are exemplified in the following quotes.

“Well with food, when you eat food like vegetables you have to be careful because if the food is dirty it can have parasites and then if you eat it you can become infected.” (2:4 - 21)

“Yes, especially like I said from food that has been lying out. Oh, and from fruits and things like that, you have to be sure to wash those kinds of things well before you eat them.” (27:19 - 67)

“Improper handling of food also causes parasites. Especially things like fruit if you don’t wash it.” (11:16 - 41)

"They can be caused by the poor handling of food and by not washing plates and your hands. If you don’t cook food well, especially meat you can get parasites as well." (12:3 - 17)

“From bad handling of food and by not washing your hands before you eat. You should always wash fruit before you eat it for example because it could have been on the ground or whatever and if you eat it you can get parasites. A good thing to do is to wash that stuff with water that has a little chlorine in it to make sure that you kill the bichos.” (23:5 - 23)

While these quotes demonstrate the level of knowledge and understanding as to how parasites can be contracted from food, there were also several cases in which participants confused other infectious agents as causing parasites. For example in these two quotes:

“Yes, especially from vegetables that are not washed well or from meat that is not cooked well or if it has been lying out for a while it can get bacteria.” (5:6 - 70)

"And with things like meat too, you should only let it thaw out once otherwise it can go bad. You also have to be careful with food because flies can get on them and they have bacteria and when they land on your food you can get [parasites] from that.” (11:18 - 41)

**Domain: Walking on Ground or Dirt**

Next, the emergent domain "Walking on the Ground or Dirt" as a source of infection or mode of transmission is interesting with is obvious relation to helminth
infections, most notably hookworm. Participants identified seven codes that related to coming into contact with dirt. The most common codes that emerged from the data as in the number (N) of interviews the code appeared was "Walking Barefoot/Walking on the Ground (N=12); and "Playing with Dirt" (N=6). Some participants even noted that "Parasites Enter Your Foot" (N=5) an obvious hookworm reference. The following quotes represent this domain.

“They say that you can get them from walking around with bare feet. The parasites can be in the ground and enter your body through your feet." (3:5 - 21)

“From walking around barefoot; the cold gets into your feet and then the parasites get in. They are also caused from playing or handling dirt. Parasites are pretty much everywhere where it is dirty or where there is no sanitation.” (8:2 - 17)

"I think you can also get them from walking around in puddles and from the ground, you know like when kids sometimes eat dirt, well there are vitamins in the dirt but there are parasites too and if kids eat dirt they can get parasites.” (27:5 - 26)

“I know that some parasites come from the ground and then enter the bottom of your foot." (16:9 - 31)

This detailed knowledge expressed by participants in reference to "walking on the ground or dirt" are for the most part due to primary health campaigns in Costa Rica that sought to eradicate or seriously reduce the incidence of common preventable helminth infections like Ascaris and Hookworm. These campaigns started in the late 60's early 70's and were met with much success mainly due to the fact that measures were taken to improve basic sanitation infrastructure and to dramatically increase the access to primary health care including anti-parasitic medication such as Albendazole.

Many participants demonstrated knowledge regarding the cause and effect relationship of "walking on the ground/dirt" and parasites. However, I believe that the specific knowledge to not let their children walk barefoot on the ground is directly based on primary health care education campaigns. While participants knew not to walk barefoot, they had no idea what kind of parasites one could get from the ground or dirt. Interestingly, while many participants cited "walking barefoot" or "dirt" as a source of infection or mode of transmission, none of the participants made the connection between dirt and helminth infections. This can be illustrated by the fact that almost all participants
mentioned the phenomena "Ataque de Lombrice" or worm attack (which will be explained later) in the interview, but none made the connection between that ubiquitous disease manifestation and walking on the ground or playing with dirt. This raises the question of the effectiveness and scope of health education campaigns.

**Domain: Hygiene/Sanitation**

The next emergent domain to come out of the data is Hygiene/Sanitation in terms of source of infection and mode of transmission was very common among both groups of participants. It is widely believed that maintaining good personal and household hygiene is an excellent way to prevent different diseases and illnesses. There are even common sayings that refer to the perceived importance and practicality of good hygiene. For example, one common phrase used by a Costa Rican mother said "good hygiene is the best vaccination against disease". While in theory this perception best represents the gold standard, the reality of household hygiene can perhaps best be represented in this common refrain also used by Costa Rican mothers "one cleans-up only where the mother-in-law is sure to pass by". This indicates that while good hygiene and household cleanliness reflects on the mother the reality is that one usually only cleans on the surface as a result of other life demands.

Within this domain the most common codes that emerged from the data as in the number (N) of interviews the code appeared was "Getting Parasites from Poor Hygiene" (N=16); "Putting Dirty Objects in Mouth" (N=9); "Getting Parasites from Feces" (N=7); and "Getting Parasites from Dirtiness" (N=5). Like the domain "food" this domain was ubiquitously found in virtually all interviews as an explanation of where parasites come and how they are contracted. While participants often referred to hygiene as a culprit, they often vague in their statements; talking of hygiene in general as illustrated in the following quotes.

"A general lack of hygiene can also cause them [parasites].” (12:3-17)

“Well, mostly from a lack of hygiene and general dirtiness. Especially from places like drainage ditches and places like that.” (19:7-37)
Another common perception was that one could get parasites from putting dirty objects on your mouth. Mothers emphasized the fact that this was one of the most common ways that children get parasites saying that "children don't know any better" and that "they are always putting thing into their mouths." Dirty objects, as perceived by mothers also include dirty fingers and eating with dirty hands, especially after handling dirty objects. These ideas are illustrated in the following quotes.

"Anyone can get them but it is more common in kids because they don't know any better and they always have thing in their mouths and eat with dirty hands and things like that." (2:8-29)

"It especially happens with children because they always put things in their mouths and don’t ever want to wash their hands.” (4:2-25)

“Well if you touch the dog and then you if you put your fingers in your mouth, you know how kids are always putting things in their mouths." (24:4-33)

Again, it is most likely that the emphasis that mothers place on poor hygiene as a source of infection/mode of transmission is most likely a result of public health campaigns that targeted general cleanliness, hand washing and not walking on the ground as means of prevention.

**Domain: Hand Washing Behaviors**

The next emergent domain to come out of the data was hand washing in terms of source of infection and mode of transmission. The most common codes that emerged from the data as in the number (N) of interviews the code appeared was "Eating with Dirty Hands" (N=14); "Not Washing Your Hands after Going to the Bathroom" (N=8); "Getting Parasites from Feces" (N=7); and finally "Getting Parasites from not Washing Your Hands" (N=6).

In many cases, participants made more than one reference to different kinds of hand washing activities, or lack thereof as a mode of transmission for parasites. For example, there was a high co-occurrence of the codes "eating with dirty hands" and the code "not washing your hands after going to the bathroom". There was also a high co-occurrence of codes referring to hand washing and general hygiene. Several participants
also made the connection among hand washing, hygiene and food. All of these concepts can be illustrated in the following quotes.

“Well, if you go to the bathroom and don’t wash your hands and then you go and eat with dirty hands you can get parasites.” (2:3-17)

"From not washing your hand before you eat especially after you go to the bathroom.” (22:3-28)

"You can get them, for example, if your hands are dirty, especially if they are dirty from the bathroom, you know, when you don’t wash your hands after going to the bathroom." (11:2-13)

“Oh, well mostly from fecal material, like when you don’t wash your hands or have good hygiene practices.” (19:8-41)

"From not washing your hands and things like that; from not washing things and from bad food...they say it’s important to keep everything clean.” (26:1-82)

Again, this knowledge is most likely a result of primary health campaigns that targeted maintaining general hygiene practices that related to food, hand washing. This domain resembled the hygiene/sanitation domain in terms of its ubiquitous nature; virtually all participants, both Nicaraguan and Costa Rican households mentioned something about hand washing in relation with contracting parasites.

**Domain: Water**

The final domain that emerged from the data relating to source of infection/mode of transmission family was water. The most common codes that emerged from the data as in the number (N) of interviews the code appeared were "Getting Parasites from Water" (N=13); "Drinking Contaminated Water" (N=11); and "Getting Parasites in the Wet Season" (N=10). Water, in contrast to codes like food, hand washing, and hygiene, was not mentioned by participants with the same intensity. Many of the references that came from water were initiated by the researcher as a result of asking a series of yes/no questions, one of which was directed at water. Some participants were unsure in their assessment of water being a possible cause, while other participants were more assertive and made a connection between the local aqueduct, contamination and disease. These variations can be seen in the following quotes.
“They come from water maybe, like from dirty or contaminated water.” (22:3-28)

“I have no idea really, maybe from water, like cholera, from contaminated water.” (13:7-17)

“Through bad handling of community water supply, contaminated water, but I really don’t know which parasites come from water specifically.” (15:7-16)

“One of the main causes of parasites comes from the water, supposedly the water here in Monteverde is potable, that’s what they tell us anyway, but actually they have to put chlorine in the water.” (11:10-29)

The last quote presented here (11:10-29) delves into an emerging contrasting domain that was discovered in the analysis and related to the questioning the quality of the community water supply on one hand and being completely confident in the fact that the local aqueduct provides potable water, thus excluding water as a potential source of infection in Monteverde. Interestingly, some participants who held this view were quick to point out that, while it is unlikely to get parasites from the water in Monteverde, it was in fact possible to get parasites from the water supply in communities with poor water management such as Puntarenas. This seems to be a slight point of contention in the community, one that will be discussed at greater depth in the analysis of the household water use interviews.

Another interesting domain that emerged from analysis of water was the fact that many of the Nicaraguan participants made the connection between the poor water quality in Nicaragua and higher prevalence of parasites on one hand and the better water quality in Monteverde and a lower prevalence of parasites on the other. This issue will also be examined at greater depth when comparing the two countries. An example of this can be seen in the following quote.

“Yes, here [Monteverde] the water is pretty clean, much more than in Nicaragua anyway. Where we lived in Nicaragua we would often have to take water out of the lake for drinking water and there was much less hygiene there.” (20:21-71)

Finally, although not directly related to contaminated water, many participants were under the impression that there were more parasites during the wet season and that
parasites are also more common in humid conditions. This can be illustrated in the following quotes.

“I think that there must be more parasites in the wet season, I don’t know, maybe because of the humidity.” (14:33-73)

“I think in the wet season when there is a lot of rain and humidity there gets to be a lot of stagnant water and that can cause parasites too.” (6:4-32)

**Symptoms of Parasites**

Both Nicaraguans and Costa Rican heads of household expressed very similar views relating with how they determine whether someone has parasites. This domain was constructed by asking participants "how do you know if someone has parasites?" after the researcher discovered that this question was more effective at eliciting information than was the question "tell me the symptoms you get from parasites." The information elicited in the interviews includes common symptoms that may or may not directly point to an infection with intestinal parasites. In addition, participants explicitly made a distinction between the symptoms related to infections with "amoebas" and symptoms that are attributed to infections with intestinal worms or helminths. The distinction made between symptoms that are attributed to either intestinal amoebas or worms are related, in part, to perceptions and knowledge of where parasites reside and what they do within the human organism as well as the specific morphology, or physical characteristics attributed to different kinds of parasites. The relationship made between an individual’s symptoms and the behavior of specific parasites is well illustrated in the following quote.

The network view shown in Figure 6-4, depicts the domain “symptoms of parasites” and distinguishes the two sub domains (symptoms of *lombrices* and symptoms of amoebas) and includes the relating codes that construct each domain and also shows two codes that are common to each domain. Analysis in ATLAS.ti also showed that while participants listed common symptoms for both *lombrices* and amoebas (for example, stomach aches, were listed as a symptom of both lombrices and amoebas) there were several symptoms that were specific to either lombrices or amoebas. See the graphic networks of both symptoms of lombrices and symptoms of amoebas below.
By looking at the graphic networks related to symptoms it becomes clear that the symptoms “being skinny”, “loss of appetite” and “not gaining weight” tend to be associated with lombrice infection and the perception that lombrices live in the intestine and eat the food in ones intestine before they can digest it. Other symptoms specifically related to infections with lombrices include “coughing up worms”, “feeling worms move in your stomach”, “pieces come out”, and “worms coming out of one’s body” refer to knowledge gained through lived experience with having worm infections in the past. Other symptoms that were related with lombrices were “grinding teeth”, “insomnia”, and “sleeping with your eyes open”, relating specifically with a certain kind of infection with lombrices commonly known as "ataque de lombrice" which I will discuss later.

The graphic network also shows several symptoms that are specifically related to infections with amoebas including “having blood in stool”, “diarrhea”, “constipation”, and “sunken eyes”. Furthermore, symptoms that were common to both lombrices and amebas included “fever”, “stomach aches”, “inflated stomachs”, and “vomiting”.

While these were the most common codes expressed in interviews, it was common for participants to provide a list of several symptoms at once that was not
specifically related to a particular species of parasite, but that related to a broad spectrum of potential symptoms related to parasites. The following quotes demonstrate this practice.

“Things like fever, diarrhea, and stomach aches.” (22:12-65)

“They can have a fever, vomiting, diarrhea; maybe they don’t have an appetite. Oh, and like I said before maybe they eat lots but don’t gain any weight.” (23:4-27)

“Well the person, like I said is usually skinny, or sometimes they even have big stomachs, and they usually have stomach aches.” (19:10-49)

“When one sleeps with their eyes open, or when they have problems falling asleep, and things like stomach aches and diarrhea.” (27:6-30)

While it was common for participants to provide a general list of symptoms not linked to any specific parasite species; it was also common for participants to be more specific in terms of relating different symptoms to specific kinds of parasites. The quotes below demonstrate how participants connected specific symptoms to specific parasites.

"Other symptoms can be that one looses their appetite or when people eat lots but are still really skinny. That is caused by the solitaria." (4:3-30)

"Parasites can cause you to have stomach aches and some cause you ass to itch, that’s from tricocephalo." (2:1-13)

"Then there is Giardia. That is another illness that you can get from parasites. With that [Giardia] you do not eat anything and have diarrhea and vomiting and everything." (5:3-49)

In addition, the quotes presented below demonstrate that participants also made a further connection between the kind of parasite and specific symptoms, by relating those symptoms to the specific characteristics of the parasite. The quotes below demonstrate this point.

“They are bichos that live inside you and live off the food that one eats. They cause stomach aches, vomiting, and malnutrition in kids, especially the lombrices.” (12:2-13)
“Oh, their skin is usually pale, their eyes too. When they don’t feel like playing. Or when they don’t gain any weight, like when their skinny, the parasites suck blood and nutrients from the kind so they don’t grow or gain weight.” (24:5-37)

“Well the person doesn’t have an appetite and can be pale. I know that this one parasite, *Giardia* clings to your intestine and eats the food that a person eats before they can digest it and it also causes vomiting and dizziness...I know that the amoebas, when there are a lot of them they give you stomach aches and your feces can have blood in them.” (2:6-25)

It is interesting to note that most all participants were able to list a variety of symptoms for parasites in general and in some cases for specific kinds of parasites. However, of special interest to this study was that fact that Nicaraguan and Costa Rican participants listed many of the same symptoms, and in fact listed the same symptoms related to similar kinds of parasites. For example, the symptoms listed by Nicaraguans related to *lombrices* and amoebas were the same symptoms listed by Costa Ricans. Again, this shows that there was no significant difference in the knowledge of symptoms between the two groups despite there being a significant difference in levels of formal education.

These similarities can be seen by comparing these two quotes; the first by a Nicaraguan mother, and the second from a Costa Rican Mother.

“Oh, their skin is usually pale, their eyes too. When they don’t feel like playing. Or when they don’t gain any weight, like when their skinny, the parasites suck blood and nutrients from the kind so they don’t grow or gain weight.” (25:5-37)

“Well they say that the parasites or whatever eats the food that you eat; they also eat vitamins from the food you eat. They also say that you have pale skin or that you don’t have any energy or happiness.” (10:8-39)

More similarities can be seen by comparing these two quotes; the first by a Nicaraguan mother, and the second from a Costa Rican Mother.

“Things like fever, diarrhea, and stomach aches.” (22:12-65)

“Oh, [parasites can cause] diarrhea, vomiting, and fever.” (11:34-78)
Illnesses from Parasites

Both Nicaraguan and Costa Rican participants reported knowing few illnesses related to infections with intestinal parasites. In fact, when excluding reported illnesses such as vomiting, diarrhea, and fever; which are better described as symptoms, and not as illnesses, participants only listed five illnesses that one can get from parasites. However, only one illness was reported with any frequency, while others were mentioned only rarely. For example, the most common reported illness reported among these as in the number of times it occurred in interviews was “Anemia” (N=5); “Malnutrition” (N=3); “Blood in Stool” (N=2); “Ausemia” (N=1); and “Paludismo” (N=1). Whereas anemia, malnutrition, and dysentery all potential illnesses related with parasites; ausemia (a defined cancer of the blood) and paludismo (an illness that resembles the flu) are most likely not related to infections with parasites.

Interestingly, the most common illness reported among participants was “Ataque de lombrice” or literally, "worm attack". This illnesses was reported ubiquitously (N=15) among all participants, both Nicaraguan and Costa Rican. According to participants, ataque de lombrice is the name given to specifically defined group of symptoms that are the result of infections with an intestinal worm. While ataque de lombrice shares many characteristics with worm infections in terms of the mode of transmission/source of infection, and available treatment pathways, participants made several distinctions between the symptoms related to ataque de lombrice and infections with worms in general.

For example, ataque de lombrice is characterized by having a heavy infection or having many worms in one’s body. The result of having many worms is that the worms try to "come up" or escape from the body. An example can be seen in the following quotes from mothers describing what happens during a worm attack.

“Then there are lombrices, there is a disease called lombrice attack and it’s when people have a lot of lombrices and those lombrices come up and try to come out of your mouth and your nose and ears.” (3:18-55)

“Oh, and there is something that a lot of people talk about called "ataque de lombrice" that’s when the lombrices try to come out of you.” (19-13-57)
“It’s when there are lots of lombrices in your stomach and the lombrices try to come up into your lungs and throat and they try to come out." (2:15-49)

The other unique symptom related to ataque de lombrice is when people choke on or cough-up worms. Participants described that people feel as if they were suffocating on the worms when they came up or that they were going to vomit. Descriptions of choking-on or coughing-up or vomiting-up worms can be seen in the following quotations.

“Sometimes if you have a cough and it’s not a cold it could be that you have lombrices. If there are lots of them they can come up from the stomach and it feels like they are going to choke or vomit." (10:18-80)

"People cough a lot and have a feeling like they are going to choke to death and they usually have inflated stomachs." (3:18-55)

"Lombrices can come up and make you feel like you are choking." (8:1-13)

"I know that when people have lots of lombrices that some of them try to escape, like they cough them up and stuff." (19:14-65)

While almost all of the participants interviewed made reference to "ataque de lombrice" in way or another, none of the participants interviewed specifically identified the species of intestinal worm that caused this well known illness. In fact, what participants was most likely referring to was an infection related to the life-cycle of Necantor americanus (hookworms) or Ascaris lumbricoides (roundworms). In order for both of these species of helminths to complete their life-cycle the larva must migrate from the lungs to the throat where they are swallowed into the stomach and later into the intestine where they mature into adults and reproduce.

Another interesting result of the interview data revealed that virtually none of the participants interviewed specifically identified the source of infection or mode of transmission relating to infections with worms or in relation to "ataque de lombrices". As stated in the discussion related to symptoms, many informants discussed the fact that one could get parasites from "walking barefoot", "playing with dirt", and "walking on the dirt" but none of the participants made the direct relationship between the source of infection and intestinal worms.
Treating Parasites

When participants were asked how they treated or how they would treat parasitic infections in their household, two obvious domains appeared. The first, and most common, were biomedical medications that were available through the clinic and local pharmacies. The second treatment domain related to home remedies that reflected locally available plants and herbs (See Figure 6-5 for an illustration of the domains and sub-domains of treatment pathways).

In general, younger participants were more aware of and tended to administer biomedical medications while older participants tended to be more familiar with home remedies. This pattern reflects a generational gap between participants who grew up with greater access to health care and those who grew up in very rural settings where access to health care was sparse. The same pattern was reflected in Nicaraguan participants; older Nicaraguan mothers who spent the majority of their lives in Nicaragua were more able to identify a wider variety of home remedies used to treat intestinal parasites compared to younger Nicaraguan mothers who have spent less time living in Nicaragua.

Figure 6-5. Network View of Treating Parasites
The most common response participants gave when asked what they do to get rid of parasites was to take a pill from either the clinic or from one of the local pharmacies. Most participants in this case could not provide the name of these pills but they were clear that they were indeed used to treat intestinal parasites. Examples of this can be seen in the following two quotes by participants.

“There are medications that you can take from the clinic and the pharmacy but I can’t remember what they are called. There are those pills that the clinic gives people to get rid of parasites.” (3:12-41)

“There is medicine and one should go to the clinic or pharmacy to get something in order to get rid of them.” (23:2-35)

Some participants mentioned that in order to treat parasites it was important to get checked first in order to make a positive diagnosis to ensure administration of the correct medication.

“First I would probably take the person to the clinic to make sure they were parasites and then give them the right medicine.” (25:10-41)

“You can get checked at the clinic and then take medication to get rid of them.” (8:8-37)

While many participants were not specific in terms of identifying medication by name, other participants were able to identify the names of specific pharmaceuticals used to treat parasitic infections. The most commonly identified and administered medication for parasites are "Albendazole" and "Sentel".

Albendazole is given as a general anti-parasitic medication by the Monteverde Clinic when in actuality it is primarily for helminth infections and is not effective against amoebic protozoa like E. histolytica and G. lamblia. The Monteverde Clinic distributes Albendazole to school children twice a year. In addition, the EBAIS distributes Albendazole to both adults and children during household visits when needed. In this case, people are often given Albendazole based on related symptoms a priori to any positive laboratory diagnosis.
However, *Sentel* is the most common over the counter anti-parasitic medication and is available at all local pharmacies. *Sentel* is basically a commercially available form of Albendazole that is intended as general anti-parasitic medication but which is effective primarily against helminth infections. In addition, *Sentel* is very accessible to the general population because it is inexpensive; at the time of this study, a dose cost around $4 USD making it affordable to even low income families.

Another medication that is used as an anti-parasitic is Mebendazole that specifically targets intestinal protozoa instead of intestinal helminths. Based on observation and interviews it appears that this medication is used much less than Albendazole and is only prescribed to a patient with a positive diagnosis of intestinal protozoa. It is not, to my knowledge, distributed by the EBAIS as part of the Ministry of Health's anti-parasite protocol which relies exclusively on distributing Albendazole to school children and to individuals at the household level. This seems to be a remnant and or indicative of anti-parasite campaigns of the past which focused on helminths due to their ubiquity and epidemiological and pathological importance at the time. Today however, this approach seems out of touch with the epidemiological profile of the community which shows that intestinal protozoa, not intestinal helminths, are of much greater epidemiological significance. This research for example shows that among all participants a period prevalence of intestinal protozoa was approximately 15% compared to a period prevalence rate of 2.3% for intestinal helminths. This indicates that among the study population intestinal protozoa were seven times more likely to occur compared to intestinal helminths.

In addition to biomedical medicines, participants were able to identify a diverse collection of home remedies used to get rid of and treat symptoms related to intestinal parasites. In total, 18 different home remedies were identified between all participants relating to parasites. While some home remedies were only rarely mentioned there were several that were mentioned with more frequency indicating common knowledge among participants. The most common home remedies mentioned in terms of the number of times it was mentioned in interviews were “Apazote” (N=9); “Garlic” (N=8); “Guaro” (N=6); “Purgantes” (N=6); “Padra” (N=5); and “Leche de Coco” (N=5). All of these
remedies were identified by both Costa Ricans and Nicaraguans at approximately the same frequency.

*Apazote*, also known as "*pazote*" is a plant that grows locally and is readily available; it is used to treat *lombrices* and in particular is used to treat *ataque de lombrice* according to participants. Garlic was also used primarily for *lombrices* and in particular to make *lombrices* go back down to the stomach during an *ataque de lombrice*. A couple participants even remembered wearing garlic necklaces when they were young in order to prevent *lombrices*. The locally grown herb *Padra* was described as being used for getting rid of amoebas as well as being used as a *purgante*. Giving *purgantes* or purges was also common practice to clean out the stomach and get rid of a variety of non-descript parasites. With *purgantes* participants noted that they are mostly used to clean out the stomach but that they do not kill all kinds of parasites. Participants also made the distinction between *purgantes* that can be bought from a pharmacy or recommended by a doctor and those made as a home remedy derived from medicinal plants and herbs including *Apazote* and *guaro*.

While biomedicine and home remedies represent different treatment systems, they are often used interchangeably and even in conjunction with each other. Some participants discussed the pluralistic and flexible nature in which treatment is applied. Take the following quote as an example of this complex interaction:

“When the *lombrices* start to move around and go up (to the lungs and windpipe) you have to give the person a bath with *guaro*, *apazote*, and *ajo*. This bath settles the *lombrices* and makes them go back down to your intestines and stomach. Then you have to treat them with medicine. You can’t take medicine when they are up or they will go all over and you can die. You have to take the medicine when they are down. That will get rid of them. After that you have to take vitamins.” (20:13-39)

“The *lombrices*, when they want to come up you should eat garlic, then they will settle down. My mother would also give us a bath of *Guaro and ajo*, she would do that and then give us some pills in order to get rid of the *lombrices*. When the *lombrices* come up that’s called *ataque de lombrices* and it’s pretty serious and can even kill kids.” (22:13-69)

“For the kids you always have to be giving them a *purgante* for the *lombrices*. You can use either *padra* (an herbal medicine) or *Vermil* (a drug). I don’t think *Sentel* (Albendazole) works at all. I gave it to my kids and it didn’t get rid of the parasites.” (20:14-43)
Older participants almost always expressed or noted the transition between using home remedies in the past and the use of biomedicine in the present. This transition coincides with the expansion of greater access to primary health care for rural residents over the past several decades. This transition also relates to the earlier discussion of widespread Albendazole distribution aims at reducing the incidence of parasitic helminths as a national primary health care campaign. Older participants that were interviewed would note that home remedies were once used because there was no other alternative and coincidently because many of them were indeed effective at getting rid of and treating the symptoms of intestinal parasites. What was lacking in these contexts was the knowledge and adequate sanitation infrastructure to prevent re-infection. The following quotes made by older female participants characterize in some ways the transition that took place between the administration of home remedies and biomedicine used to treat intestinal parasites.

“Nowadays people take pills you get at the clinic or the pharmacy like Sentel. Before people used more home remedies like garlic, people used to put garlic necklaces on their kids. Also I remember there is a leaf called pazote which people used to get rid of lombrices. With the pills you get you can kill the lombrices but I can’t remember which ones.” (4:4-42)

“Yes before that’s all people used were home remedies but nowadays people just go to the clinic for that stuff. There are just a few people that really know about that.”

For home remedies for parasites there is: guaro chakal which was used for la solitaria; apazote; yerba buena; massages with alcohol; esencia for stomach ache; and padra for amoebas.” (7:1-41)

This transition from home remedies to biomedicine is also evident in the following quotes by younger female participants who relied on knowledge passed down to them from their mothers, but that they themselves rarely employed. This again stems from the fact that their mothers lived in a time when the use of home remedies was standard due to the lack of access to primary health care services.

"For lombrices there was Guaro Charra and Apazote which you would also give in the mornings while fasting...These are all things I remember my mom telling me.” (14:20-45)
“Um, there is pazote and you take that for lombrices; my mom told me about that one, that is what she used to use. There are also other ones like with coconut milk and things like that. My mom knows a lot more…I just don’t remember all that well.” (3:13-45)

Do you know of any home remedies that one can use to get rid of parasites? “Me? No, my mom knew all that stuff.” (29:1-39)

While the use of biomedicine to treat intestinal parasites has become institutionalized for the majority of households, the application of home remedies to treat the same parasites has not disappeared but remains an important part of the medical toolkit employed by mothers in spite of the dominance of the biomedical model. In fact, Lind et.al (2001) carried out an informal research project aimed at looking at health access issues in the Monteverde Zone including the use of alternative medicine. The study collected an impressive list of 54 herbal home remedies that are used in the region; the majority 43% were said to be used to treat stomach aches, diarrhea, and similar gastro-intestinal problems. Another 7% of the home remedies listed in the study was used as purges for parasites including apazote and garlic. The study concluded that the use of home remedies in the community was nearly ubiquitous and that in general home remedies were used as a first choice over biomedicine for minor health problems, stomach aches, colds, and diarrhea. Illnesses that were perceived as being serious were more likely treated at the clinic.

**Preventing Parasites**

Similar to their knowledge regarding the source of infection and mode of transmission, participants were equally as knowledgeable about what they could do to prevent getting parasites in the first place. Logically, the domains relating to the knowledge of prevention strongly reflected the knowledge domains related to source of infection and mode of transmission. To reiterate, the domains relating to the source of infection and mode of transmission were insects and animals, ground/dirt, food, washing hands, water, and hygiene. Based on qualitative analysis, a total of 13 codes emerged relating to the prevention of parasites. The most common codes, based on the number (N)
of interviews the code appeared were "Washing Hands" (N=11); "Maintaining Hygiene" (N=10); "Washing Food" (N=9); and “Boiling Water” (N=7).

Further analysis of the data revealed 4 principal domains that emerged from the codes that exemplified the scope of knowledge, practices and perceptions regarding preventing infections with intestinal parasites. The four domains included the following: 1) avoiding the ground or dirt; 2) ensuring water quality; 3) practicing good hygiene; and 4) practicing food hygiene. A view of this network can be seen in the following graphic followed by a short description of each domain.

**Figure 6-6. Network View of Parasite Prevention**

The emergent domain "dirt" and its role in preventing parasites is directly related to the same domain found in source of infection and mode of transmission. In that domain, participants noted that walking on the ground barefoot or playing with dirt was a potential source of infection; a reference relating to helminth infections such as hookworm. When asked about how they could prevent parasite infections a few participants (N=5) mentioned "Not Letting Kids Play with Dirt" (N=2) and "Wearing Shoes" (N=3). These participants made the cognitive link between source of infection and prevention demonstrating a high level of understanding which is apparent in the following quotes.

“Well it's really hard to prevent getting them, you have to be careful. One shouldn't play around in the dirt or touch things in the street and then put their fingers in their mouth.” (22:10-58)
"Yes, they say that you should wash your hands, always wear shoes outside, wash your food well, and maintain this in the house as clean as possible." (3:14-49)

The domain "water" and its role in preventing parasites were also directly related to its role as a source of infection. Participants cited that drinking contaminated water was the main way that one could get parasites. As mentioned earlier, participants did not mention water as a source of infection with the same intensity as they did with other domains such as hygiene or food. Still, participants identified three codes that made a connection between water and prevention. The most common way to prevent parasites mentioned by participants related to water was "Boiling Water" (N=7). The practice of boiling water as a way to eliminate potential water-borne pathogens is well known, especially in places with compromised water quality. In Monteverde however, residents do not regularly boil water due to the perception that their water is already potable because AyA chlorinates the local water supply. Still, residents are very familiar with the practice, especially if they grew up in rural areas with no potable water supply. The following quotes characterize how participants conceptualize the utility of boiling water as a way to prevent parasites.

“Yes, although the water here has chlorine people should still boil it because you never know; the water can still have parasites.” (7:2-64)

“Yes, and if you have to use water from another source you should always boil it first.” (8:7-71)

“Boiling the water makes it safe and kills stuff that might be in the water, but the problem here is that people are not used to boiling their water because they [AyA] tell us that it is safe and that the people here take it for granted. In any case many people say that boiled water tastes different and that’s why people don’t do it. If you have to give someone suero, for diarrhea or vomiting, that you have to use boiled water to make sure that it is good, otherwise if the water you are using to make the suero is bad you will just make the person sicker.” (11:46-37)

Similar to boiling water, participants also mentioned that one could prevent parasites by putting chlorine in the water supply. The idea of putting chlorine in the water comes from actual water management practices in Monteverde where the AyA oversees water chlorination in Santa Elena and Cerro Plano. Other participants were also familiar with the practice of putting a few drops of chlorine in the water to be used to wash fruits
and vegetables to kill parasites and bacteria residing on food. The following quotes demonstrate this knowledge of using chlorinated water to wash fruits and vegetables.

“Well, you can put chlorine in the water to wash fruit and other foods before eating them, that’s supposed to kill all the bugs and stuff.” (14:22-53)

“A good thing to do is to wash that stuff [fruits and vegetables] with water that has a little chlorine in it to make sure that you kill the bichos.” (23:14-23)

Finally, some participants stated that an obvious way to prevent parasites was to simply avoid drinking contaminated water. This of course is directly related to the mode of transmission of drinking contaminated water. Participants often mentioned not drinking contaminated water with a host of other common knowledge and practices used to prevent parasites. The following quotes illustrate this idea.

“Things like not eating with dirty hands, not drinking contaminated water. If the water is bad you should boil it. You should also wash your fruits and vegetables. The water here is good, it’s potable.” (2:14-45)

“Well you need to have good hygiene and pretty much keep everything clean. Wash hand before eating and you should only drink good water. The water here is from springs and AyA has filters on all of the tubes, they put chlorine in the water and they clean the storage tanks and tubes on a regular basis.” (9:5-45)

The domain "food" and its role in preventing parasites were also directly related to perceptions and knowledge of food as a principal source of infection and mode of transmission of parasites. To reiterate, participants noted that "eating contaminated food"; "improper food handling"; and "not washing food" as the most common mode of transmission in terms of food and parasites. Within the prevention domain "food" three principal codes emerged including "Washing Food" (N=9); "Cooking Food Thoroughly" (N=3); and "Not Eating Contaminated Food" (N=2). In this sense, participants were more likely to emphasize proper food handling as a way to avoid eating contaminated food. The following quotes provide a look at the level of participants' knowledge regarding this domain.

“You should also wash fruits and vegetables, like cabbage, with water with a little chlorine in it. With food that is eaten raw one should really be careful to wash it.
Those things are exposed to the environment and bugs and bacteria and things like that can land on it. And if you don’t wash it would get sick.” (5:5-43)

“You also have to be careful with food and make sure you handle it well and cook it enough. I have been cooking in restaurants for a long time and you have to be careful otherwise you can get people sick and that's bad for business.” (23:1-43)

These quotes demonstrate a high level of knowledge about food hygiene. In addition, these quotes also mention using chlorinated water to wash fruits and vegetables as a means to kill parasites and bacteria that may reside on them. This of course directly related to the prevention domain "water" described earlier.

The most common prevention domain to emerge from the data was "hygiene" which was strongly related to the same domains of source of infection and mode of transmission. To reiterate, the hygiene domain relating to source of infection and mode of transmission includes a variety of general hygiene concepts and specific behaviors; "getting parasites from dirtiness/poor hygiene" and "putting dirty objects in mouth" are good examples of codes that constructed this domain. The emerging prevention domain "hygiene" follows a similar pattern and includes codes relating to general hygiene as well as more specific practices including hand washing as means to prevent parasites. The most common codes to emerge as in the number (N) of interviews where it was mentioned include "Washing Hands" (N=11); "Maintaining Hygiene" (N=10); Maintaining Personal Hygiene (N=3); and "Not Eating with Dirty Hands" (N=3). The following quotes illustrate participant’s view of hygiene as an integrated concept of behaviors and ideals.

“Well you need to have good hygiene and pretty much keep everything clean and wash hand before eating.” (9:6-45)

“One should practice good hygiene; washing your hands before eating, wash food like fruits. If the water is contaminated you should boil it.” (13:5-45)

“You should wash your hands and bathe every day and things like that, oh and maintain everything clean around the house…just good hygiene.” (16:19-53)

“You have to practice good hygiene like cleaning your house and washing your hands and things like that.” (23:1-43)
The codes relating to "hand washing" were included in the "hygiene" domain in contrast to the source of infection/mode of transmission domain where they were separate. In this case, hand washing was included in the hygiene domain because hand washing behavior was expressed as a part of maintaining both general and personal hygiene.

**Knowledge of Parasites**

One of the most important domains to emerge from the data that was not explicitly asked as part of the interview was the source of participants’ knowledge about parasites in general. While the semi-structured interview asked participants about their knowledge and perceptions regarding parasites, it became clear in the analysis that participants obtained their knowledge through various sources. Based on this analysis, participants referred to seven different sources of information that they used to construct their understanding of parasites. The most common source of knowledge, as in the number (N) of interviews the code appeared was "Knowledge from Ones Mother" (N=12); followed by "Knowledge from Experience" (N=10); "Knowledge from Neighbors or Other Family Member" (N=9); "Knowledge from TV or Books" (N=3); "Knowledge from Nicaragua" (N=3); and finally "Knowledge from the Clinic" (N=2). A view of this network can be seen in Figure 6-7.

The emergent domain "knowledge from mother" appeared in 12 of 28 interviews. Taking into account that 4 of the interviews were conducted primarily with men who did not mention their mothers, half all of the women interviewed (12 out of 24) mentioned their mother as a source of information concerning parasites. Based on analysis from the interviews, knowledge that was passed down from mother to daughter was related to illnesses from parasites, symptoms, treating parasites, and describing parasites. For example, much of the narration from participants regarding *ataque de lombrice* originated from their mothers telling them stories about their personal experiences with that particular condition. In fact, many of the stories told by participants' mothers related to when they themselves or their siblings had parasites as children.
Interestingly, the majority of participants interviewed had never experienced their children having *ataque de lombrice* as mothers themselves due primarily to better access to primary health care that targeted helminth infections. Still, this knowledge had been passed down to them from their mothers and many participants were able to talk about it at length. The following quotes illustrate this.

“Then there are *lombrices*, there is a disease called *lombrice* attack and it’s when people have a lot of *lombrices* and those *lombrices* come up and try to come out of your mouth and your nose and ears. People cough a lot and have a feeling like they are going to choke to death and they usually have inflated stomachs. It’s a very serious illness. My mom knows about that because she said that one of my brothers had it.” (3:18-55)

“My mom used to talk about the *lombrice* attack. She says that there were a couple of her cousins that died from *lombrices*.” (13:3-61)

In addition to knowledge about specific illnesses, many participants also noted that some of their knowledge of specific symptoms related to parasites such as grinding teeth, sleeping with eyes open and having inflated stomachs originated with their mothers. While mothers are very attune to changes in their children’s behavior and their relation to certain illnesses, much of the knowledge used to correlate specific symptoms with disease or illness is passed down from their mothers. However, knowledge of folk
symptoms seems to be more and more devalued as mothers become more dependent on laboratory and other means of testing.

“My mom told me all about that but I can’t remember. Like when a kid doesn’t want to eat because they are already full of lombrices or when they have big stomachs.” (13:1-25)

“Parasites cause things like stomach aches and like my mom said they caused kids to grind their teeth.” (14:29-65)

In terms of treating parasites it was clear that much of the knowledge regarding biomedical medication such as Albendazole had been gained through relatively recent interaction with the modern health care services. Knowledge of home remedies on the other hand is almost invariably passed down from generation to generation. Many participants talked readily about using home remedies noting that they had learned about their application from their mothers, while some participants admitted knowing nothing about home remedies and that their mother's would best answer questions about home remedies.

"When I was little my mother would give us a remedy called padra, it’s a plant and it is supposed to be good for getting rid of parasites, especially when you have an inflated stomach like that." (11:25-58)

For lombrices there was Guaro Charral and Apazote which you would also give in the mornings while fasting. These are all things I remember my mom telling me.” (14:20-45)

The following quote sums up quite nicely how knowledge through experience about certain illnesses, symptoms, and treatment are passed down from mother to daughter.

“My mom always used to say that when kid’s grinded their teeth it was an indication that they had parasites. Mom also talked about ataque de lombrices; that was when there was so many worms that they would get into all parts of your body that kids would cough them up. Mom said that they used garlic to make the worms go back down.” (14:10-27)
Other emergent domains of knowledge regarding household health and parasites follow similar lines as knowledge passed down from mother to daughter. For example, knowledge from experience, knowledge from neighbors and other family members, knowledge from Nicaragua, and knowledge from media sources such as TV and magazines all point to a communal knowledge that is deconstructed and shared in one way or another among members of close-knit communities. This spirit of communal knowledge is still alive and well in the Monteverde Zone where people tend to know their neighbors well and have family that live nearby. The following quotes illustrate the different kinds of knowledge expressed by participants.

“I read in a book about one called “pin worm” they are the ones that suck blood I think and they can actually come out of your body. That’s what my mom used to say anyway, that when we were kids we would have lombrices coming out of us.” (45:1-61)

“You have to purge them, clean out their stomach. Here they always use Albendazole; I remember in Nicaragua that we always used home remedies. I remember that my mother would always use Apazote con Guaro which is like a plant mixed with strong cane liquor that's usually taken for worms.” (27:8-33)

“[My son] had lombrices when he was three months old. People use garlic to make them go back down. This causes stomach ache and the person can get dehydrated. You should be sure not to give them milk. It’s a serious illness, my mother in law told me that he had worms and that if they came up he could choke to death. I remember we gave him some home remedies but that did not do the trick and we had to bring him to the doctor. He got medicine there and then he got better.” (5:1-47)

Finally, the domain “knowledge from the clinic” appears not to be very significant compared to the other domains in this network; only two participants mentioned explicitly that their knowledge of parasites came from the clinic. However, the fact that only two participants mentioned that their knowledge of parasites came from the clinic fails to recognize that participants were extremely knowledgeable about preventing parasitic infections. Analysis demonstrates that participants’ knowledge about prevention bore an exact reflection to participants’ domain structures of source of infection and mode of transmission. Participants’ prevention models were similar in many ways to common public health campaigns; not walking barefoot and wearing shoes; washing your hands before you eat and after you go to the bathroom; careful food handling; and
practicing general hygiene are examples of participants’ mantras on preventing parasites that strongly resemble public health parasite prevention campaigns. See the analysis on parasite prevention for a more detailed analysis.

Knowledge of Parasites between Nicaraguans and Costa Ricans

A domain that emerged from qualitative analysis and that was not part of the interview guide but relevant to this research was the contrast between Nicaraguans and Costa Ricans in terms of knowledge and experience with parasites. This small domain emerged from the data based on comments and narratives by Nicaraguan participants during the interviewing. In many cases, Nicaraguan participants would offer insights into this domain in reference to related questions about treatment practices and questions about the prevalence of parasites in the community. As mentioned earlier, Nicaraguan participant’s knowledge and conceptions about parasites was influenced by their experience living in Nicaragua.

Interestingly, comments made by Nicaraguan's reflect a deep understanding of how political economic and social infrastructure play an important role in the epidemiologic make-up of parasitic infections. This understanding of how parasites are found at a higher prevalence in relation to certain socio-economic realities. This idea can be seen in the following quotes by two Nicaraguan mothers when asked why they thought there were more parasites in Nicaragua.

“Well, it has to do with the environment and everything, I mean Nicaragua is worse off, people are poor, the kids walk around without shoes and without clothes, and the people don’t have work. The food there as well, people just have to eat what is available to them, the situation is much more difficult. I remember when there was hardly any food and all we ate was watermelon and bananas and things we could gather.” (27:13-49)

“Well you know, Nicaragua is a really pretty place with the lakes and everything but there have been lots of problems, like the war, land mines, contamination. Lots of the rivers are really contaminated so if you drink water from the rivers or lakes you can get sick. There are more illnesses and diseases. Compared to here [Costa Rica] the water is really bad, it's not treated and if you drink bad water you can get sick with parasites and viruses and such.” (11:37-88)
These quotes illustrate the level of knowledge of these participants to be able to draw conclusions between social and economic infrastructure and epidemiological trends of parasitism and other related health issues. Another Nicaraguan participant discussion this same subject made mention of how lacking primary health services and potable water systems can increase disease incidence.

“Well, lots of people just went to the bathroom outside and there is just less sanitation and the people walk around without shoes lots. In Nicaragua there are also less health services, people have to use natural medicine because it’s hard sometimes to get drugs, I mean the health services would rarely give you anything like that. And here [Costa Rica] kids are better attended. There are better health services here in general and you can get medicine for parasites. The guy from the EBAIS comes and gives the kids medicines for parasites.” (20:19-59)

“Well, Nicaragua is a lot poorer and lots of people live in really bad conditions. It’s common for the water to be contaminated and things are just dirtier and there is a real lack of hygiene and there aren’t lots of health programs like there are here [Costa Rica].” (25:2-72)

“Yes, here [Costa Rica] the water is pretty clean, much more than in Nicaragua anyway. Where we lived in Nicaragua we would often have to take water out of the lake for drinking water and there was much less hygiene there.” (20:21-71)

These mothers note that primary health services and water quality are much better in Costa Rica compared to the situation in Nicaragua. These participants make a tacit connection between lacking health services and poor water and sanitation conditions as an explanation as to why there are more parasites in Nicaragua compared to Costa Rica.

While many Nicaraguan participants made a comparison between Costa Rica and Nicaragua in terms of economic and social infrastructure and the prevalence of intestinal parasites, Costa Rican participants also made similar comparisons of past and present day Costa Rica in terms of parasite prevalence. When asked whether intestinal parasites were common in the community several Costa Rican participants mentioned that parasites were much more common in the past compared to the present. When asked to further explain their analysis of why parasites were common in the past and less common in the present many Costa Rican participants cited the poor economic and social infrastructure; specifically the lack of access to health care (especially in rural areas) and the lack of clean potable water and water sanitation infrastructure that existed in the past. The
following quote is from a Costa Rican mother when asked to explain why she thought parasites were more common in the past compared to the present.

“Before the people lived in bad conditions; they had dirt floors, the kids would drink water from the river, they didn’t know about good hygiene, they cooked with wood, and the people had pit latrines. When I lived in [town] we had a pit latrine. But back then there were not control measures, there were no doctors, and people didn’t have transportation to go to a doctor. Nowadays, people live in better conditions and are better educated and there is better access to doctors and medication.” (13:4-65)

This is an excellent explanation as to why there were more parasites in the past compared to the present time. This mother describes everything regarding poor living conditions of the past: dirt floors, drinking water from the river, lack of knowledge, having pit latrines, lack of medical controls and programs from the clinic. She also talks about the fact that there were no doctors and that people did not have transportation to get to a doctor. She goes on to say that nowadays people live in better living conditions, are more educated about hygiene and that they have better access to doctors and medication. Other participants shared these views when asked the same question. The comparisons made between past and present center around access to primary health care, potable water, and good sanitation infrastructure.

“The government has more control now with things like that. They come to the schools now and give the kids medication to get rid of parasites and nowadays there is better access to doctors and medication than there was before.” (15:9-56)

“Yes, you can also get parasites from the feces of animals; that’s why it’s important to wear shoes, back then the people walked around barefoot and most of the people had pit latrines or the people just went to the bathroom outside. We had a pit latrine until the 70’s when we got a regular bathroom. There are still people here with pit latrines though and I think that the CAJA should invest in providing materials so that people can have regular bathrooms...The community needs to have a good water source, before people used to drink water from shallow wells but now the water is treated and everything. It seems like the government has really made an effort to provide good water." (15:5-42)

“Yes before there were more parasites it seems. I think that parasites are more common in very rural areas where the water supply might not be that good.” (9:9-61)

“I don’t know, before people had more parasites but now there is better health care and the clinic provided people with pills and all that.” (1:2-60)
In historical context of the evolution of the Costa Rican primary health care these are excellent explanations as to why parasites were more common in the past. This shows that informants are cognizant of the changes and improvements to basic primary health care of the rural population that the Costa Rican health care system has made. It is very telling that this concept came through in interviews.

**Summary of Qualitative Results**

The knowledge demonstrated here in this semi-structured interview of parasite knowledge and perception clearly show that participants have a high level of understanding of etiologic pathways of parasites (what parasites are, what causes them, how they are transmitted and how they can be prevented). In addition, and of importance to this study was that Nicaraguan participants share this high level of knowledge with their Costa Rican counterparts, thus demonstrating that a lack of understanding or knowledge about parasite etiology cannot, in part, explain the difference in prevalence rates among the two study populations.

While participants exhibit a high level of knowledge regarding the specifics of symptoms, source of infection, mode of transmission, treatment, and prevention of parasites, this knowledge appeared to be isolated into separate pieces of information that did not appear to be connected. For example, participants were able to name and talk about different symptoms of parasites; common sources of infection; common modes of transmission; biomedical and alternative treatment pathways; and prevention strategies. However, for the most part, participants were unable to connect the dots between parasite, source of infection and prevention. For example, many participants knew explicitly the symptoms and treatment pathways of hookworm infection; they also knew that one could prevent “parasites” by not walking barefoot in the dirt, but they did not specifically know that hookworm infection was caused by walking barefoot in infected soil.

Another example of this disconnect was that participants were very aware of the fact that parasites were a result of bad hygiene and sanitation in general and that consistent hand washing and maintaining good hygiene prevented one from getting
parasites. The general perception here was that parasites always exist in un-hygienic environments. However, for the most part, participants were unclear about the fecal-oral route of transmission where parasites are primarily passed in the feces of an infected individual that are later ingested by non-infected individuals as a result of poor personal and household hygiene.
Chapter Seven – Quantitative Results Relating to Parasite Prevalence

Presented here are the quantitative results of data gathered to determine factors associated with the prevalence of intestinal parasites among the study population. The results are presented in three distinct sections according with how they were gathered. First, basic household demographic data will be presented from household surveys; second, data concerning household water supply and sanitation will be presented; finally, epidemiological data will be presented regarding factors associated to the period prevalence of intestinal parasites.

Household Demographic Data

In total, demographic data was collected on 126 individuals from two study populations; data was collected on 76 Costa Ricans taken from 18 households, and on 50 Nicaraguans taken from 11 households. The mean age for the two study populations was similar. For Costa Rican participants the mean age was 20.1 years; for Nicaraguans the mean age was 18.3 years; and the mean age for the entire study population was 19.4 years. The median age for all participants was 14.5 years. According to Table 7-1, the difference in mean age between Costa Rican and Nicaraguan study participants was not significant.

The mean age of all male participants was 18.2 years and 20.6 years for all female participants. For Costa Rican males the mean age was 18.8 years, while for females the mean age was 21.4 years. For Nicaraguan males the mean age was 17.3 years and for females the mean age was 19.4 years. According to Table 7-1, the difference in mean age between males and females was not significant.

In the total study population, children 0 to 5 years of age made up approximately 20% of the population; school age children 6 to 17 years of age made up 34% of the population; and adults 18 years of age and older made up 46% of the study population. The distribution of age categories was similar for both Costa Ricans and Nicaraguans.
Table 7-1. Age and Gender Distribution of Study Population

<table>
<thead>
<tr>
<th>Age Category</th>
<th>All Participants: n=126</th>
<th>Costa Rican Participants: n=76</th>
<th>Nicaraguan Participants: n=50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Age¹</td>
<td>19.4 Years</td>
<td>20.1 Years</td>
<td>18.3 Years</td>
</tr>
<tr>
<td>Median Age</td>
<td>14.5 Years</td>
<td>14.5 Years</td>
<td>14.5 Years</td>
</tr>
<tr>
<td>0 to 5 Years</td>
<td>19.8% (25)</td>
<td>17.1% (13)</td>
<td>24.0% (12)</td>
</tr>
<tr>
<td>6 to 17 Years</td>
<td>34.1% (43)</td>
<td>35.5% (27)</td>
<td>32.0% (16)</td>
</tr>
<tr>
<td>18 and &gt; Years</td>
<td>46.0% (58)</td>
<td>47.4% (36)</td>
<td>44.0% (22)</td>
</tr>
<tr>
<td>Mean Age Male²</td>
<td>18.2 Years (62)</td>
<td>18.8 Years (37)</td>
<td>17.3 Years (25)</td>
</tr>
<tr>
<td>Mean Age Female²</td>
<td>20.6 Years (64)</td>
<td>21.4 Years (39)</td>
<td>19.4 Years (25)</td>
</tr>
</tbody>
</table>

¹ Differences in mean age of Costa Rican and Nicaraguan study participants were not statistically significant based on a two-tailed independent sample t-test ($t = .661, p = .510, df = 124, Mean Difference = 1.792, Standard Error = 2.712$).

² Differences in mean age of male and female participants was not statistically significant based on a two-tailed independent sample t-test ($t = .887, p = .377, df = 124, Mean Difference = 2.352, Standard Error = 2.651$).

Table 7-1 shows that the distribution of gender among the total study population was extremely similar; females accounted for 50.8% (N=62) while males accounted for 49.2% (N=64). The gender distribution between Costa Ricans and Nicaraguans was also extremely similar; Costa Rican females made up 51.3% while Costa Rican males made up 48.6%. The gender distribution was split evenly between Nicaraguans; females made up 50% while males made up 50%.

According to Table 7-2, demographic data collected by the Monteverde Clinic in 2001 show that children 0 to 5 years of age made up 12.8% of the population; whereas school aged children 6 to 17 years of age made up 28.7% of the population; finally, adults 18 years of age and older accounted for 59% of the population in the Monteverde Zone (ASIS 2002).

These findings support the Monteverde Clinic data which reported that females represented 51.4% of the total population while males made up 48.6% of the total population in Monteverde. The distribution of age categories was similar among both male and females in the total study population. Unfortunately, data provided by the Monteverde Clinic was unable to produce mean ages of the population.
Table 7-2. Age and Gender Distribution of Monteverde, Costa Rica, 2001

<table>
<thead>
<tr>
<th>Age Category</th>
<th>Total Population</th>
<th>Male Population</th>
<th>Female Population</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Freq.</td>
<td>Percent</td>
<td>Freq.</td>
</tr>
<tr>
<td>0 to 5 Years</td>
<td>383</td>
<td>12.8%</td>
<td>178</td>
</tr>
<tr>
<td>6 to 17 Years</td>
<td>844</td>
<td>28.7%</td>
<td>416</td>
</tr>
<tr>
<td>18 and &gt; Years</td>
<td>1,767</td>
<td>59.0%</td>
<td>862</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2,994</td>
<td>100%</td>
<td>1,456</td>
</tr>
</tbody>
</table>

It should be noted that demographic data collected by the Monteverde Clinic does not distinguish national origin. As such, the number of Nicaraguans living in the area and information regarding their age is unknown. However, a study of Nicaraguans living in Costa Rica in 2001, directed by the International Organization for Migration (OIM), estimates that there is a higher presence of Nicaraguan adults than children; adults 20 years of age and older make up approximately 67.4% of the total Nicaraguan population living in Costa Rica. In contrast, only 4.8% of the total Nicaraguan Population living in Costa Rica are children between the ages of 0 and 5 years. Comparatively, school aged children 6 to 19 years of age make up an estimated 27.8% of the total population (OIM 2001).

The distribution of gender in the total study population compared to the nation as a whole is similar. According to the 2001 national household survey, females made up 50.8% of the population while males make up 49.2% of the entire national population (Proyecto Estado de la Nación 2002). For the Nicaraguan population living in Costa Rica the 2001 IOM study estimates that females represent 50.9% of the population while males make up 49.1% of the total Nicaraguan immigrant population (OIM 2001). In terms of gender distribution, the study populations are extremely similar to the both local and national level data.

Table 7-3 shows the mean years of education obtained between Costa Rican and Nicaraguan adults. Among the total study population, adult Costa Ricans, 18 years of age and older (n=36), had attained an average of 5.97 years of schooling with a median of 6 years of schooling. In contrast, adult Nicaraguans, 18 years of age and older (n=22), had attained an average of 3.82 years of schooling with a median of 4 years. On average,
adult Costa Ricans had attained 2.15 more years of schooling compared to adult Nicaraguans.

**Table 7-3. Years of Education Attained among Costa Rican and Nicaraguan Adults**

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean Years of Education¹</th>
<th>Median Years of Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult Costa Ricans</td>
<td>5.97 years</td>
<td>6 years</td>
</tr>
<tr>
<td>Adult Nicaraguans</td>
<td>3.82 years</td>
<td>4 years</td>
</tr>
</tbody>
</table>

¹ Differences in mean years of education between adult Costa Ricans 18 years of age and older compared to Nicaraguan adults 18 years of age or older was statistically significant based on a two-tailed independent sample t-test \( t = 2.78, p = .007, df = 56, \text{Mean Difference } = 2.154, \text{Standard Error } = .772 \).

According to Table 7-3, there is a significant difference in the mean years of education obtained by adult Costa Ricans compared to adult Nicaraguans. The difference in mean years of formal education between Costa Rican and Nicaraguan adult women within the study populations is especially marked. On average, Costa Rican women had attained 3.3 more years of education compares to Nicaraguan adult women. Table 7-4 shows that on average, adult Nicaraguan women had attained 2.55 years of formal education with a median of 2.0 years. In contrast, adult Costa Rican women had attained 5.86 years of formal education with a median of 6 years of education.

**Table 7-4. Mean Years of Education Attained Among Adult Women**

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean Years of Education¹</th>
<th>Less than 6 years of Education²</th>
<th>6 years of Education²</th>
<th>More than 6 years of Education²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Freq.</td>
<td>Percent</td>
<td>Freq.</td>
</tr>
<tr>
<td>Costa Rican Women</td>
<td>5.86</td>
<td>5</td>
<td>25%</td>
<td>9</td>
</tr>
<tr>
<td>Nicaraguan Women</td>
<td>2.55</td>
<td>10</td>
<td>83.3%</td>
<td>2</td>
</tr>
</tbody>
</table>

¹ Differences in mean years of education between adult Costa Rican women 18 years of age and older compared to adult Nicaraguan women 18 years of age or older was statistically significant based on a two-tailed independent sample t-test \( t = 3.640, p = .001, df = 30, \text{Mean Difference } = 3.312, \text{Standard Error } = .910 \).

² Odds Ratio of Costa Rican women who have obtained 6 or more years of education compared to Nicaraguan women = 11.250; CI 95 %, Lower = 1.858, Upper = 68.132

Table 7-4 demonstrates that the majority of adult Costa Rican women (75%) have completed at least 6 or more years of education. In contrast, only 16.7% of adult Nicaraguan women had completed 6 years of education. In fact, Costa Rican women were more than 11 times as likely to have completed at least 6 years of formal education.
compared to Nicaraguan women. Furthermore, none of the Nicaraguan women in this study population had completed more than 6 years of education compared to 30% of Costa Rican women. According to the data, there is a significant difference in the mean years of education obtained by Costa Rican women compared to Nicaraguan women. Local data collected by the Monteverde Clinic regarding education is limited; data was only collected in terms of literacy among persons 12 years of age and older. According to the clinic data, only 4% of the entire local population is “illiterate” while the rest (96%) are considered “literate” (ASIS 2002). It is unclear what criteria were used to assess literacy among the population.

On the national level, the 2001 IOM study reports that Costa Rican adults 15 years of age or older had completed on average 7.2 years of schooling. In contrast, Nicaraguan adults 15 years of age or older living in Costa Rica had completed on average 5.4 years of education; 1.8 years less than their Costa Rican peers. The IOM study states that 16.1% of Nicaraguans living in Costa Rica have no formal training compared to 5.6% of Costa Ricans; 25.9% of Nicaraguans living in Costa Rica have not finished elementary school compared to 18.3% of Costa Ricans; and only 11.1% of Nicaraguans had finished high school or have higher education studies compared to 23.6% of Costa Ricans (OIM 2001).

The 2001 OIM study points out that Nicaraguans living in Costa Rica have significantly lower levels of education compared to Costa Ricans. In comparing the national education statistics with data from the total study population, Nicaraguans in Monteverde have significantly lower levels of education compared Costa Ricans. However, both Nicaraguans and Costa Ricans in Monteverde have lower levels of education compared to their counterparts on the national level. It should also be mentioned that Nicaraguans living in Costa Rica tend to have higher education standards in all categories compared to Nicaraguans living in Nicaragua.

Among the total study population, Nicaraguans tended to have larger households (the total number of people living within a single dwelling) compared to Costa Ricans. According to Table 7-5, the mean household size for the total study population was 4.9 people per household with a median of 5.0 people per household. The average Costa
Rican household had 4.29 people with a median of 4 people per household while the average Nicaraguan household had 5.73 people with a median of 6 people per household. On average, Nicaraguan households had nearly 1.5 more people per household compared to Costa Rican households.

**Table 7-5. Mean Size of Costa Rican and Nicaraguan Households**

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean Household Size¹</th>
<th>Median Household Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Costa Ricans</td>
<td>4.29 people per HH</td>
<td>4.0 people per HH</td>
</tr>
<tr>
<td>Nicaraguans</td>
<td>5.73 people per HH</td>
<td>6.0 people per HH</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>4.9 People per HH</strong></td>
<td><strong>5.0 People per HH</strong></td>
</tr>
</tbody>
</table>

¹ Differences in mean household size of Costa Rican households compared to the mean household size of Nicaraguan households was statistically significant based on a two-tailed independent sample t-test ($t = 2.295, p = .030, df = 26, Mean Difference = 1.433, Standard Error = .624$).

² Odds Ratio of Nicaraguan households with more that 6 people per household compared to Costa Rican households with 6 or more people per household = 9.000; CI 95 %, Lower = 1.355, Upper = 59.783

According to Table 7-5, the difference in mean household size between Costa Rican and Nicaraguan households was significant. In fact, Nicaraguan households were 9 times as likely to have 6 or more people per household compared to Costa Rican households.

According to local data from the Monteverde Clinic, 41.6% of households in Monteverde are made up of 2-3 people, while 40.5% of households have between 4 and 5 people. In contrast, only 12% of all households have 6 or more people. The data shows that Costa Rican households in the study population are more or less the same size as households reported by the Monteverde Clinic, while the Nicaraguan households in the study population are larger than the average household in the region (ASIS 2002).

National level data report an average of 3.9 people per household; a number relatively close to that of the local population in Monteverde and to the study population (Proyecto Estado de la Nación 2002). In addition, the IOM study reports that households where at least one head of household is Nicaraguan have on average 4.8 people per household (OIM 2001). Thus, the Nicaraguan households of the study population tented to be much larger on average than other Nicaraguan households in Costa Rica. Interestingly, the IOM study reports that an average Nicaraguan household of 4.8 people, two are Costa Rican citizens; many of which are children born in Costa Rica of Nicaraguan parents (OIM
In the study population, there were on average 5.73 people per Nicaraguan household; 2.27 of which are Costa Rican citizens. Again, the majority of Costa Ricans living in Nicaraguan households are children born in Costa Rica to Nicaraguan parents. To reiterate, for this research children born to Nicaraguan parents were categorized as Nicaraguan regardless of whether or not they were born in Costa Rica.

Table 7-6 demonstrates that household ownership among the study population is extremely divergent. The majority of Costa Ricans (72%), own their own home; 44.5% claimed to have their home paid for in full while 27.5% owned their own home with a mortgage. In contrast, only 36.4% of Nicaraguans households own their own home; all which had their home paid for in full; none had a mortgage. The majority Nicaraguans (64%) rent their home, compared to only 28% of Costa Ricans.

<table>
<thead>
<tr>
<th>Group</th>
<th>Home Owners¹</th>
<th>Rent Home</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Freq.</td>
<td>Percent</td>
<td>Freq.</td>
</tr>
<tr>
<td>Costa Rican Households</td>
<td>13</td>
<td>72%</td>
<td>5</td>
</tr>
<tr>
<td>Nicaraguan Households</td>
<td>4</td>
<td>36%</td>
<td>7</td>
</tr>
</tbody>
</table>

¹ The frequency of Costa Rican households that own their own home compared to Nicaraguan households that own their own home was not statistically significant for nonrandom association based on Fisher’s exact test (p = 0.119, df = 1).
² Odds Ratio of Costa Rican households that own their home compared to Nicaraguan households that own their own home = 4.550; CI 95%, Lower = .915, Upper = 22.627

According to the data in Table 7-6, Costa Ricans were 4.5 times as likely to own their own home compared to Nicaraguans. However, the association between home ownership and nationality was not significant for nonrandom association. Data from the Monteverde Clinic concerning home ownership show that 69.5% of homes in the Monteverde Zone are owned whereas 25.5% are rented (ASIS 2002).

Data regarding the reported monthly household income from all household workers was collected for the entire study population. Table 7-7 shows that reported household income among Nicaraguan and Costa Rican households is similar. However, it should be noted that the author believes the data to be highly variable from month to month and that in some cases informants may have exaggerated their monthly incomes to a high or low degree.
Table 7-7. Reported Monthly Household Income by Nationality

<table>
<thead>
<tr>
<th>Group</th>
<th>Reported Monthly Income¹</th>
<th>U.S. Dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Costa Rican Households</td>
<td>C.104,647</td>
<td>261.00 USD</td>
</tr>
<tr>
<td>Nicaraguan Households</td>
<td>C.118,181</td>
<td>295.00 USD</td>
</tr>
</tbody>
</table>

¹ Differences in reported household income of Costa Rican households compared to the reported household income of Nicaraguan households was not statistically significant based on a two-tailed independent sample t-test ($t = .734, p = .470, df = 26, Mean Difference = $33.80, Standard Error = 46.139$).

On average, Nicaraguan households reported a slightly higher monthly income than did Costa Rican households. However, according to table 7-6, the difference in reported household income between Costa Rican and Nicaraguan households was not significant.

It should be noted in terms of reported monthly income that on average, Nicaraguan households had 1.55 workers per household, whereas Costa Rican households had an average of 1.1 workers per household. This may explain why Nicaraguan households reported a slightly higher monthly income compared to Costa Ricans. Still, there was a wide range of reported household income among Nicaraguans and Costa Ricans. For example, both Nicaraguans and Costa Ricans reported a monthly income between 100 and 500 USD. To reiterate, the sample of Costa Rican households were selected to represent low income households and that no high income households were chosen to participate in the study.

Table 7-8 shows the three most commonly held jobs between Nicaraguan and Costa Rican men. The majority of Nicaraguan men, 63.7% work as construction day laborers, carpenters, or similar jobs. To a lesser degree only 26.7% of Costa Rican men worked in a construction related field. The Majority of Costa Rican men (40%) worked in the business or tourism sector as restaurant operators, hotel workers, and tour guides. Comparatively, only 9.1% of Nicaraguan men worked in business of tourism related jobs. Another popular line of employment in the Monteverde area is driving taxi. In this field, 18.2% of Nicaraguan men drove taxi compared to 6.7% among Costa Rican men. Interestingly, 13% of Costa Rican men in the study sample worked in Agriculture, whereas none of the Nicaraguan men worked in Agriculture.
Table 7-8. Most Common Jobs among Adult Costa Rican and Nicaraguan Men

<table>
<thead>
<tr>
<th>Most Common Jobs Among Costa Rican Men</th>
<th>Percentage</th>
<th>Most Common Jobs Among Nicaraguan Men</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Business/Tourism:</td>
<td>40.0%</td>
<td>1. Construction:</td>
<td>63.7%</td>
</tr>
<tr>
<td>2. Construction:</td>
<td>26.7%</td>
<td>2. Taxi Drivers:</td>
<td>18.2%</td>
</tr>
<tr>
<td>3. Agriculture:</td>
<td>13.4%</td>
<td>3. Tourism:</td>
<td>9.1%</td>
</tr>
</tbody>
</table>

Employment numbers for the study population vary greatly compared to national statistics. According to the 2001 IOM report, almost 25% of Nicaraguans living in Costa Rica work in agriculture, compared to only a fraction of Costa Ricans who still work in the agriculture sector. In addition, the IOM reports that only 16% of Nicaraguans work in construction related fields (OIM 2001). However, the employment numbers gathered for this research follow in line with recent changes in the Monteverde economy; a significant reduction in the agricultural sector and a subsequent increase in the development of the tourism sector. In Monteverde, Costa Rican men tend to hold the most valued tourism jobs, working as guides or in restaurants, whereas Nicaraguan tend to work in construction.

Table 7-9 shows the most commonly held jobs between Costa Rican and Nicaraguan women.

Table 7-9. Most Common Jobs among Adult Costa Rican and Nicaraguan Women

<table>
<thead>
<tr>
<th>Employment Among Costa Rican Women</th>
<th>Percentage</th>
<th>Employment Among Nicaraguan Women</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. In the Home:</td>
<td>42.9%</td>
<td>1. In the Home:</td>
<td>72.7%</td>
</tr>
<tr>
<td>2. Restaurants:</td>
<td>14.3%</td>
<td>2. Restaurants:</td>
<td>18.2%</td>
</tr>
<tr>
<td>4. Domestic Employee:</td>
<td>14.3%</td>
<td>3. Hotel:</td>
<td>9.1%</td>
</tr>
</tbody>
</table>

The majority of Nicaraguan women (72.7%) worked in the home, compared to 42.9% of Costa Rican women. In Monteverde, 18.2% of Nicaraguan women worked as restaurant cooks and 9.1% worked in hotels. For Costa Rican women, 14.3% worked as restaurant cooks, 14.3% worked as artisans and 14.3% worked as domestic employees.

According to national statistics, 49.9% of Nicaraguan women living in Costa Rica participate in the labor market, whereas nationally, only 38.2% of Costa Rican women...
participate in the labor market (Proyecto Estado de la Nación 2002). This means that, compared to national statistics, in Monteverde, fewer Nicaraguan women participate in the local labor market, whereas more Costa Rican women work in the local labor market. Interestingly, more Costa Rican and Nicaraguan women are working outside of the home than were 5 years ago; an indication that employment opportunities in the Monteverde area have opened up for all women as a result of the growing tourism sector.

Table 7-10 shows reported cases of unemployment among the adult study population. Adult participants were asked whether any household worker had been unemployed at any time during the past year. Also, women who reported staying at home were not included in unemployment statistics.

<table>
<thead>
<tr>
<th>Group</th>
<th>Unemployed Last Year¹</th>
<th>Not Unemployed Last Year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Freq.</td>
<td>Percent</td>
</tr>
<tr>
<td>Nicaraguan Workers</td>
<td>7</td>
<td>53.8%</td>
</tr>
<tr>
<td>Costa Rican Workers</td>
<td>7</td>
<td>25.9%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>14</strong></td>
<td><strong>29.8%</strong></td>
</tr>
</tbody>
</table>

¹ The frequency of Nicaraguan workers who reported being unemployed during the past year compared to Costa Rican workers was not statistically significant for nonrandom association based on Fisher’s exact test (p = 0.155, df = 1)
² Odds Ratio of Nicaraguan workers who reported being unemployed in the past years compared to Costa Rican workers = 3.333; CI 95 %, Lower = .831, Upper = 13.372

Table 7-10 shows 29.8% of adult workers reported being unemployed at some point during the past year compared to 70.2% who reported being fully employed. In terms of nationality, 53.8% of Nicaraguan workers reported being unemployed at some point during the past years compared to 25.9% of Costa Rican workers. According to the data, Nicaraguan workers are 3.3 times as likely to have been unemployed in the past year compared to Costa Rican workers. However, according to a 2X2 contingency table the frequency in the number of cases of unemployed adult Nicaraguan workers compared to unemployed adult Costa Rican workers was not statistically significant for nonrandom association.

Although not significant, reported unemployment can perhaps be explained by the high number of adult workers employed in construction related fields. While construction
work in Monteverde is ample, it is often unstable. As such, workers are forced to work from one contract to the next. A construction worker may be employed on a contract full time for several months and then be unemployed for several weeks as the workers looks for a new contract. Jobs outside of construction tend to be more stable but can still wax and wane in relation to the high and low tourist season; a good example are hotel staff. Another important consideration is whether household members have access to health insurance through the Costa Rican Social Security Fund (CCSS). Table 7-11 shows the disparity between Nicaraguans and Costa Ricans in the percent of households in the study population that have uninsured household members. In this case, 81.8% of Nicaraguan households had at least one household member that did not have health care coverage compared to 35.3% of Costa Rican households.

**Table 7-11. Household Health Coverage by Nationality**

<table>
<thead>
<tr>
<th>Group</th>
<th>Freq.</th>
<th>% of Households with Uninsured Members¹</th>
<th>Freq.</th>
<th>% of Households where all Members are Insured</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nicaraguan Households</td>
<td>9</td>
<td>81.8%</td>
<td>2</td>
<td>18.2%</td>
</tr>
<tr>
<td>Costa Rican Households</td>
<td>6</td>
<td>35.3%</td>
<td>11</td>
<td>64.7%</td>
</tr>
</tbody>
</table>

¹ The frequency of Nicaraguan households with uninsured members compared to Costa Rican households with uninsured members was statistically significant for nonrandom association based on Pearson $x^2(1) = 5.815; p = 0.016.$

² Odds Ratio of Nicaraguan households with at least one uninsured household member compared to Costa Rican household members = 8.250; CI 95 %, Lower = 1.328, Upper = 51.263

According to Table 7-11, Nicaraguan households in the study population are 8.3 times as likely to have household members that are uninsured compared to participants living in Costa Rican households. Again, cross-tabulations of a 2X2 contingency table show that the frequency of uninsured Nicaraguan households compared to uninsured Costa Rican households was statistically significant for nonrandom association. Table 7-12 demonstrates a large disparity in the percent of individual health care coverage by nationality. Among the total study population, 54% of Nicaraguan participants did not have health coverage at the time of this study, whereas 46% of Nicaraguans reported having health coverage. In contrast, only 20% of Costa Rican
participants reported not having health coverage, while 80% of Costa Ricans reported having health care coverage.

Table 7-12. Individual Health Coverage by Nationality

<table>
<thead>
<tr>
<th>Group</th>
<th>Uninsured Individuals¹</th>
<th>Insured Individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Freq.</td>
<td>Percent</td>
</tr>
<tr>
<td>Nicaraguan Households</td>
<td>27</td>
<td>54%</td>
</tr>
<tr>
<td>Costa Rican Households</td>
<td>15</td>
<td>20%</td>
</tr>
</tbody>
</table>

¹ The frequency of uninsured Nicaraguan individuals compared to uninsured Costa Rican individuals was statistically significant for nonrandom association based on Pearson $x^2$ (1) = 15.932; $p = < 0.001$

² Odds Ratio of Nicaraguan individuals with no health insurance compared to Costa Rican individuals with no health insurance workers = 4.774; CI 95 %, Lower = 2.161, Upper = 10.547

According to Table 7-12, Nicaraguans were almost 5 times as likely to not have health care coverage compared to Costa Ricans. Cross-tabulations of a 2X2 contingency table show that the frequency of uninsured Nicaraguan individuals compared to uninsured Costa Rican individuals was statistically significant for nonrandom association. Although no local data exists as to the percentage of the local population covered under a CCSS health plan, national statistics point out that 87.7% of the Costa Rican population was covered (no data for Nicaraguan nationals exists) under some sort of CCSS health insurance (Proyecto Estado de la Nación 2002).

Household Water and Sanitation Data

Semi-structured interviews were conducted with all heads of household in order to gain information concerning household water use, access, cost, water quality, water security, sanitation, wastewater management and perceptions about water services. In total, data from this interview was collected for 17 Costa Rican households with a total of 69 people as well as 11 Nicaraguan households with a total of 53 people. In total, the household water and sanitation interview corresponds to a total of 122 individuals from the two study populations.

One purpose of the household water and sanitation interview was to determine whether both study populations in study had equal access to water and sanitation infrastructure. According to Figure 7-1, all respondents (100%) stated that their water
came from local springs and that the Santa Elena Aqueduct was responsible for the distribution and quality of the local water supply.

**Figure 7-1. Reported Source of Household Water**

When asked their opinion regarding the quality of the water distribution services they receive from AyA, the majority of respondents replied that the services were either excellent or satisfactory. Figure 7-2 shows the distribution of reported satisfaction with the local aqueduct. The majority of Costa Ricans (82.4%) classified their local aqueduct as satisfactory, while 17.6% classified their aqueduct as excellent. None of the Costa Rican households classified their local aqueduct as “poor”. Similarly, the majority of Nicaraguans (72.7%) classified their aqueduct as satisfactory, while 18.6% said it was excellent. Only one Nicaraguan household categorized their aqueduct as “poor”, citing the frequent cuts in water supply to their household.

It is interesting that the majority of respondents had a positive opinion of their local water distribution services when in fact almost all of the respondents reported that they have experienced cuts in their water services. Cuts in water service refer to the common occurrence that the households’ water supply is cut off without prior notice for an indefinite amount of time (ranging from several minutes to several hours). Cuts in water services can be the result of many factors, the most common being repairs to the...
distribution system itself and less commonly to water shortages during the dry season. Cuts in water supply are extremely common in Santa Elena; in fact, all of the households that participated in this study (with the exception of one) reported that their water is cut off periodically.

Figure 7-2. Reported Quality of Local Aqueduct

Despite frequent cuts in the household water supply, when asked to describe the quality of water they receive from AyA all participants were positive about the quality of water they received from AyA. Figure 7-3 shows the distribution of responses by Nationality. The majority of Costa Ricans 58.8% reported that their water quality was buena or muy buena (good or very good), while 29.3% said that their water was limpia or clean; and 11.8% described their water as potable water that is treated and piped to the house. Nicaraguans had very similar opinions of their water quality; 63% said that their water quality was buena or muy buena, while 27.3% said that their water was limpia, and 9.1% described their water as potable.

Participants were also asked on average how much they spend on their monthly water bill. For Costa Rican households, the mean reported monthly water bill was 5.35 USD. For Nicaraguan households, the mean reported monthly water bill was 6.38 USD.
The difference of close to one dollar per month is most likely related to the larger mean household size between the two groups.

**Figure 7-3. Reported Quality of Household Water Quality by Nationality**

Data were gathered concerning the presence and condition of household sanitation infrastructure including bathroom, kitchen, graywater system, and septic tank. For example, the majority of households in the region and in this study population enjoy modern flush toilets. However, according to Table 8-1, three households in the study report using a pit latrine.

Based on repeated direct observation methods by the researcher, bathrooms were categorized as “unsanitary” if any one of the following criteria were met upon observation: the absence of a sink to wash hands; the absence of soap to wash hands; exposure of dirty toilet paper; and dirt floors. Pit latrines were automatically categorized as “unsanitary”, while bathrooms that met all of these criteria were categorized as “sanitary”. According to Table 7-13, the majority of bathrooms in Nicaraguan households (72.7%) were classified as “unsanitary”. In contrast, the majority of bathrooms in Costa Rican households (76.5%) were classified as “sanitary”.
### Table 7-13. Type and Condition of Household Bathroom

<table>
<thead>
<tr>
<th>Group</th>
<th>Type of Bathroom</th>
<th>Freq.</th>
<th>Percent</th>
<th>Condition of Bathroom¹</th>
<th>Freq.</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Costa Rican Households</td>
<td>Flush Toilet:</td>
<td>15</td>
<td>88.2%</td>
<td>Adequate:</td>
<td>13</td>
<td>76.5%</td>
</tr>
<tr>
<td></td>
<td>Latrine:</td>
<td>2</td>
<td>11.8%</td>
<td>Inadequate:</td>
<td>4</td>
<td>23.5%</td>
</tr>
<tr>
<td>Nicaraguan Households</td>
<td>Flush Toilet:</td>
<td>10</td>
<td>90.9%</td>
<td>Adequate:</td>
<td>3</td>
<td>27.3%</td>
</tr>
<tr>
<td></td>
<td>Latrine:</td>
<td>1</td>
<td>9.1%</td>
<td>Inadequate:</td>
<td>8</td>
<td>72.7%</td>
</tr>
</tbody>
</table>

¹ The frequency of Nicaraguan households with unsanitary bathrooms compared to Costa Rican households with unsanitary bathrooms was statistically significant for nonrandom association based on Fishers Exact Test (p = 0.019, df = 1)

² Odds Ratio of Nicaraguan households with inadequate bathrooms compared to Costa Rican households = 8.667; CI 95 %, Lower = 1.526, Upper = 49.220

Table 7-13, shows that Nicaraguans were 8.66 times more likely to have an unsanitary bathroom compared to Costa Ricans. In addition, cross-tabulations of a 2X2 contingency table show that the frequency of unsanitary bathrooms in Nicaraguan households compared to the frequency of unsanitary bathrooms in Costa Rican households was statistically significant for nonrandom association.

Due to the fact that the AyA does not have the infrastructural capacity to treat solid waste, most all of the households in the Monteverde area have septic tanks. Septic tanks in Monteverde have drainage fields and are independently constructed and maintained by each household.

As shown in Table 7-14, the number of households with septic tanks is in direct correlation to the number of households with flush toilets. Septic tanks were categorized as “inadequate” if any one of the following criteria were met upon observation: not working properly, not draining properly; overflowing; broken; exposed to the elements. Septic Tanks that met all of these criteria were categorized as “adequate”.

Based on inspections by the researcher, Table 7-14 shows that 80% of household septic tanks (both among Nicaraguan and Costa Rican households) were considered adequate. In contrast, only 20% septic tanks were deemed inadequate; either they were not sealed properly and thus exposed, or they were full and not properly draining. As a result, there was no significant association between septic tank conditions and household nationality.
Table 7-14. Percentage of Households with Septic Tanks

<table>
<thead>
<tr>
<th>Group</th>
<th>Households with Septic Tanks</th>
<th>Condition of Septic Tank¹</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Freq.</td>
<td>Percent</td>
</tr>
<tr>
<td>Costa Rican Households</td>
<td>Yes: 15</td>
<td>88.2%</td>
</tr>
<tr>
<td></td>
<td>No: 2</td>
<td>11.8%</td>
</tr>
<tr>
<td>Nicaraguan Households</td>
<td>Yes: 10</td>
<td>90.9%</td>
</tr>
<tr>
<td></td>
<td>No: 1</td>
<td>9.1%</td>
</tr>
</tbody>
</table>

¹ The frequency of Nicaraguan households with adequate septic tanks compared to Costa Rican households with adequate septic tanks was not statistically significant for nonrandom association based on Fishers Exact Test (p = 1.000, df = 1)

Graywater (water from sinks and showers) disposal is also a sanitation concern in the Monteverde Zone as it is not disposed of or treated by AyA. Graywater systems were classified as “inadequate” if they were disposed of openly into the environment in a way that facilitated human contact (for example, onto the ground where children play).

According to Table 7-15, 47% of Costa Rican households had designated graywater drainage systems consisting of a concrete holding tank and drainage field. In contrast, only 9% of Nicaraguan households had such graywater drainage boxes. The majority of Nicaraguan households (91%) dispose of graywater into streets and rivers, compared to 53% of Costa Rican households.

Table 7-15. Graywater Disposal and Condition of Graywater System

<table>
<thead>
<tr>
<th>Group²</th>
<th>Graywater Disposal</th>
<th>Condition of Graywater System¹</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Freq.</td>
<td>Percent</td>
</tr>
<tr>
<td>Costa Rican Households</td>
<td>Graywater Box: 8</td>
<td>47%</td>
</tr>
<tr>
<td></td>
<td>Street/Ground: 8</td>
<td>47%</td>
</tr>
<tr>
<td></td>
<td>River: 1</td>
<td>6%</td>
</tr>
<tr>
<td>Nicaraguan Households</td>
<td>Graywater Box: 1</td>
<td>9%</td>
</tr>
<tr>
<td></td>
<td>Street/Ground: 3</td>
<td>27%</td>
</tr>
<tr>
<td></td>
<td>River: 7</td>
<td>64%</td>
</tr>
</tbody>
</table>

¹ The frequency of Nicaraguan with inadequate graywater disposal systems compared to Costa Rican households with inadequate graywater systems was not statistically significant for nonrandom association based on Fishers Exact Test (p = 0.441, df = 1)
² Odds Ratio of Nicaraguans households with inadequate graywater systems compared to Costa Rican households with inadequate graywater systems = 2.200; CI 95 %, Lower = .468, Upper = 10.350

According to Table 7-15, 35% of Costa Rican households had inadequate graywater disposal systems, compared to 55% of Nicaraguan households with inadequate
graywater disposal systems. Also, Nicaraguans were 2.2 times more likely to have an inadequate graywater system compared to Costa Ricans. Cross-tabulations of a 2X2 contingency table the frequency of inadequate graywater systems in Costa Rican households was not statistically significant for nonrandom association.

An assessment of household kitchen conditions was also taken by the researcher based on multiple visits to the home; kitchens were rated as sanitary if countertops and eating utensils were clean, if food were properly stored, if soap or detergent were readily available, and if there was few or an absence of vectors such as flies or cockroaches. Kitchens were rated as unsanitary if one or more of these conditions were not met. Table 7-16 Shows that 55% of kitchens in Nicaraguan households were categorized as unsanitary compared to 24% of Costa Rican kitchens. In addition, the researcher observed the presence of vectors in 64% of Nicaraguan kitchens compared to 41% of Costa Rican kitchens.

Based on Table 7-16, Nicaraguans were 3.9 times as likely to have an unsanitary kitchen compared to Costa Ricans. Cross-tabulations of a 2X2 contingency table the frequency of unsanitary kitchen conditions in Nicaraguan households compared to the frequency of unsanitary kitchen conditions in Costa Rican households was not statistically significant for nonrandom association.

<table>
<thead>
<tr>
<th>Table 7-16. Condition of Household Kitchen and Presence of Vectors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Group</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Costa Rican Households</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Nicaraguan Households</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

1 The frequency of Nicaraguan with unsanitary kitchens compared to Costa Rican households with unsanitary kitchens was not statistically significant for nonrandom association based on Fishers Exact Test ($p = 0.125, df = 1$)

2 Odds Ratio of Nicaraguans households with unsanitary kitchens compared to Costa Rican households with unsanitary kitchens = 3.900; CI 95%, Lower = .762, Upper = 19.951

**Period Prevalence of Intestinal Parasites**

Out of the total study population of 126 people, a total of 84 participants; 35 Nicaraguan participants from 11 households and 49 Costa Rican participants from 17
households provided fecal samples that were collected and analyzed to determine the period prevalence of intestinal parasites. In all cases, fecal samples were prepared and tested for the presence of intestinal protozoa, helminths and *Cryptosporidium parvum* using procedures described in the methodology chapter.

Table 7-17 demonstrates the age distribution for all 84 participants and by national origin. The investigator attempted to include participants representing a wide diversity in age. As a result, participants range in age from 1 year old to 61 years of age. The mean age for those who participated in the parasite prevalence study was 16.4 years with a median age of 11 years.

### Table 7-17. Age and Gender Distribution of Participants of the Parasite Study

<table>
<thead>
<tr>
<th>Age Category</th>
<th>Total Participants (n=84)</th>
<th>Costa Rican Participants (n=49)</th>
<th>Nicaraguan Participants (n=35)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Age¹</td>
<td>16.37 Years</td>
<td>16.1 Years</td>
<td>16.74 Years</td>
</tr>
<tr>
<td>Median Age</td>
<td>11 Years</td>
<td>11 Years</td>
<td>11 Years</td>
</tr>
<tr>
<td>0 to 5 Years</td>
<td>25% (21)</td>
<td>22.4% (11)</td>
<td>28.6% (10)</td>
</tr>
<tr>
<td>6 to 17 Years</td>
<td>40.5% (34)</td>
<td>44.9% (22)</td>
<td>34.3% (12)</td>
</tr>
<tr>
<td>18 and &gt; Years</td>
<td>34.5% (29)</td>
<td>32.7% (16)</td>
<td>37.1% (13)</td>
</tr>
<tr>
<td>Males</td>
<td>10.6 Years² (36)</td>
<td>9.4 Years (22)</td>
<td>12.4 Years (14)</td>
</tr>
<tr>
<td>Females</td>
<td>20.6 Years² (48)</td>
<td>21.6 Years (27)</td>
<td>19.6 Years (21)</td>
</tr>
</tbody>
</table>

¹ Differences in mean age of Costa Rican and Nicaraguan participants from whom fecal samples were examined were not statistically significant based on a two-tailed independent sample *t*-test (*p* = .846, df = 82).

² Differences in mean age of female and male participants from whom fecal samples were examined was statistically significant based on a two-tailed independent sample *t*-test (*p* = .002, df = 82).

As demonstrated in Table 7-17, the age distribution between Costa Rican and Nicaraguan participants was similar. The mean age for Costa Rican participants was 16.1 years while the mean age of Nicaraguan participants was 16.7 years; the median age was 11 years for both groups. However, there was a significant difference in mean age by gender in the study population; female participants were older (20.6 years) than male participants (10.6 years).

In terms of gender distribution, slightly more females (N=48) participated by providing fecal samples than male participants (N=36). Among Costa Ricans, males represented 45.8% (n=22) and females 55.1% (n=27) of the group study population.
Among Nicaraguans, males represented 40% (n=14) and females 60% (n=21) of the group study population. Finally, Table 7-18 and Figure 7-4 demonstrates the distribution and intensity of intestinal parasites, including pathogenic intestinal protozoa and helminths and commensal (non-pathogenic) intestinal protozoa among Nicaraguan and Costa Rican participants.

**Table 7-18. Distribution of Intestinal Parasites among Study Participants**

<table>
<thead>
<tr>
<th>Pathogenic Parasites</th>
<th>Costa Rican Participants n=49</th>
<th>Nicaraguan Participants n=35</th>
<th>Global Prevalence Parasites n=84</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Freq.</td>
<td>p %</td>
<td>Freq.</td>
</tr>
<tr>
<td><strong>Intestinal Protozoa</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>E. histolytica</em></td>
<td>3</td>
<td>6.1%</td>
<td>4</td>
</tr>
<tr>
<td><em>G. lamblia</em></td>
<td>1</td>
<td>2.0%</td>
<td>1</td>
</tr>
<tr>
<td><em>C. parvum</em></td>
<td>0</td>
<td>0%</td>
<td>0</td>
</tr>
<tr>
<td><strong>Intestinal Helminths</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Uncinarias</em></td>
<td>0</td>
<td>0%</td>
<td>2</td>
</tr>
<tr>
<td><em>T. trichiura</em></td>
<td>0</td>
<td>0%</td>
<td>1</td>
</tr>
<tr>
<td><em>A. lumbricoides</em></td>
<td>0</td>
<td>0%</td>
<td>0</td>
</tr>
<tr>
<td><strong>Comensal Parasites</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>E. coli</em></td>
<td>3</td>
<td>6.1%</td>
<td>8</td>
</tr>
<tr>
<td><em>E. nana</em></td>
<td>1</td>
<td>2.0%</td>
<td>4</td>
</tr>
<tr>
<td><em>I. butschlii</em></td>
<td>0</td>
<td>0%</td>
<td>0</td>
</tr>
</tbody>
</table>

*Including multiple infections among participants

The period prevalence of pathogenic protozoa was *E. histolytica* (8.3%) and *G. lamblia* (2.4%), while the period prevalence of commensal intestinal protozoa was *E. coli* (13%) and *E. nana* (6.0%). The period prevalence of intestinal helminths was *Uncinarias* (2.4%) and *T. trichiura* (1.2%). In addition, there were no (0) positive cases of other common parasites such as *C. parvum* (0%) and *A. lumbricoides* (0%). Figure 7-4 shows the distribution and intensity of intestinal parasites that were significant and excludes parasites not found in the study population. Figure 7-4, provides a graphic representation of Table 7-18.
Figure 7-4. Prevalence of Intestinal Parasite Species by National Origin

Table 7-19 demonstrates the frequency and prevalence of multiple parasitic infections among Costa Ricans and Nicaraguans. All of the Costa Rican participants that tested positive for intestinal parasites (n=4) had multiple parasitic infections, that is, the individual was infected with more than one parasite at the same time. In addition, all of the Costa Rican participants who tested positive for parasites were infected with pathogenic species, specifically, *E. histolytica* and *G. lamblia*. In three specific cases, the pathogenic intestinal protozoa *E. histolytica* was found along with the non-pathogenic parasite *E. coli*. In the other positive case the pathogenic parasite *G. lamblia* was found along with the non-pathogenic parasite *E. nana*. It should be noted that none of the Costa Rican participants were found to be infected with any species of helminths, including hookworms (*Uncinarias*), whipworms (*T. trichiura*), or roundworms (*A. lumbricoides*).

Among the Nicaraguan participants, seven out of the eleven cases positive for intestinal parasites had multiple infections and two cases that tested positive for three parasite species. In addition, six out of the eleven cases positive for parasites among Nicaraguan participants were infected with pathogenic species. Common multiple infections among Nicaraguan participants consisted of the pathogenic parasite *E.*
*histolytica* appearing along with the non-pathogenic parasite *E. coli*; the two non-pathogenic parasites *E. coli* and *E. nana*; and the two pathogenic helminths species *N. americanus* and *T. trichiura*.

Table 7-19. Prevalence of Multiple Parasite Infections by Nationality

<table>
<thead>
<tr>
<th>Multiple Parasite Infections</th>
<th>Costa Rican (n=4)</th>
<th></th>
<th>Nicaraguan (n=11)</th>
<th></th>
<th>Total (n=15)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Freq.</td>
<td>p%</td>
<td>Freq.</td>
<td>p%</td>
<td>Freq.</td>
<td>p%</td>
</tr>
<tr>
<td>Infected with 1 Parasite</td>
<td>0</td>
<td>0%</td>
<td>4</td>
<td>36.4%</td>
<td>4</td>
<td>26.7%</td>
</tr>
<tr>
<td>Infected with 2 Parasites¹</td>
<td>4</td>
<td>100%</td>
<td>5</td>
<td>45.5%</td>
<td>9</td>
<td>60.0%</td>
</tr>
<tr>
<td>Infected with 3 Parasites¹</td>
<td>0</td>
<td>0%</td>
<td>2</td>
<td>18.2%</td>
<td>2</td>
<td>13.3%</td>
</tr>
</tbody>
</table>

Of public health interest, it should be emphasized that there were only two cases positive for intestinal helminths; both cases were from adult women. This epidemiological pattern indicates that helminth infections are under control thanks to preventive primary care measures. It is quite possible that both women positive for helminth infection were chronic sufferers and that they became infected in a geographical location with endemic helminths, either in Nicaragua or in another area of Costa Rica.

**Factors Associated with the Individual Prevalence of Intestinal Parasites**

In this study, 84 fecal samples were collected and analyzed for intestinal parasites from a study population of Nicaraguan and Costa Rican participants. Laboratory results conducted between January 1st, 2004 to June 30th, 2004 confirmed that 15 (18%) individuals in the study population were positive for at least one parasite, and 11 (13%) of the samples had multiple infections (73.3% of infected individuals). The other 69 (82%) individuals were considered uninfected based on a negative fecal examination.

Figure 7-5 shows that the period prevalence for Costa Ricans was 8.3% and that 91.7% of Costa Ricans were negative for intestinal parasites. The period prevalence rate for Nicaraguans was 31.4%, whereas 68.6% of Nicaraguans were negative for intestinal parasites. The period prevalence rate for the entire study population (n=84) was low (15%) compared to other similar studies done in Costa Rica (Abrahams-Sandi 2005; Blanco 2007; Hernández 1998).
Figure 7-5. Period Prevalence of Intestinal Parasites by National Origin

However, period prevalence rates of intestinal parasites calculated by national origin demonstrate significantly divergent prevalence rates. Table 9-20 demonstrates the period prevalence (from January 1st, 2004 to June 30th, 2004) of intestinal parasites as calculated for both the Costa Rican and Nicaraguan study populations.

Results in Table 7-20 show that Nicaraguans were 5.2 times as likely to be positive for parasites as compared to Costa Ricans. Among the study population, infection status with intestinal parasites was significantly associated with nationality. In terms of period prevalence of intestinal parasites, the results obtained from this study of parasite prevalence are significantly different from those results obtained from the Monteverde Clinic during the same time period (January 1st, 2004 to June 30th, 2004).

<table>
<thead>
<tr>
<th>Group</th>
<th>Positive for Parasites Rate¹</th>
<th>Prevalence²</th>
<th>Negative for Parasites Rate</th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Costa Ricans</td>
<td>4/49</td>
<td>8.3%</td>
<td>45/49</td>
<td>91.7%</td>
</tr>
<tr>
<td>Nicaraguans</td>
<td>11/35</td>
<td>31.4%</td>
<td>23/35</td>
<td>68.6%</td>
</tr>
<tr>
<td>Total</td>
<td>15/84</td>
<td>17.9%</td>
<td>69/84</td>
<td>82.1%</td>
</tr>
</tbody>
</table>

¹ The frequency of Nicaraguans infected with intestinal parasites compared to the frequency of Costa Ricans not infected with intestinal parasites was statistically significant for nonrandom association based on Pearson $\chi^2$ (1) = 7.534; p = 0.006.
² Prevalence Odds Ratio of Nicaraguans infected with intestinal parasites compared to Costa Ricans infected with intestinal parasites = 5.156; CI 95 %, Lower = 1.482, Upper = 17.943
Though it is difficult to determine the exact period prevalence rates for parasites gathered during that time by the Monteverde Clinic, the results can be inferred. According to the Monteverde Clinic (Personal Communication) approximately 40 fecal samples per week are transported to the Puntarenas Hospital for analysis.

Therefore, between January and June, 2004 approximately 960 fecal samples were analyzed from the Monteverde Clinic. Of those 960 samples, only 24 were positive for any kind of parasitic infection. These numbers indicate an approximate period prevalence rate of 2.5% for those samples tested by the Monteverde Clinic. It should be noted that the clinic data does not specify or publish the national origin, gender, or species of parasite among its results. Clinic data regarding the period prevalence of intestinal parasites, though not reliable, provide nonetheless an indication that parasite infections are under detected among the population.

Figure 7-6. Parasite Prevalence by Age Group and Nationality

Age of participants also appears to be associated with the infection status of individual participants. Figure 7-6 shows the distribution and prevalence of intestinal parasites by age and national origin. Among Costa Rican participants there were no positive cases of intestinal parasites in children between 1 and 5 years old.
In contrast, the prevalence rate among Costa Rican school children between 6 and 17 years of age was 5.9% while the prevalence rate among Costa Rican adults 18 years of age and over was 6.9%. Among the Nicaraguan participants that were positive for intestinal parasites, the period prevalence rate for children between 1 and 5 years of age was 4.8%; the prevalence rate in school children between 6 and 17 years of age was 14.7%; finally, the prevalence rate in Nicaraguan adults 18 years of age or older was 17.2%. For all participants positive for intestinal parasites the period prevalence among children 1 to 5 years of age was 4.8%; the prevalence for school age children 6 to 17 years of age was 20.5%; and the prevalence rate for adults 18 years of age and older was 24.1%.

According to Table 7-21, school children aged 6 to 17 years of age are 5.2 times as likely to be infected with intestinal parasites compared to children 1 to 5 years of age. Likewise, Adults aged 18 years of age and up were 6.4 times as likely to be infected with intestinal parasites compared to children 1 to 5 years of age.

Table 7-21. Parasite Prevalence by Age and National Origin

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Costa Rican Cases Rate</th>
<th>Costa Rican Cases p%</th>
<th>Nicaraguan Cases Rate</th>
<th>Nicaraguan Cases p%</th>
<th>Total Rate</th>
<th>Total p%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 &lt; 5 years</td>
<td>0/21</td>
<td>0%</td>
<td>1/21</td>
<td>4.8%</td>
<td>1/21</td>
<td>4.8%</td>
</tr>
<tr>
<td>6 &gt; 17 years¹</td>
<td>2/34</td>
<td>5.9%</td>
<td>5/34</td>
<td>14.7%</td>
<td>7/34</td>
<td>20.5%</td>
</tr>
<tr>
<td>&gt; 18 years²</td>
<td>2/29</td>
<td>6.9%</td>
<td>5/29</td>
<td>17.2%</td>
<td>7/29</td>
<td>24.1%</td>
</tr>
</tbody>
</table>

Mean Age Positive
- 26.7 Years³
- 17.6 Yearsª
- 20.1 Years*

Mean Age Negative
- 15 Years
- 16.3 Years
- 15.6 Years

¹ Prevalence Odds Ratio of children ages 6>17 compares to children ages 1<5 years of age = 5.185; CI 95%, Lower = 0.590, Upper = 45.587
² Prevalence Odds Ratio of Adults ages >18 compared to children ages 1<5 years of age = 5.156; CI 95 %, Lower = 0.119, Upper = 56.363
³ Difference in the mean age of Costa Rican participants positive for intestinal parasites compared to Costa Rican participants negative for intestinal parasites was not significant based on a two tailed independent sample t-test (p = .119, df = 47).
ª Difference in the mean age of Nicaraguan participants positive for intestinal parasites compared to Nicaragua participants negative for intestinal parasites was not significant based on a two tailed independent sample t-test (p = .820, df = 33).
* Difference in mean age of participants positive for intestinal parasites compared to participants negative for intestinal parasites were not statistically significant based on a two-tailed independent sample t-test (p = .290, df = 82).
Independent sample $t$-tests were done to determine whether the age of infected individuals compared to non-infected individuals differed significantly. Table 7-21 shows the mean age of Costa Rican participants infected with intestinal parasites was 26.7 years while the mean age Costa Rican participants not infected with intestinal parasites was 15 years of age. The difference in mean age between infected Costa Rican participants and non-infected Costa Rican participants was not significant.

The mean age of Nicaraguan participants infected with intestinal parasites was 17.6 years compared to a mean age of 16.3 years for those not infected. The difference in the mean age between infected and non-infected Nicaraguan participants was not significant. Finally, the mean age for all infected participants was 20.1 years while the mean age of participants that tested negative for intestinal parasites was 15.6 years of age. The difference in mean age of participants positive for intestinal parasites compared to those negative for intestinal parasites was not significant.

In order to test for association between parasite prevalence and household size, data were simplified into binary categories; living in a household with 5 or fewer residents and living in households with 6 or more residents.

Figure 7-7. Parasite Prevalence by Household Size and Nationality
According to Figure 7-7, the prevalence of intestinal parasites of Costa Rican individuals living in households of 5 people or less was 7.7% while the prevalence rate for Costa Rican individuals living in households with 6 people or more was 10%.

The prevalence of intestinal parasites of Nicaraguan individuals living in households of 5 people or less was 7.7% while the prevalence rate for Nicaraguan individuals living in households with 6 people or more was 45.5%. Finally, the prevalence of intestinal parasites of all participants living in households of 5 people or less was 9.1% while the prevalence rate for all participants living in households with 6 people or more was 34.5%.

According to Table 7-22, participants living in households with 6 or more inhabitants compared to participants living in households with 5 people or less were 5.3 times as likely to be infected with intestinal parasites, thus there is a significant association between parasite prevalence and household size. As association between national origin and household size is evident; Nicaraguans were 6.6 times as likely to live in a household with 6 or more household member compared to Costa Ricans. The data show an association between infection status and the number of household residents and that Nicaraguans are more likely to live in households with 6 or more residents.

### Table 7-22. Parasite Prevalence by Household Size and National Origin

<table>
<thead>
<tr>
<th>Household Size</th>
<th>Costa Rican Rate</th>
<th>p%</th>
<th>Nicaraguan Rate</th>
<th>p%</th>
<th>Total Rate¹</th>
<th>p%²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Households &lt; 5</td>
<td>3/39</td>
<td>7.7%</td>
<td>1/13</td>
<td>7.7%</td>
<td>4/52</td>
<td>7.7%</td>
</tr>
<tr>
<td>Households 6 &gt;</td>
<td>1/10</td>
<td>10.0%</td>
<td>10/22</td>
<td>45.5%</td>
<td>11/32</td>
<td>34.4%</td>
</tr>
</tbody>
</table>

¹ The frequency in the number of samples positive for parasitic infection between participants living in households with 6 or more residents compared to those living in households with 5 or fewer residents was statistically significant for nonrandom association based on Pearson $x^2 (1) = 8.346; p = 0.004$.

² Prevalence Odds Ratio of individuals living in households with 6 or more people infected with intestinal parasites compared to individuals living in households with 5 people or fewer infected with intestinal parasites = 5.263; CI 95 %, Lower = 1.591, Upper = 17.412

³ Prevalence Odds Ratio of Nicaraguans living in households with 6 or more people with compared to Costa Ricans living in households with 6 or more people = 6.600; CI 95 %, Lower = 2.487, Upper = 17.517

Living in a household with an infected family member was also associated with individual infection status. Figure 7-8 shows that the period prevalence for infected Costa Ricans living with other infected family members was 22.2% and just 5.0% for those
living in households without other infected family members. The period prevalence for infected Nicaraguans living in households with other infected family members was 38.1%, while for infected Nicaraguans living in households without other infected household members was 21.4%. In total, the period prevalence rate for infected participants living in households with other infected family members was 33.3%, while the prevalence rate for infected participants living in households without other infected family members was only 9.3%.

Figure 7-8. Parasite Prevalence by Infected Family Member and Nationality

Table 7-23. Parasite Prevalence by Presence of Infected Family Member

<table>
<thead>
<tr>
<th>Presence of Infected Family Member</th>
<th>Costa Rican Rate</th>
<th>p%</th>
<th>Nicaraguan Rate</th>
<th>p%</th>
<th>Total Rate¹</th>
<th>p%²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infected Family Member</td>
<td>2/9</td>
<td>22.2%</td>
<td>8/21</td>
<td>38.1%</td>
<td>10/30</td>
<td>33.3%</td>
</tr>
<tr>
<td>No Infected Family Member</td>
<td>2/40</td>
<td>5.0%</td>
<td>3/14</td>
<td>21.4%</td>
<td>5/54</td>
<td>9.3%</td>
</tr>
</tbody>
</table>

¹ The frequency of infected individuals residing in households with other infected family members compared to uninfected participants residing in households with uninfected family members was statistically significant for nonrandom association based on Pearson $x^2 (1) = 7.620; p = 0.006$.

² Prevalence Odds Ratio of individuals that tested positive for intestinal parasites and living in households with infected family members compared to individuals that tested negative for intestinal parasites and living in households uninfected family members = 4.900; CI 95 %, Lower = 1.486, Upper = 16.153
According to the data in Table 7-23, there was a significant association between the prevalence of participants with intestinal parasites and the frequency of infected individuals residing in households with other infected family members compared to participants uninfected with intestinal parasites residing in households with uninfected family members.

Finally, the data represented in Table 7-23 shows that participants who were living with an infected family member were 4.9 times as likely to be infected with intestinal parasites compared to those participants who did not live with another infected family member.

**Figure 7-9. Parasite Prevalence by Individual Health Coverage and Nationality**

Not having individual health care coverage through the CCSS was also associated with individual prevalence for intestinal parasites. According to Figure 7-9, the prevalence for Costa Ricans infected with intestinal parasites that did not have individual health coverage was 14.3%, while the prevalence for those with individual health coverage was 5.7%.

The prevalence for Nicaraguans infected with intestinal parasites who did not have individual health care coverage was 41.2%, while the prevalence of those who did have
individual health insurance was 22.2%.

In total, the period prevalence for all participants infected with intestinal parasites that did not have health coverage was 29% while the prevalence for those that did have health coverage was 11.3%.

Based on Table 7-24, the frequency of individual participants infected with intestinal parasites that do not have health coverage compared to individual participants not infected with intestinal parasites and who have health coverage was statistically significant. Thus, the data show that there is an association between the lack of individual health coverage and individuals positive for intestinal parasites.

Table 7-24. Parasite Prevalence by Health Care Coverage and National Origin

<table>
<thead>
<tr>
<th>Status of Health Care Coverage</th>
<th>Costa Rican Rate</th>
<th>p%</th>
<th>Nicaraguan Rate</th>
<th>p%</th>
<th>Total Rate</th>
<th>p%</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Health Care Coverage</td>
<td>2/14</td>
<td>14.3%</td>
<td>7/17</td>
<td>41.2%</td>
<td>9/31</td>
<td>29.0%</td>
</tr>
<tr>
<td>Health Care Coverage</td>
<td>2/35</td>
<td>5.7%</td>
<td>4/18</td>
<td>22.2%</td>
<td>6/53</td>
<td>11.3%</td>
</tr>
</tbody>
</table>

¹ The frequency of individual participants infected with intestinal parasites that do not have health coverage compared to individual participants not infected with intestinal parasites that have health coverage was statistically significant for nonrandom association based on Pearson $x^2 (1) = 4.183; p = 0.041$.

² Prevalence Odds Ratio of individuals that tested positive for intestinal parasites that do not have health care coverage compared to individuals that tested negative for intestinal parasites that have health care coverage = 3.205; CI 95%, Lower = 1.114, Upper = 10.125.

The prevalence odds ratio in Table 7-24 demonstrates that participant’s positive for intestinal parasites were 3.2 times as likely to not have individual health coverage compared to those that were negative for intestinal parasites.

Factors Not Associated to Individual Prevalence of Intestinal Parasites

The prevalence of intestinal parasite infections was not associated with the gender of the individual. According to Table 7-25, the prevalence rate among Costa Rican males was 9.1% and 7.4% for female participants. The prevalence rate among male Nicaraguan participants was 28.6% while for female Nicaraguan participants the prevalence rate was 33.3%. In total, the period prevalence rate for females was 18.8% while for males it was 16.7%. Cross-tabulations of a 2X2 table to calculate Chi-square statistics were done to determine whether there was a significant association in terms of gender and period

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prevalence of intestinal parasites. According to the data in Table 7-25, there was no significant difference in the frequency of intestinal parasites and gender.

Table 7-25. Parasite Prevalence by Gender and National Origin

<table>
<thead>
<tr>
<th>Gender</th>
<th>Costa Rican Rate</th>
<th>p%</th>
<th>Nicaraguan Rate</th>
<th>p%</th>
<th>Total Rate</th>
<th>p%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males (n=36)</td>
<td>2/22</td>
<td>9.1%</td>
<td>4/14</td>
<td>28.6%</td>
<td>6/36</td>
<td>16.7%</td>
</tr>
<tr>
<td>Females (n=48)</td>
<td>2/27</td>
<td>7.4%</td>
<td>7/21</td>
<td>33.3%</td>
<td>9/48</td>
<td>18.8%</td>
</tr>
</tbody>
</table>

¹ The frequency in the number of samples positive for parasitic infection between male and female study participants was not statistically significant for nonrandom association based on Pearson $x^2 (1) = 0.061; p = 0.805$.

² Prevalence Odds Ratio of females infected with intestinal parasites compared to males infected with intestinal parasites = 1.154; CI 95 %, Lower = 0.370, Upper = 3.598

According to the prevalence odds ratio in Table 7-25, Costa Rican males were just as likely as Costa Rican females to have intestinal parasites; and Nicaraguan males were just as likely as Nicaraguan females to have intestinal parasites. Among both study populations, males were just as likely to have intestinal parasites as females.

Table 7-26 shows that the prevalence of all participants infected with intestinal parasites living in a household where the mother had less than 6 years of formal education was 23.3%. In contrast, the period prevalence of all participants infected with intestinal parasites living in households where the mother had at least 6 years of formal education or more was 12.2%.

Table 7-26. Parasite Prevalence by Mothers Education

<table>
<thead>
<tr>
<th>Level of Education</th>
<th>Costa Rican Rate</th>
<th>p%</th>
<th>Nicaraguan Rate</th>
<th>p%</th>
<th>Total Rate</th>
<th>p%</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 6 Years of Education</td>
<td>3/10</td>
<td>23%</td>
<td>7/23</td>
<td>28.3%</td>
<td>10/33</td>
<td>29.0%</td>
</tr>
<tr>
<td>6 &gt; Years of Education</td>
<td>1/35</td>
<td>2.9%</td>
<td>4/1</td>
<td>80%</td>
<td>5/36</td>
<td>12.2%</td>
</tr>
</tbody>
</table>

¹ The frequency of individual participants infected with intestinal parasites living in a household where the mother has less than 6 years of formal education compared with individual participants not infected with intestinal parasites and who live in households where the mother has 6 or more years of formal education was not statistically significant for nonrandom association based on Pearson $x^2 (1) = 1.750; p = 0.186$.

According to Table 7-26, there was no significant association between intestinal parasite infections among study participants and the formal education levels of the female head of household.
Factors Associated to the Household Prevalence of Intestinal Parasites

According to Figure 7-10, the household period prevalence rate for intestinal parasites, where at least one household member tested positive for intestinal parasites was 32% (n=9). The other 68% (n=19) of households were considered negative when all household members tested negative for intestinal parasites. The household prevalence rate among Nicaraguan households was 54.5% (n=6). The other 45.5% (n=5) of Nicaraguan households were considered negative because all household members tested negative. The household prevalence rate for Costa Rican households was 17.6% (n=3) and whereas 82.4% (n=14) were considered negative because all household members tested negative for intestinal parasites.

Figure 7-10 Period Prevalence of Intestinal Parasites by Household Nationality

Among the Nicaraguan households, the 11 participants who tested positive for intestinal parasites were concentrated in 5 households; 2 households had only one infected household member; 2 households had 2 infected household members; and 1 household had 4 infected members. Among the Costa Rican study population, the 4 participants who tested positive for intestinal parasites were concentrated in 3
households; that is, 2 households had 1 infected member each while 1 household had 2 infected members.

According to the data in Table 7-27, the prevalence odds ratio shows that Nicaraguan households were 5.6 times as likely to have at least one household member who was positive for intestinal parasites compared to Costa Rican households. However, the frequency of Nicaraguan households where at least one household member was positive for intestinal parasites compared to Costa Rican households where at least one household member was positive for intestinal parasites was not significant for random association.

Table 7-27. Period Prevalence of Intestinal Parasites by Household National Origin

<table>
<thead>
<tr>
<th>Group</th>
<th>Positive for Parasites</th>
<th>Negative for Parasites</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rate¹</td>
<td>Prevalence²</td>
</tr>
<tr>
<td>Costa Ricans</td>
<td>3/17</td>
<td>17.6%</td>
</tr>
<tr>
<td>Nicaraguans</td>
<td>6/11</td>
<td>54.5%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>9/28</td>
<td>32.1%</td>
</tr>
</tbody>
</table>

¹ The frequency of Nicaraguan households with at least one member positive for parasite compared to Costa Rican households was not significant for random association based on Fisher's exact test (p = 0.095, df = 1).
² Prevalence Odds Ratio of Nicaraguan households with at least one infected household member compared to Costa Rican households with at least one infected member = 5.600; CI 95 %, Lower = 1.001, Upper = 31.319

Factors Associated to Household Parasite Prevalence and Household Conditions

Household conditions, including condition of kitchen, condition of bathroom and the presence of vectors were associated with households that had at least one household member test positive for intestinal parasites.

According to Figure 7-11 the household prevalence of intestinal parasites was associated with unsanitary bathroom conditions. For example, the household prevalence rate for Costa Rican households with unsanitary bathrooms was 50%, while for Costa Rican households with sanitary bathrooms the household prevalence rate was 7.7%. The household prevalence rate for Nicaraguan households with unsanitary bathrooms was 62.5% while for Nicaraguan households with sanitary bathrooms the prevalence rate was 33.3%. For the entire study population, the household parasite prevalence rate for
households with unsanitary bathrooms was 41.7% and 12.5% for households with sanitary bathrooms.

**Figure 7-11 Household Parasite Prevalence by Bathroom Condition**

Table 7-28 demonstrates that the frequency of households with unsanitary bathrooms that had at least one household member positive for intestinal parasites compared to households with sanitary bathrooms and no household members positive for intestinal parasites was statistically significant.

**Table 7-28. Household Parasite Prevalence by Bathroom Conditions**

<table>
<thead>
<tr>
<th>Condition of Bathroom</th>
<th>Costa Rican Rate</th>
<th>p%</th>
<th>Nicaraguan Rate</th>
<th>p%3</th>
<th>Total Rate¹</th>
<th>p%²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unsanitary Bathroom</td>
<td>2/4 50%</td>
<td></td>
<td>5/8 62.5%</td>
<td></td>
<td>7/12  58.3%</td>
<td></td>
</tr>
<tr>
<td>Sanitary Bathroom</td>
<td>1/13 7.7%</td>
<td></td>
<td>1/3 33.3%</td>
<td></td>
<td>2/16 12.5%</td>
<td></td>
</tr>
</tbody>
</table>

¹ The frequency of households with unsanitary bathrooms that had at least one household member positive for intestinal parasites compared to households with sanitary bathrooms and no household members positive for intestinal parasites was statistically significant for nonrandom association based on Fisher’s exact test (p = 0.017, df = 1)

² Prevalence Odds Ratio of households with unsanitary bathrooms and at least one infected household member compared to households with sanitary bathrooms = 9.800; CI 95 %, Lower = 1.504, Upper = 63.846

³ Prevalence Odds Ratio of Nicaraguan households with unsanitary bathrooms compared to Costa Rican households = 8.667; CI 95 %, Lower = 1.526, Upper = 49.220
According to the prevalence odds ratio, Table 7-28 demonstrates that households with unsanitary bathrooms were almost 10 times as likely to have at least one household member test positive for intestinal parasites compared to households with sanitary bathrooms. Furthermore, Nicaraguans were more than 8 times as likely to have unsanitary bathrooms compared to Costa Ricans.

According to Figure 7-12 the household prevalence of intestinal parasites was associated with unsanitary kitchen conditions.

**Figure 7-12 Household Parasite Prevalence by Kitchen Condition and Nationality**

For example, the household prevalence rate for Costa Rican households with unsanitary kitchens was 50%, while for Costa Rican households with sanitary kitchens the household prevalence rate was 7.7%. The household prevalence rate for Nicaraguan households with unsanitary kitchens was 83.3% while for Nicaraguan households with sanitary kitchens the prevalence rate was 20%. For the entire study population, the household parasite prevalence rate for households with unsanitary kitchens was 70% and 11.1% for households with sanitary bathrooms.

Table 7-29 shows that the frequency of households with unsanitary kitchens that had at least one household member positive for intestinal parasites compared to
households with sanitary kitchens and no household members positive for intestinal parasites was statistically significant.

Table 7-29. Household Parasite Prevalence by Kitchen Conditions

<table>
<thead>
<tr>
<th>Condition of Kitchen</th>
<th>Costa Rican Rate</th>
<th>p%</th>
<th>Nicaraguan Rate</th>
<th>p%³</th>
<th>Total Rate¹</th>
<th>p%²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unsanitary Kitchen</td>
<td>2/4</td>
<td>50%</td>
<td>5/6</td>
<td>83.3%</td>
<td>7/10</td>
<td>70%</td>
</tr>
<tr>
<td>Sanitary Kitchen</td>
<td>1/13</td>
<td>7.7%</td>
<td>1/5</td>
<td>20%</td>
<td>2/18</td>
<td>11.1%</td>
</tr>
</tbody>
</table>

¹ The frequency of households with unsanitary kitchens that had at least one household member positive for intestinal parasites compared to households with sanitary kitchens and no household members positive for intestinal parasites was statistically significant for nonrandom association based on Fisher’s exact test (p = 0.003, df = 1)

² Prevalence Odds Ratio of households with unsanitary kitchens and at least one infected household member compared to households with sanitary kitchens = 18.667; CI 95 %, Lower = 2.533, Upper = 137.587

³ Prevalence Odds Ratio of Nicaraguan households with unsanitary kitchens compared to Costa Rican households = 3.900; CI 95 %, Lower = .762, Upper = 19.951

The prevalence odds ratio in Table 7-29 demonstrates that households with unsanitary kitchens were 18 times as likely to have at least one household member test positive for intestinal parasites compared to households with sanitary kitchens. Furthermore, Nicaraguans were almost 4 times as likely to have unsanitary kitchens compared to Costa Ricans.

According to Figure 7-13 the household prevalence of intestinal parasites was associated with the presence of vectors (flies and/or cockroaches) in the household. For example, the household prevalence rate for Costa Rican households with observed vectors was 42.9%, while for Costa Rican households with no observed vectors the household prevalence rate was 0%. The household prevalence rate for Nicaraguan households with observed vectors was 85.7% while for Nicaraguan households with no observed vectors the prevalence rate was 0%. For the entire study population, the household parasite prevalence rate for households with observed vectors was 64.3% and 0% for households with no observed vectors.
According to Table 7-30, the frequency of households with the presence of vectors where at least one household member positive for intestinal parasites compared to households with no vectors present and no household member positive for intestinal parasites was statistically significant for nonrandom association. It should be noted that since there were no cases of households where there were no observed vectors and positive parasites it was impossible to calculate the prevalence odds ratio for this association.

Table 7-30. Household Parasite Prevalence by Observed Vectors in Household

<table>
<thead>
<tr>
<th>Presence of Vectors</th>
<th>Costa Rican Rate</th>
<th>p%</th>
<th>Nicaraguan Rate</th>
<th>p%</th>
<th>Total Rate¹</th>
<th>p%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vectors Observed</td>
<td>3/7</td>
<td>42.9%</td>
<td>6/7</td>
<td>85.7%</td>
<td>9/14</td>
<td>64.3%</td>
</tr>
<tr>
<td>No Vectors Observed</td>
<td>0/10</td>
<td>0%</td>
<td>0/4</td>
<td>0%</td>
<td>0/10</td>
<td>0%</td>
</tr>
</tbody>
</table>

¹ The frequency of households with the presence of vectors where at least one household member positive for intestinal parasites compared to households with no vectors present and no household members positive for intestinal parasites was statistically significant for nonrandom association based on Fisher’s exact test (p = 0.001, df = 1).

² Prevalence Odds Ratio unable to calculate.

³ Prevalence Odds Ratio unable to calculate.
Factors Not Associated with Household Parasite Prevalence and Household Conditions

Household conditions including the disposal of household graywater and household septic tank conditions were not associated to household parasite prevalence according to 2x2 contingency tables. According to Table 7-31, the household parasite prevalence rate of households with poor graywater disposal systems was 50%. In contrast, households with good graywater disposal systems had a household parasite prevalence rate of 17.6%. However, this association was not significant based on a 2x2 contingency table.

Table 7-31. Household Parasite Prevalence by Graywater Disposal

<table>
<thead>
<tr>
<th>Graywater Disposal</th>
<th>Positive for Parasites Rate¹</th>
<th>Prevalence</th>
<th>Negative for Parasites Rate</th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adequate Disposal</td>
<td>3/16</td>
<td>17.6%</td>
<td>13/16</td>
<td>81.3%</td>
</tr>
<tr>
<td>Inadequate Disposal</td>
<td>6/12</td>
<td>50.0%</td>
<td>6/12</td>
<td>50.0%</td>
</tr>
</tbody>
</table>

¹ The frequency of households with inadequate graywater disposal systems and at least one household member positive for intestinal parasites compared to households with adequate graywater disposal systems and no household members positive for intestinal parasites was not statistically significant for nonrandom association based on Fisher’s exact test (p = 0.114, df = 1)

According to Table 7-32, the household parasite prevalence rate of households with inadequate septic tank systems was 50%. In contrast, households with adequate septic tank systems had a household parasite prevalence rate of 25.0%. However, this association was not significant based on a 2x2 contingency table.

Table 7-32. Household Parasite Prevalence by Septic Tank Condition

<table>
<thead>
<tr>
<th>Septic Tank Condition</th>
<th>Positive for Parasites Rate¹</th>
<th>Prevalence</th>
<th>Negative for Parasites Rate</th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adequate Condition</td>
<td>5/20</td>
<td>25.0%</td>
<td>15/20</td>
<td>75.0%</td>
</tr>
<tr>
<td>Inadequate Condition</td>
<td>4/8</td>
<td>50.0%</td>
<td>4/8</td>
<td>50.0%</td>
</tr>
</tbody>
</table>

¹ The frequency of households with inadequate septic tank systems and at least one household member positive for intestinal parasites compared to households with adequate septic tank systems and no household members positive for intestinal parasites was not statistically significant for nonrandom association based on Fisher’s exact test (p = 0.371, df = 1)
**Association between Household Conditions and Household Ownership**

Household conditions, including condition of bathroom and condition of kitchen were strongly associated with the type of home ownership.

**Table 7-33. Household Bathroom Conditions by Household Ownership**

<table>
<thead>
<tr>
<th>Home Ownership</th>
<th>Unsanitary Bathroom Frequency¹</th>
<th>Prevalence²</th>
<th>Sanitary Bathroom Frequency</th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rent Home</td>
<td>7</td>
<td>75.0%</td>
<td>3</td>
<td>18.8%</td>
</tr>
<tr>
<td>Own Home</td>
<td>3</td>
<td>25.0%</td>
<td>13</td>
<td>81.3%</td>
</tr>
</tbody>
</table>

¹ The frequency of households that rent their home and had unsanitary bathrooms compared with households that owned their own home and had sanitary bathrooms was statistically significant for nonrandom association based on Fisher’s exact test (p = 0.006, df = 1)
² Prevalence Odds Ratio of households with unsanitary bathrooms who rent their home compared to households that own their own home = 13.000; CI 95 %, Lower = 2.123, Upper = 79.594

According to the data in Table 7-33, 75% of households in the study population that rented their home had an unsanitary bathroom, while only 25% of households that owned their home had an unsanitary bathroom. The data show that the frequency of households that rent their home and had unsanitary bathrooms compared with households that owned their own home and had sanitary bathrooms was statistically significant for nonrandom association. According to an odds ratio shown in Table 7-33, households that rented their home were 13 times as likely to have unsanitary bathrooms compared to households that owned their own home.

The contrast between home ownership and kitchen condition was even greater. According to the data in Table 7-34, 90% of households in the study population that rented their home had an unsanitary kitchen, while only 10% of households that owned their home had an unsanitary kitchen.

**Table 7-34. Household Kitchen Conditions by Household Ownership**

<table>
<thead>
<tr>
<th>Home Ownership</th>
<th>Unsanitary Kitchen Frequency¹</th>
<th>Prevalence²</th>
<th>Sanitary Kitchen Frequency</th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rent Home</td>
<td>9</td>
<td>90.0%</td>
<td>3</td>
<td>7.7%</td>
</tr>
<tr>
<td>Own Home</td>
<td>1</td>
<td>10.0%</td>
<td>15</td>
<td>83.3%</td>
</tr>
</tbody>
</table>

¹ The frequency of households that rent their home and had unsanitary kitchens compared with households that owned their own home and had sanitary kitchens was statistically significant for nonrandom association based on Fisher’s exact test (p > = 0.001, df = 1)
Prevalence Odds Ratio of households with unsanitary kitchens who rent their home compared to households that own their own home = 45.000; CI 95 %, Lower = 4.044, Upper = 500.693

The data show that the frequency of households that rent their home and had unsanitary kitchens compared with households that owned their own home and had sanitary kitchens was statistically significant for nonrandom association. According to the odds ratio in Table 7-34, households that rented their home were over 45 times as likely to have an unsanitary kitchen compared to households that owned their own home.

Home ownership was also associated with household prevalence of intestinal parasites. Figure 7-14 shows that the household prevalence rate among Costa Rican households who rent their home was 40% while the prevalence rate for Costa Rican households that own their own home was 8.3%.

**Figure 7-14 Household Parasite Prevalence by Home Ownership**

The household prevalence rate for Nicaraguan households that rent their home was 71.4% while the household prevalence for Nicaraguans who own their own home was 25%. In total, the household prevalence rate for households that rent their home was 58% while for those that rent their home the prevalence rate was 12.5%.
Table 7-35. Household Parasite Prevalence by Household Ownership

<table>
<thead>
<tr>
<th>Home Ownership</th>
<th>Costa Rican Rate</th>
<th>p%</th>
<th>Nicaraguan Rate</th>
<th>p%³</th>
<th>Total Rate¹</th>
<th>p%²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rent Home</td>
<td>2/5</td>
<td>40%</td>
<td>5/7</td>
<td>71.4%</td>
<td>7/12</td>
<td>58.3%</td>
</tr>
<tr>
<td>Own Home</td>
<td>1/11</td>
<td>8.3%</td>
<td>1/3</td>
<td>25%</td>
<td>2/14</td>
<td>12.5%</td>
</tr>
</tbody>
</table>

¹ The frequency of households where at least one resident tested positive for intestinal parasites and who rent their home compared to households where no residents tested positive for intestinal parasites and who own their own home was statistically significant for nonrandom association based on Fisher’s exact test (p = 0.017, df = 1)
² Prevalence Odds Ratio of households with at least one infected household member and who rent their home compared to households that own their own home = 9.800; CI 95 %, Lower = 1.504, Upper = 63.846
³ Prevalence Odds Ratio of Nicaraguan households that rent their home compared to Costa Rican households = 4.200; CI 95 %, Lower = .838, Upper = 21.047

Table 7-35 shows that the frequency of households where at least one resident tested positive for intestinal parasites and who rented their home compared to households where no residents tested positive for intestinal parasites and who owned their own home was statistically significant for nonrandom association. According to the prevalence odds ratio in Table 7-35, households that rent their home were 9.8 times as likely to have at least one family member tested positive for intestinal parasites compared to households that own their own home. Also, Nicaraguan households were more than 4 times as likely to rent their home compared to Costa Rican households.

Household Parasite Prevalence and Household Health Care Coverage

Household health care coverage was also associated to household parasite prevalence rates. Households were considered to have “full health care coverage” if all household residents were covered. In contrast, households were considered to have “inadequate health care coverage” if at least one household member was not covered.

According to Figure 7-15, he household parasite prevalence rate for Costa Rican households with inadequate health coverage was 33.3% and just 9.1% for households with full health care coverage. For Nicaraguan households, the parasite prevalence rate among households with inadequate health care coverage was 66.7%, while for Nicaraguan households with full health care coverage the parasite prevalence rate was 0%. In total, the parasite prevalence rate among households with inadequate health care coverage was 53.3% and just 7.7% for households with full health care coverage.
Figure 7-15 Household Parasite Prevalence by Household Health Coverage

Table 7-36 illustrates that the frequency of households that had at least one household member test positive for intestinal in addition to having uninsured household members compared with households where all household members tested negative for intestinal parasites in addition to all household members having health coverage was statistically significant for nonrandom association.

Table 7-36. Household Parasite Prevalence by Household Health Coverage

| Household Health Coverage | Costa Rican Rate | | Nicaragua Rate | | Total Rate¹ | |
|---------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
|                           | Rate | p%   | Rate | p%   | Rate | p%   |
| Full Health Coverage      | 1/9   | 9.1%  | 0/2   | 0%   | 1/13 | 7.7% |
| Inadequate Health Coverage| 2/6   | 33.3% | 6/3   | 66.7% | 8/15 | 53.3% |

¹ The frequency of households that had inadequate health care coverage and at least one resident tested positive for intestinal parasites compared to households that had full health coverage and no residents that tested positive for intestinal parasites was statistically significant for nonrandom association based on Fisher’s exact test (p = 0.016, df = 1)
² Prevalence Odds Ratio of households that had inadequate health care coverage and at least one infected household member compared to households with full health care coverage = 6.933; CI 95 %, Lower = .995, Upper = 48.238

The prevalence odds ratio in Table 7-36 shows that households where at least one resident tested positive for intestinal parasites were 7 times as likely to also have
household members that did not have state health coverage compared to households where no residents tested positive for intestinal parasites and where all household residents had state health coverage.

**Household Variables Not Associated with Household Parasite Prevalence**

Factors such as household size, mothers’ formal education level, household unemployment, and household income were not significantly associated with households where at least one household member tested positive for intestinal parasites. For example, according to Table 7-37, the household parasite prevalence rate for households with 6 or more household residents was 62.5%, whereas for households with 5 residents or less the parasite prevalence rate was 20%.

**Table 7-37. Household Parasite Prevalence by Household Size**

<table>
<thead>
<tr>
<th>Household Size</th>
<th>Positive for Parasites Rate¹</th>
<th>Prevalence²</th>
<th>Negative for Parasites Rate</th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 &gt; People per Household</td>
<td>5/8</td>
<td>62.5%</td>
<td>3/8</td>
<td>37.5%</td>
</tr>
<tr>
<td>&lt; 5 People per Household</td>
<td>4/20</td>
<td>20.0%</td>
<td>16/20</td>
<td>80.0%</td>
</tr>
</tbody>
</table>

¹ The frequency of households with 6 or more residents that had at least one household resident positive for intestinal parasites compared to households with 5 or fewer residents was not statistically significant for nonrandom association based on Fisher’s exact test (p >= 0.068, df = 1)

² Prevalence Odds Ratio of households with 6 or more residents that had at least one household resident positive for intestinal parasites compared to households with 5 or fewer residents = 6.667; CI 95 %, Lower = 1.099, Upper = 40.434

According to a 2x2 contingency table this association between household size and household parasite prevalence was not significant. Still based on a prevalence odds ratio, households with 6 or more residents were more than 6 times as likely to have at least one household member test positive for intestinal parasites compared to households with 5 residents or fewer.

Table 7-38 shows that the household parasite prevalence rate for households where the mother had obtained 5 or fewer years of formal education was 50%, whereas for households where the mother had obtained 6 or more years of formal education the parasite prevalence rate was 18.8%.
According to a 2x2 contingency table the association between the mothers’ years of formal education and household parasite prevalence was not significant. Still based on a prevalence odds ratio, households where the mother had obtained 5 years of formal education or less were more than 4 times as likely to have at least one household member test positive for intestinal parasites compared to households where the mother had obtained 6 or more years of formal education.

Table 7-38. Household Parasite Prevalence by Mothers Years of Formal Education

<table>
<thead>
<tr>
<th>Household Size</th>
<th>Positive for Parasites</th>
<th>Negative for Parasites</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rate¹</td>
<td>Prevalence²</td>
</tr>
<tr>
<td>6 &gt; Years of Education</td>
<td>3/16</td>
<td>18.8%</td>
</tr>
<tr>
<td>&lt; 5 Years of Education</td>
<td>6/12</td>
<td>50.0%</td>
</tr>
</tbody>
</table>

¹ The frequency of households where the mother achieved 5 or fewer years of formal education that had at least one household resident positive for intestinal parasites compared to households where the mother achieved 6 or more years of formal education was not statistically significant for nonrandom association based on Fisher’s exact test (p ≥ 0.114, df = 1)
² Prevalence Odds Ratio of households where the mother achieved 5 of fewer years of formal education and where at least one household resident positive for intestinal parasites compared to mothers with 6 or more years of formal education residents = 4.333; CI 95 %, Lower = .799, Upper = 23.487

Table 7-39 shows that the household parasite prevalence rate for households where at least one household member had been unemployed in the past 6 months was 50%, whereas for households where all household members had been employed the parasite prevalence rate was 14.3%. According to Table 7-39, the association between household unemployment and household parasite prevalence was not significant. Still based on a prevalence odds ratio, households where at least one household member had been unemployed in the past year were 6 times as likely to have at least one household member test positive for intestinal parasites compared to households where all household members were employed.

Table 7-39. Household Parasite Prevalence by Household Unemployment

<table>
<thead>
<tr>
<th>Household Size</th>
<th>Positive for Parasites</th>
<th>Negative for Parasites</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rate¹</td>
<td>Prevalence²</td>
</tr>
<tr>
<td>Employed in Last Year</td>
<td>2/14</td>
<td>14.3%</td>
</tr>
<tr>
<td>Unemployed in Last Year</td>
<td>7/14</td>
<td>50.0%</td>
</tr>
</tbody>
</table>

¹ The frequency of households where at least one household member was unemployed in the last 6 months at where at least one household resident was positive for intestinal parasites compared to households where
all adults were fully employed was not statistically significant for nonrandom association based on Fisher’s exact test ($p > = 0.103$, $df = 1$)

2 Prevalence Odds Ratio of households where at least one household member was unemployed in the last 6 months at where at least one household resident was positive for intestinal parasites compared to households where all adults were fully employed = $6.000$; CI 95 %, Lower = $.965$, Upper = $37.296$

Finally, Table 7-40 shows that the household parasite prevalence rate for households with a monthly income between $100$ and $250$ dollars was $40\%$, whereas for households where the monthly income was between $251$ and $500$ dollars the parasite prevalence rate was $23.1\%$.

Table 7-40. Household Parasite Prevalence by Household Monthly Income

<table>
<thead>
<tr>
<th>Household Monthly Income</th>
<th>Positive for Parasites Rate¹</th>
<th>Positive for Parasites Prevalence²</th>
<th>Negative for Parasites Rate</th>
<th>Negative for Parasites Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>$251 - $500 USD</td>
<td>3/13</td>
<td>23.1%</td>
<td>10/13</td>
<td>76.9%</td>
</tr>
<tr>
<td>$100 - $250 USD</td>
<td>6/15</td>
<td>40.0%</td>
<td>9/15</td>
<td>60.0%</td>
</tr>
</tbody>
</table>

¹ The frequency of households where the monthly income was between $100$ and $250$ and where at least one household resident was positive for intestinal parasites compared to households with a monthly income between $251$ and $500$ was not statistically significant for nonrandom association based on Fisher’s exact test ($p > = 0.435$, $df = 1$)

² Prevalence Odds Ratio of households where the monthly income was between $100$ and $250$ and where at least one household resident was positive for intestinal parasites compared to households with a monthly income between $251$ and $500$ = $2.222$; CI 95 %, Lower = $.426$, Upper = $11.603$

According to Table 7-40, the association between household income and household parasite prevalence was not significant. The prevalence odds ratio shows that households with a monthly income between $100$ and $250$ dollars where were $2.2$ times as likely to have at least one household member test positive for intestinal parasites compared to households where the monthly income was between $251$ and $500$ dollars.

A summary of the quantitative research results will be presented in the following chapter.
Chapter Eight – Discussion of the Research Results

This chapter discusses the results of the research relating to the period prevalence of intestinal parasites and will focus on the significant findings of this research following the research objectives described in Chapter 4. To reiterate, the following research objectives were addressed in this research:

(O-1) Determine the period prevalence of intestinal parasites among the study population
(O-2) Determine the distribution and the most likely sources of infection and modes of transmission of intestinal parasites among the study population
(O-3) Describe the factors associated to the prevalence of intestinal parasites among the study population at the individual and household level.
(O-4) Provide a general political ecological framework that explains the prevalence of intestinal parasites among the study population in Monteverde, Costa Rica.

The significant findings of this research are outlined as follows. Based on epidemiological data gathered from this research, intestinal parasite infections were significantly underreported by the Monteverde Clinic when compared with prevalence rates of intestinal parasites gathered by this research during the same time period. This finding follows a trend in the Costa Rican public health literature (see Chapter 3) that questions the findings of the National Survey of Intestinal Parasites (Mata 1998) and demonstrates that intestinal parasites continue to be a public health concern, especially among marginalized populations in Costa Rica. Perhaps the most significant finding of this research was that among the study population, Nicaraguans were 5 times as likely to have intestinal parasite infections compared to Costa Ricans; thus constituting a significant health disparity.

Apart from gathering epidemiological data on parasite prevalence, one of the main objectives of this research was to characterize the principal sources of infection and modes of transmission of intestinal parasites among the two study populations.
Epidemiological data show that intestinal protozoa accounted for 87% of all parasitic infections among the study population; whereas infections with intestinal helminths accounted for only 13% of infections. This evidence strongly suggests that solid waste and wastewater management do not play a significant role in parasite transmission. Furthermore, the low prevalence of common water-borne intestinal protozoa and the high water quality standards of the Santa Elena Aqueduct indicate that potable water does not play a significant role in transmission. In contrast, epidemiological data show a relatively high prevalence of the pathogenic amoebae *Entamoeba histolytica* and similar commensal intestinal protozoa. This, coupled with data showing that individuals living in household with infected family members are at greater risk of being infected with similar parasites strongly indicates that the fecal-oral rout is the principal mode of transmission and that the primary locus of infection occurs at the household level; most likely the result of a range of poor hygiene behaviors and infrastructure.

Another principal objective of this research is to discuss the social and political economic factors associated with the prevalence of intestinal parasites among the study population. Based on household surveys and epidemiological data, three primary factors were associated with parasite infections: 1) a lack of access to health care; 2) household ownership; and 3) poor household environmental conditions. Reasons for not having access to health care vary from underemployment to immigration status. Results of the survey data show that individuals without access to health care, regardless of nationality, were more likely to have parasitic infections compared to those individuals with access to health care. However, the fact that Nicaraguans had significantly higher prevalence rates of intestinal parasites can be partially explained by the fact that they were almost 5 times as likely to not have access to health care compared to Costa Ricans. According to interviews with heads of households, a lack of access to health care creates barriers to testing and treatment of intestinal parasites.

Household ownership, specifically living in a rented home, was significantly associated with inadequate household environmental conditions, namely unsanitary bathroom and kitchen conditions. These conditions were then significantly associated with parasitic infections among individuals regardless of nationality. However, data from
household surveys show that Nicaraguans were more likely to live in a rented home compared to Costa Ricans and thus were more likely to live with inadequate household sanitation conditions compared to Costa Ricans.

Interviews with heads of household provide context in helping explain the complex reality of housing inequalities between Nicaraguans and Costa Ricans. International tourism in the Monteverde region has created a shortage of affordable housing. Nicaraguans who immigrated to Monteverde looking for work often find themselves underemployed. Both underemployment and immigration status precludes most Nicaraguan households from access to credit or from receiving housing subsidies. Without credit or government support, many Nicaraguan families have no other choice but to rent substandard housing, many of which have inadequate sanitation infrastructure. These factors, coupled with the fact that Nicaraguan households tend to be larger, and thus more crowded, than Costa Rican households provides both the social, behavioral and environmental conditions that promote the transmission of intestinal parasites at the household level.

The results of this research support the literature in defining parasitic infections as a “disease of poverty” in that the factors associated with parasitoses correlate with underdevelopment and social injustice (Vecchiato 1997). In addition, much of the medical anthropology literature related to infectious disease, including intestinal parasites tend to stress the importance of culturally determined beliefs, knowledge and behaviors as associated with increased disease transmission (Inhorn and Brown 1997). However, the results from this research demonstrate a significant departure from the literature in that research participants exhibited an extremely high level of knowledge about parasites, including their prevention and treatment. This finding is significant because it suggests that political ecological factors best explain the intensity and prevalence of intestinal parasites among the study population than does culturally determined beliefs and knowledge. As such, the principal themes outlined here will be examined in greater depth in the following discussion.
Research Objective (O-1): Determine the period prevalence of intestinal parasites among the study population

One issue this research sought to address were the conflicting reports from local residents who claimed that intestinal parasites are common in the community and interviews with local physicians who, based on laboratory results, claim that the prevalence of intestinal parasites is extremely low in the community and thus does not constitute a public health concern. As such, the following research question was asked:

Research Question (RQ-1): Are infections with intestinal parasites significantly underreported by the Monteverde Clinic?

The Alternative Hypothesis (H-1): Infections with intestinal parasites are significantly underreported by the Monteverde Clinic.

Unfortunately, it was impossible to determine the exact period prevalence of intestinal parasites for samples collected and analyzed by the Monteverde Clinic. However, it is possible to speculate with relative accuracy the period prevalence of intestinal parasites for the same time period as this study. According the Monteverde EBAIS (Primary Health Care Team), each week approximately 40 fecal samples are taken to the hospital in Puntarenas for analysis. Based on these approximations, between January and July, 2004 approximately 960 fecal samples were taken from Monteverde to Puntarenas to be examined for intestinal parasites. Results show that only 24 of these samples were positive for any kind of parasite. These numbers indicate an approximate period prevalence rate of 2.5% for the samples analyzed from the Monteverde Clinic. It is worth mentioning that these numbers are consistent with the data from the 1996 National Survey of Intestinal Parasites (Mata 1998).

Unfortunately, the Monteverde Clinic does not report the species of parasite for the infected patient making it impossible to know whether infection was the result of pathogenic or commensal species or even whether infection was the result of an intestinal protozoa or intestinal helminth. Making matters worse, the results do not specify the national origin, age, or gender of infected individuals. At best, data from the Monteverde Clinic provide a rough estimate of parasite prevalence among clinic patients who
volunteered fecal samples for analysis during the months that this research was undertaken.

In comparison, from January to July, 2004, the period prevalence rate of intestinal parasites reported from this research was 18%; considerably higher compared to data from the Monteverde Clinic. While it is difficult to compare these two data sets because of the difference in selection criteria, the prevalence odds ratio shows that participants who submitted fecal samples for analysis in this study were over 8 times as likely to have been diagnosed with intestinal parasites compared to patients who submitted fecal samples to the Monteverde Clinic. While the prevalence rates from this study are lower than those reported in other community studies in Costa Rica, they follow a trend in the Costa Rican public health literature (Abrahams-Sandí 2005; Blanco 2007; Cerdas 2003; González 1996; Hernandez-Chavarria 2005; Hernández 1998; Pardo 1997; Sanchez 1999) who’s findings regarding parasite prevalence differs significantly from those of the 1996 National Survey of Intestinal Parasites (Mata 1998), demonstrating that intestinal parasites continue to be a public health concern, especially among marginalized populations in Costa Rican. How can the difference in prevalence rates be explained?

One explanation is that the difference in the collection and preservation methods of fecal specimens employed by the Monteverde Clinic compared with the methods used in this study had significant consequences on the sensitivity/specificity of the results obtained. As explained in Chapter 4, this study employed the use of a PIF collection and preservation kit in which participants were instructed to immediately place stool samples into the collection/preservation vials. This process is effective for collecting, fixing, preserving, and staining the trophozoites, cysts and eggs of intestinal parasites, thus significantly increasing the chances of observing parasites upon microscopic analysis.

In contrast, stool specimens collected by the Monteverde Clinic are not placed in preservation solution; but rather collected and stored up to 5 days before they are taken to Puntarenas for analysis. Research has shown that cysts and trophozoites of intestinal protozoa, if not preserved properly, start to desiccate and break down several hours after being passed, making them difficult to identify through normal diagnostic microscopy (Price 1994). Thus, the practice of not preserving stool specimens can seriously affect the
specificity of the results, thereby increasing the probability of a false-negative (type II error) diagnosis which could potentially lead to significant underreporting of positive results and thus explain the low prevalence rates reported by the Monteverde Clinic.

Another consideration regarding the significant difference in prevalence rates is the potential for selection bias. Selection bias occurs when the relationship between exposure and disease in a study is not representative of the true relationship of exposure and disease in the general population because the study population had been selected in a non-representative way (Frumkin 2005). This researcher believes that parasite prevalence rates determined by the Monteverde Clinic suffer from selection bias because they only represent a cross section of clinic patients who volunteer fecal samples and not the population in general. For example, the clinic’s parasite prevalence rate excludes those who are healthy, those who self-medicate, those who seek diagnosis and treatment elsewhere, and those who lack health insurance. While it is impossible to determine the age, gender and nationality of patients who provided fecal samples at the Monteverde Clinic, evidence from clinic staff suggests that young children make up the majority of those who volunteer fecal samples. Consequently, adolescents and adults may be significantly underrepresented in the clinic sample. This finding is significant considering that the results of this study concluded that adults and adolescents were five times as likely to be positive for parasites compared to children under 5 years old.

In contrast, participants who volunteered fecal samples in this study did not differ significantly by age or gender. Therefore the researcher believes that prevalence rates obtained by this research more accurately reflect the actual prevalence rate of the study population. In conclusion, while there are significant comparative differences, the researcher is confident to accept the Alternative Hypothesis (H-1): infections with intestinal parasites are significantly underreported by the Monteverde Clinic. Underreporting parasitic infections can have serious public health consequences including the discontinuation of public health prevention efforts such as education, screening, and suppressive drug therapy which in time can lead to the reemergence of parasitic infections.
Research Question (RQ-2): Within the study population, do Nicaraguan immigrants have higher prevalence rates of intestinal parasites compared to Costa Ricans?

The Null Hypothesis (H-2): There is no difference in the prevalence of intestinal parasites between Nicaraguan and Costa Rican participants.

Laboratory results from the study population who provided fecal samples for analysis of intestinal parasites concluded that the prevalence rate among Costa Ricans was 8.3% while the prevalence rate among Nicaraguan immigrants was 31.4%.

Figure 8-1. Distribution of Parasites in Households by Nationality

![Map of Parasite Distribution by Nationality](image)
The difference in prevalence rates between the two populations was statistically significant and according to an odds ratio calculation, Nicaraguans were more than 5 times as likely to be positive for parasites compared to Costa Ricans during the study period. Figure 8-1 shows a map of the distribution of infected vs. non-infected households by nationality.

Based on these results, the researcher rejects the Null Hypothesis (H-2): that there is no difference in the prevalence of intestinal parasites between Nicaraguan and Costa Rican participants. Moreover, these results provide an excellent indicator of the overall health status and environmental conditions experience by each group, indicating that serious health disparities exist between Nicaraguan and Costa Ricans study participants. How can these significant differences in basic health outcomes among Nicaraguan immigrants and Costa Rican residents be explained, especially when these two groups live side by side in the same small rural community? What are the socio-demographic, economic and cultural variables associated with these differential health outcomes? These questions will be examined as part of the discussion of Research Objective (O-3).

**Research Objective (O-2): Determine the distribution and the most likely sources of infection and modes of transmission of intestinal parasites among the study population**

While it is impossible to determine with certainty the precise source of infection and mode of transmission of any one infection due the study design, knowing how parasites are distributed among the study population provides significant insights as to the most likely source of infection and mode of transmission. As a result the following question was asked:

**Research Question (RQ-3): Among the study population, are infections with intestinal protozoa more common than infections with intestinal helminths?**

*The Alternative Hypothesis (H-3): There is no significant difference in the prevalence of intestinal protozoa and intestinal helminths among the study population.*
Data from this research show that the prevalence of intestinal protozoa among study participants was 15%, (accounting for 87% of infected individuals), whereas the prevalence rate for intestinal helminths was only 2.4%. According to the prevalence odds ratio, participants in this study were 8.2 times as likely to be infected with intestinal protozoa compared to intestinal helminths. This conclusion leaves the question; how can the difference in the prevalence between intestinal protozoa and intestinal helminths among the study population be explained?

Data from the household water survey shows that nearly 90% of households in the study population have flush toilets and septic tanks, while only three households had a pit latrine. This finding is supported by a Monteverde Clinic report (ASIS 2002), indicating that over 98% of households in Santa Elena have working flush toilets and septic tanks. The ubiquity of flush toilets and septic tanks almost eliminate the practice of defecating in the open environment, thus effectively breaking the cycle of helminth transmission. It is also worth noting that while pit latrines can be extremely unsanitary, they are effective at breaking the mode of transmission of intestinal helminths while at the same time facilitating fecal-oral transmission of intestinal protozoa. In addition to supporting the epidemiological results, this explanation is supported by data that reported no significant association between household septic tank conditions and household parasite prevalence.

Another explanation of the disparity in prevalence rates between protozoa and helminths is that the Monteverde EBAIS actively promotes suppressive drug therapy among school age children in the Monteverde Zone. School age children are treated at least once a year with a single dose of Albendazole (it should be noted that both Nicaraguan and Costa Rican children have access to this program). In addition, the community health promoter from the EBAIS distributes Albendazole pills to family members during his annual household visit. Also, data from qualitative interviews on knowledge, perceptions and behaviors of intestinal parasites revealed that mothers will sometimes purchase Albendazole pills over the counter as a purge when they suspect their children may have parasites. The extremely low rates of helminth infection may be an indicator of the success of these blanket prevention strategies.
While Albendazole is known to be effective against helminths, it is often given to treat intestinal protozoa. However, this practice most likely has little effect on reducing rates of intestinal protozoa because the drug has been shown to have limited efficacy against these parasites (Faulkner 2003). Other drugs, such as Metronidazole and Iodoquinol are known to be more effective against parasites such as *Entamoeba histolytica*. Another consideration is that compared to helminths, intestinal protozoa require a relatively short time to establish infection suggesting that semi-annual drug treatment would do little to break the life-cycle of the parasite without sustained personal hygiene measures.

Epidemiological data reported that only two study participants tested positive for intestinal helminths. A closer look at these two cases indicate that both participants were Nicaraguan mothers ages 39 and 42. One of the women was infected with *Uncinarias* (hookworm) while the other woman was infected with both *Uncinarias* and *Trichiura trichiura* (whipworm). Both of the women had moved to Monteverde with their families approximately 3 years ago. Since it has been documented that it is possible for an individual to be continually infected with helminths for many years, it is possible that both women arrived in Monteverde already infected, having acquired their infections in Nicaragua or in their previous home in Costa Rica. In addition, the fact that both participants’ households in Monteverde had flush toilets, thus breaking the parasites life-cycle would explain why no other household members living with these women tested positive for helminth infections.

Based on epidemiological data and the evidence presented here the researcher rejects The Null Hypotheses (H-3): that there is no significant difference in the prevalence of intestinal protozoa and intestinal helminths among the study population. In Monteverde at least, prevalence of intestinal helminths are similar to those reported in the 1996 National Survey of Intestinal Parasites (Mata 1998) which reported a global prevalence rate of intestinal helminths of less than 3%. It is also worth noting that results of this study differ significantly from those recently published in Costa Rican public health journals including Abrahams-Sandi (2005), Cerdas (2003), Hernandez-Chavarria (2005), and Hernandez (1998) which report prevalence rates of intestinal helminths.
between 10% and 24%. These studies report higher prevalence rates of helminths that are most likely linked to significant deficiencies in the community waste water and sanitation infrastructure. In contrast, results of this study suggest that Monteverdes’ sanitation infrastructure (the ubiquity of flush toilets and septic tanks), along with effective suppressive drug therapy among school age children have been extremely effective at breaking the life-cycle of intestinal helminths. However, the lack of effective control strategies has given rise to the continued prevalence of intestinal protozoa. The following research question addresses this issue.

Research Question (RQ-4): Are parasites primarily transmitted as water-borne infections, or through the fecal-oral route of transmission?

The Alternative Hypothesis (H-4): There is no difference in parasite transmission; that is, intestinal parasites are just as likely to be transmitted via water as they are via the fecal-oral route of transmission.

To answer this question, it is necessary to know the prevalence of individual species of parasites and how they are distributed throughout the study population. This information is a good predictor of transmission because different parasites exhibit different etiological life-cycles that are associated with common sources of infections and modes of transmission.

In this study, *Entamoeba histolytica*, a common intestinal amoeba associated with producing diarrheal related diseases, was the most common pathogenic parasite with a global prevalence of 8.3%. This parasite was found in 6.1% of Costa Rican participants and 11.4% of Nicaraguan participants. While transmission of *E. histolytica* can be water-borne, it is most commonly associated with fecal-oral transmission and tends to cluster in households and schools. Results show that individuals infected with *E. histolytica* were more likely to have family members infected with parasites; while all participants infected with *E. histolytica* also tested positive for other commensal parasites like *Entamoeba coli*, and *Endolimax nana*, a trend which is consistent with fecal-oral transmission.
Giardia lamblia, a flagellated protozoan associated with producing severe diarrhea and dysentery, was the other pathogenic parasite found in the study population with a global prevalence of 2.4%. While G. lamblia can be spread through the fecal-oral route of transmission much like E. histolytica, this parasite is commonly associated with water-borne transmission where it has been documented infecting water distribution systems worldwide due to its resistance to chlorination. The low prevalence of G. lamblia suggests that water-born transmission of parasites in Monteverde is not common and related to isolated cases.

Notably absent was the intestinal coccidian, Cryptosporidium parvum, which is associated with severe diarrhea and gastrointestinal illnesses. This small intestinal parasite is associated with contaminated water supplies and has been implicated in large-scale water-borne outbreaks worldwide, including reported outbreaks in Costa Rica. The absence of C. parvum in this study suggests that water-born transmission of parasites in Monteverde is not common and provides a good indicator of water quality management in Monteverde.

The prevalence of commensal (nonpathogenic) protozoa was 19% when counting multiple parasite infections among individuals. Entamoeba coli were the most common commensal parasite found in this study with a global prevalence rate of 13.1%. This parasite infected 6.1% of Costa Rican participants and 22.9% of Nicaraguan participants. Another common commensal parasite, Endolimax nana was found in 6% of the study population; 2% of Costa Rican participants and 11.4% of Nicaraguan participants. Although they do not cause disease, nonpathogenic parasites are of significant public health interest because they serve as biological indicators of how well individuals and households follow and practice public health recommendations aimed at preventing infectious diseases that stem from fecal-oral transmission.

Commensal parasites such as E. coli and E. nana are especially good indicators of personal and household hygiene precisely because they do not cause clinical disease and are not targeted for treatment by physicians or school based suppressive drug campaigns. More importantly, commensal parasites share the exact same source of infection and mode of transmission as pathogenic species of intestinal protozoa (E. histolytica and G.
It is worth noting that while *E. histolytica* and *G. lamblia* are known as pathogenic parasites in humans, asymptomatic infections with these parasites are extremely common, especially with *E. histolytica*. Often, individuals with asymptomatic *E. histolytica* act as important reservoirs that can spread infective cysts of the parasite to susceptible persons.

The co-occurrence of both commensal and pathogenic protozoa in the feces of individuals is indirect evidence of a range of behaviors necessary to maintain fecal-oral transmission of parasites between infected and susceptible persons. In addition, the presence of commensal parasites significantly increases the probability that pathogenic parasites will spread among household members. In this study, epidemiological data indicate that participants living with infected family members were almost 5 times as likely to be infected with intestinal parasites compared to those participants who do not. This evidence suggests that the primary mode of transmission among the study population is through the fecal-oral route of transmission or through water-borne transmission. The likelihood that parasite transmission among the study population is primarily water-born is discussed in the following section.

**Water Resource Management and Water Quality:**

It should be noted that this research did not conduct independent water quality testing. As a result, the discussion regarding the potential association between water quality and parasite transmission is based entirely on secondary data sources. For study participants, the biggest risk in terms of water-borne transmission of intestinal parasites is the potential contamination of the Santa Elena Aqueduct. As mentioned earlier, water is an excellent vehicle of transmission for parasites like *Giardia lamblia* and *Cryptosporidium parvum*. Both species have been shown to be resistant to chlorine and as a result, can easily spread through water supplies with faulty chlorination systems (Byers 2001; Craun 1978; Schmunis 2002).

A report written in 1998 by *La Asociación Administradora del Acueducto de Santa Elena* (The Santa Elena Aqueduct Association) suggested that one of the potable water distribution systems in Santa Elena was at high risk due to surface water run-off.
contaminated with cattle feces (ICEA 1998). In Santa Elena, broken and leaky water pipes are common; a situation that can produce transient pressure events (excessive positive or negative pressure within the water pipe) caused by sudden changes in demand and pump outages. Negative pressure transients cause suction whereby leaks in water pipes provide a potential portal of entry for parasites and other pathogens that are present in the soil; especially \textit{C. parvum} which has been linked to surface water run-off contaminated by cattle feces (LeChevallier 2003).

Similar studies of parasite prevalence conducted in Costa Rica including Blanco (2007), Hernandez-Chavarria (2005), and Pardo (1997) reported significantly higher rates of infection with \textit{G. lamblia}, (between 5\% and 10\%) compared with 2.3\% reported in this research. These studies cite a lack of access to potable water supplies in the study communities as being partially responsible for the high prevalence of \textit{G. lamblia}. In contrast, residents of Monteverde enjoy access to high quality potable water which significantly reduces the probability of water-borne transmission of intestinal parasites.

Currently, The Santa Elena Aqueduct Association consists of three integrative water distribution systems that serve the communities of Santa Elena, Cerro Plano, Cañitas and Los Llanos providing services to approximately 5,000 permanent residents and more than two hundred thousand annual tourists (AAASE 2003). All households that participated in this research received water from the Santa Elena Aqueduct.

Upon the initiation of this research (2003), the Santa Elena Aqueduct received the prestigious “\textit{Sello de Calidad Sanitaria}” (Seal of [Water] Quality Sanitation) from the \textit{Instituto Costarricense de Acueductos y Alcantarillados} (The Costa Rican Institute of Aqueducts and Sewers) also known as AyA. According to Feoli (2007), the \textit{Sello de Calidad Sanitaria} program was initiated in 2001 by AyA as an incentive to local aqueduct operators in Costa Rica to provide high quality water to local populations in a sustainable and environmental friendly manner. The program consists of 6 active parameters that local aqueduct operators must follow in order to receive this distinction; 1) to protect local water sources including areas around springs through reforestation efforts and periodic spring inspection; 2) to periodically clean water storage tanks and distribution tubing; 3) to chlorinate all water and monitor residual chlorination levels; 4)
to implement environmental education programs and to disseminate information about the aqueduct to the local community; 5) to periodically measure water quality throughout the entire aqueduct and maintain specific water quality standards at all times; 6) a comprehensive risk assessment and water mediation program in addition to futures planning.

The *Sello de Calidad Sanitaria* distinction demonstrates that the Santa Elena Aqueduct provides high quality water to the local population and maintains a high standard of quality control to ensure the consistency of service. For example, results of independent laboratory testing from January to June 2004 demonstrate that potable water from the Santa Elena Aqueduct met water quality standards and residual chlorine levels for human consumption.

From a behavioral standpoint, research findings indicate that households do not engage in point source chlorination of tap water, thus excluding the possibility of a protective behavior in terms of water contamination. In addition, data from the household water survey suggest that periodic water shortages do not appear to force residents to store water, nor does it appear to alter basic hygienic behaviors such as hand washing and bathing. The data show that water shortages are predictable and are of short duration; therefore reducing the possibility that parasite transmission is associated with personal hygiene behaviors related to water insecurity.

While water-borne transmission of intestinal parasites in Monteverde is possible, the high prevalence of *E. histolytica* and other commensal species like *E. coli* and *E. nana* coupled with the low prevalence of *G. lamblia* and an absence of *C. parvum* are clear indicators that water from the Santa Elena Aqueduct is not a primary source of infection among the study population.

Had the primary source of infection been potable drinking water, one would expect a higher prevalence of *G. lamblia* and *C. parvum* distributed randomly throughout the study population because all study participants had access to the same potable water. In conclusion, the researcher rejects the Null Hypothesis (H-4): that intestinal parasites are just as likely to be transmitted via water as they are via fecal-oral transmission. In terms of parasite transmission, the data clearly indicate that intestinal parasites are
primarily transmitted through fecal-oral transmission and that infections primarily cluster at the household level. Evidence discussed in the next research objective confirms that parasite infections were not random, but rather significantly associated with certain household sanitation conditions and other socio-demographic variables.

**Research Objective (O-3): Determine the significant socio-demographic, economic and cultural factors associated with the prevalence of intestinal parasites among the study population at the individual and household level.**

Results presented in chapter 8 conclude that serious health disparities exist between Nicaraguan and Costa Rican study participants in terms of parasite prevalence. How can these significant differences in basic health outcomes be explained, especially when these two groups live side by side in the same rural community? The objective here is to discuss the socio-demographic, economic and cultural variables associated with disparities in parasite prevalence as well as those common to all study participants.

**Research Question (RQ-5): Are infections with intestinal parasites more common among study participants with no access to health care?**

**The Alternative Hypothesis (H-5): A lack of access to health care among study participants is associated with a higher prevalence of intestinal parasites.**

Of significant interest to medical anthropology, and the political economy of health in particular, are the structural causes of disease distribution, commonly referred to as “health inequalities”. According to Singer and Bear (2007) health inequalities, most notably unequal access to health care, are responsible, in part, for continued health disparities among marginalized populations. Lack of health insurance coverage is a significant barrier to the prevention and management of disease which carry significant health related consequences both in the short and long term.

Household demographic data show significant inequalities between Nicaraguan and Costa Rican study participants in terms of overall access to health care (defined as an individual having up-to-date health insurance through the CCSS providing access to all levels of health care). Demographic data report that Nicaraguans were almost 5 times as
likely to not have health coverage compared to Costa Ricans. In addition, participant’s positive for intestinal parasites were 3.2 times as likely to not have individual health coverage compared to those that were negative for intestinal parasites. These results raise several questions: 1) what are the principal barriers to health care coverage for Costa Ricans? 2) what are the barriers to health care coverage for Nicaraguans and why are they more likely to not have health insurance? and 3) how is a lack of health care access associated with parasite prevalence?

Based on ethnographic interviews and household health surveys with Costa Rican heads of household, three principal barriers to health care emerged. They are explained in detail as follows. **Barrier #1** new CCSS qualification requirements for recipients of state sponsored health insurance and the time and money required to obtain the documentation.

As explained in the description of the research site (Chapter 3), access to the CCSS based health insurance is employer based. However, the state offers free health insurance (similar to Medicaid in the U.S.) to qualifying single mothers, the poor, the mentally and physically disabled and school age children not covered by their parents’ health insurance. It is worth noting that 8 out of the 18 Costa Rican households that took part in this research relied on state health insurance as their primary access to health care.

While this research was being conducted, the CCSS was in the process of revising its inclusion requirements for recipients of state sponsored health care as part of its overall health reform measures. As a result, state health insurance recipients were asked to resubmit documentation to the CCSS as a way to justify their continued inclusion in the program. According to informants, the CCSS required the following documentation to confirm their continued eligibility: 1) proof of real estate/property holdings; 2) local electric, water and phone bills; 3) documentation of civil status; 4) birth certificates for all household members; 5) documentation of home rental contract from landlord (if renting home); and 6) a bank statement of home mortgage.

During interviews, several mothers complained that the new CCSS requirements were too strict. The following is a quote from a Costa Rican mother explaining why she no longer qualified for state health care insurance.
“I am the only one who doesn’t have health insurance. [My husband] has insurance through the UPA but it only covers him and the kids. I have gone to try to see if I could get insurance through the state because we are pretty poor but they kept giving me the run around and making me fill out a ton of paperwork. Then they finally told me that I couldn’t receive the health insurance because I own a house…that is, our house is in my name.”

The quote above was common among participants who were denied health insurance because they no longer met economic requirements stipulated by the CCSS. Making matters worse, many informants explained that the required CCSS documentation was only obtainable by going to the provincial capital of Puntarenas. For poor families, round trip bus fare to and from Puntarenas can be a serious financial burden. As a result, the lack of time and money needed to obtain the required documentation was a significant barrier. The following quote provides a good example.

“Well right now none of us has health insurance. We have been without health insurance for the last 5 months. We had insurance through the state but since they started asking people for paperwork and February was the deadline to turn all that stuff in and I have not been able to do it. I still have to go to Puntarenas one of these days to get all the papers. The clinic said that until we get the papers in they could not insure us. They also said that once we get the papers in then they do a review to see if we still qualify for state insurance. It is too bad but luckily they [her children] have not gotten sick enough to have to take them to the clinic. If they do get sick we’ll have to pay for it.”

In this case, the barrier of traveling to Puntarenas left an entire family, including 5 children without health care; not to mention financially vulnerable if someone in the family required medical treatment.

**Barrier #2** domestic issues resulting in incomplete CCSS documentation prevent children access to health care. This was the case in two Costa Rican families who participated in this research. The following quote sums up the dilemma.

[My daughter] is supposed to have insurance through her father, but he has not done anything with the papers, it’s as if he never had her! The CAJA told me that [her father] has to be responsible, and since he has insurance, [her daughter] should automatically be covered through his insurance. The problem is that he won’t complete the paperwork to make it happen. Until then I have to pay out of pocket for both of our medical expenses. She has been without insurance for 6 months now. And I don’t have any insurance because I don’t have a job yet that provides it and I can’t afford to pay for it on my own.”

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While this barrier is not as common, it points out inconsistencies in Costa Rican health care policy claiming that all children deserve access to health care. This quote also provides insight into the next barrier relating to underemployment.

**Barrier #3**) limited employment options open to mothers and young adults that provide health insurance benefits. As stated earlier, CCSS health insurance is primarily employer based, however, to avoid paying expensive employee health care benefits, employers often hire employees part-time or on a contract only basis. This practice is especially notorious among small employers in the service sector; the primary type of employment in Monteverde. The following quote provides a good example of the challenges many workers face in dealing with employers, the CCSS system, and the health consequences of not having affordable access to health care.

“I don’t have any insurance. I have not had insurance for about 6 years now or so because of my age (24 years old). And the [housekeeping] job that I have does not provide insurance at all because it is considered hourly work and it is not full time. When I have gone [to the clinic] they threaten you that they are going to make you pay and that you should have insurance and that you have to get it worked out, otherwise they won’t attend you the next time. It has affected me lots. I can’t really pay to go to the clinic. I have only been there 2 times in the last 6 years because I know I can’t pay. It affects my total health because I know that there are certain tests that I should get done every year but I can’t do it.”

In 2002, the CCSS claimed that 87.7% of all citizens had access to health care (Proyecto Estado de la Nación 2002). In contrast, 80% of Costa Ricans who participated in this research reported having health coverage. However, it should be noted that rates of health care coverage would have been significantly higher among Costa Rican study participants had it not been for the new documentation requirements.

For Costa Ricans, the biggest barriers in terms of access to health insurance are underemployment, including employer refusal to provide health insurance, and the new documentation requirements for recipients of state insurance. With regard to the latter, several parents who participated in this research were told by the Monteverde Clinic that their children no longer qualified for health care coverage. However, Costa Rican law states that children have the right to health care until they turn 18 years of age, or until
they acquire their own health coverage. Based on ethnographic interviews, it appears that the clinic may knowingly deny children access to health care based on the pretext of their parents’ insurance status. In other words, the clinic may be threatening parents by telling them that their children will not be attended at the clinic until the parent’s secure health care coverage when this is simply not the case. As a result, some children may be denied access to health care through scare tactics aimed at their parents. While the new requirement policies undertaken from the CCSS are understandable given the health care reform goals to cut down on costs, the consequences of denying basic health services to women and children is neither cost effective nor ethical.

The former is also disconcerting because Costa Rican health insurance is employer based, that is, both employers and employees pay a percentage of wages to the state to provide health coverage. However, some employers intentionally use illegal tactics to avoid paying employee health benefits. For example, some employers only employ on a part time basis because they are only forced to pay health benefits if the employee works over a certain number of hours. Other employers hire employees on the condition that they not ask for health coverage. Others hire employees on a trial basis saying that they will pay for health coverage after the employee has worked 6 months, only to be laid off before they have completed 6 months on the job. While these practices are illegal, informants claim that they would lose their job if they spoke out.

**Access to Health Care Among Nicaraguans**

While access to health care can be challenging for Costa Ricans, Nicaraguans face even greater challenges accessing health care. According to demographic data, 54% of Nicaraguans who participated in this study did not have any kind of health insurance. Moreover, 9 out of the 11 Nicaraguan households that participated in this study had at least one family member who did not have insurance. These results are consistent with those reported by Marquette (2006) who claims that over 50% of Nicaraguans do not have health insurance; suggesting that Nicaraguan nationality has an independent effect in reducing insurance coverage.
Based on ethnographic interviews and household health surveys with Nicaraguan heads of household, three principal barriers to health care emerged. They are explained as follows. **Barrier #1** new CCSS qualification requirements for recipients of state sponsored health insurance and the time and money required to obtain the documentation. Like many Costa Ricans, Nicaraguans who did not have health coverage claimed that they were recently denied coverage as a result of the new CCSS documentation requirements. This category included individuals who at one time received state health care insurance, but who were now unable to produce the proper paperwork and those who were told that they no longer qualified for such services because of their financial status or their ability to find work. For example, one Nicaraguan mother who stayed at home to care for her four young children explained that she was told that her state health insurance had been denied because the CCSS determined that she was able to work full time and therefore should obtain health insurance through an employer.

**Barrier #2** Underemployment and limited employment opportunities for Nicaraguan workers that provide health care. Data show that 64% of Nicaraguan men who participated in this research worked in construction related fields. While Monteverde was experiencing a construction boom around the time of this research, the majority of construction jobs available to Nicaraguans consisted of short term contracts and low-skill wage labor. According to Marquette (2006), unemployment levels tend to be higher for Nicaraguans who work in lower skilled occupations, including construction, due to the rapid influx of low-skilled workers into the country. Because the majority of construction contracts are short term, typically lasting a few weeks or several months, employers do not offer workers health insurance. The following quote from a Nicaraguan construction worker sums up this experience well:

“Right now I am working construction, I pretty much work with one contractor here in town, I have worked with him for a long time…When there is work I work more than full time but when there is no work I just work a little here and there. If the contractor does not have any work then I really don’t have work…Like most of us workers we have a contract for hours that means that the employers don’t have to provide us with [health] insurance.”
Information gathered from ethnographic interviews and household surveys found that Costa Rican construction workers more often hold skilled construction jobs, such as crew leader or site supervisor which tend to be more secure over the long term and offer full health insurance for workers and their families. One explanation for this discrepancy is that many Nicaraguan workers are “irregular” immigrants. As explained by Marquette (2006), irregular migrants have no recourse to formal protection or rights enforcement in the workplace. Thus, immigration status may contribute to lower wages and prevent them from negotiating better contract and work conditions including health care benefits.

**Barrier #3)** For Nicaraguans, the most significant barrier to health care is immigration status. In Costa Rica, foreign nationals who are in the country legally can apply for health insurance while those who are in the country illegally, or whose immigration documents have expired are not able to apply for, or receive health coverage through the CCSS.

Interviews with Nicaraguans concerning their “irregular” immigration status showed that some had no documentation whatsoever, having entered the country illegally while others had expired immigration documentation. In Costa Rica, Nicaraguan immigrants are supposed to renew their residency each year. However, residency renewals can only be done at Nicaraguan consulates and can cost over $100 USD per individual. As a result, time and money present significant barriers that prevent many Nicaraguans from renewing their immigration status. The following quotes exemplify the difficulties Nicaraguans face accessing health care.

“Well, the girls (all born in Costa Rica) have health insurance through the state until they are 18 years old, but we [my wife and I] don’t have insurance here because we don’t have our [immigration] papers in order, and we haven’t had insurance since 1994… It’s really hard for us, whatever we need we have to pay for it, no matter what, and usually [the clinic] wants the money up front or they won’t even let you in for a consultation with the doctors so we usually don’t have any money to pay for medical attention. Only when it’s something serious will we go in, otherwise we just try to stick it out or go to the pharmacy and buy some medication if we can.”

The following is a quote from a young undocumented Nicaraguan female who described the difficulties she had receiving pre-natal care from the Monteverde Clinic during her recent pregnancy due to her immigration status.
“I never had any pre-natal doctor visits here in Monteverde during my pregnancy. I tried to go to the clinic here on several occasions for pre-natal care but each time they turned me away at the door saying that I had to agree to pay for the consultation (which cost around $25 US). I told them that I did not have any money to pay and that I wanted to apply for coverage through the state but the people at the clinic told me that I had to get my [immigration] papers in order before I could do anything.”

Another barrier to renewing immigration papers was the possibility of being detained by immigration police while traveling outside of the Monteverde Zone. Several informants expressed this concern saying that busses going into San Jose are often stopped and passengers are asked to produce papers. The fear of possible detention by immigration police prevents many Nicaraguans from traveling freely about the country; some Nicaraguans even said they feared going to San Jose to renew their immigration documentation because of the possibility of being detained.

For many Nicaraguans, access to health care is complicated by immigration politics which deny them the right to qualify for affordable health care. In fact, Nicaraguans who lack essential documentation like passports or birth certificates have little hope of ever being able to apply for health insurance under current law. Although officials at the Monteverde Clinic maintained that they do not deny health services to Nicaraguans, evidence collected from interviews suggests that Nicaraguans who are unable to prove immigration status are often hassled and repeatedly denied basic services unless they agree to pay expensive consultation fees up front. For many, this precludes them from accessing basic health services leaving them vulnerable to significant health consequences.

Access to Health Care and Parasite Prevalence

Results presented in Chapter 8 show that access to health care is an important predictor of parasite prevalence among Costa Ricans and Nicaraguans alike. Epidemiological results demonstrate that prevalence rates for Costa Ricans with access to health care was 5.7%, while those with no health coverage had a prevalence rate of 14.3%. Likewise, the prevalence rate for Nicaraguans with access to health care was 22.2%, while those with no health coverage had a prevalence rate of 41.2%. These
statistics represent a significant association between parasite prevalence and access to health care among study participants.

While access to health care is not directly related to parasite prevalence, individuals with no health coverage tend to be poor, underemployed, and in the case of many Nicaraguan participants, illegal immigrants. Based on evidence from ethnographic interviews, individuals who do not have health insurance are less likely to go to the clinic for basic health services, choosing to go to the clinic only under extreme medical cases. In terms of intestinal parasites, individuals with no access to basic health care are much less likely to get tested and treated for intestinal parasites because common symptoms are usually perceived as not being serious. While anti-parasite medication is inexpensive even by Costa Rican standards, it is not commonly sold over the counter without a doctor’s prescription, making access to suppressive drug therapy for parasites difficult. Without suppressive drug therapy, infected individuals may harbor parasitic infections for long periods of time, increasing the probability that the infection be transmitted to other household members through fecal-oral transmission.

Another important consideration is access to health care at the household level. For instance, many households had at least one member with no health insurance. Epidemiological results show that households with inadequate health care coverage (where at least one household member was uninsured) were 7 times as likely to have at least one family member test positive for intestinal parasites compared to households where all members were insured. According to several personal accounts, the presence of uninsured family members can significantly influence the way in which insured household members access health care. Informants noted that the staff at the Monteverde Clinic sometimes hassle the non-insured about getting their insurance paperwork in order by threatening denials in service. As a result, parents with no health insurance are less likely to take their insured children to the clinic for fear of being confronted by clinic staff about their insurance status. The following is a quote illustrates this point.

“When I have needed to go [to the clinic] they hassle me about getting my paperwork done and stuff like that. So I don’t like to go because of that. Well, I mean, I go [to the clinic] and take the kids and stuff like that but for my part I don’t go [because] I have to pay for it and we really don’t have anything to pay with.”

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Although her children are insured, the fact that the clinic confronts her about her insurance papers ultimately affects her decision to take her children to the clinic. While she would not hesitate to take her children to the clinic for a serious health concern, she may think twice about taking her children for routine health checkups and screenings in order to avoid hassles with clinic staff. While cases like this cannot be generalized to the entire population, they do provide a glimpse as to how the lack of health care coverage of household members affects the way insured household members assess health care.

In conclusion, the researcher accepts the Alternative Hypothesis (H-5): the lack of access to health care among participants is associated with a higher prevalence of intestinal parasites. A lack of access to health care was significantly associated with increased prevalence rates of intestinal parasites among both Nicaraguans and Costa Ricans. This situation placed both Costa Ricans and Nicaraguans alike in difficult and unstable positions regarding both individual and household health by creating barriers that prevented the access of simple diagnostic and treatment procedures that could otherwise treat existing infections and eliminate further transmission.

Research Question (RQ-6): Is the household hygiene environment associated with the prevalence of intestinal parasites?
The Alternative Hypothesis (H-6): Inadequacies in household hygiene infrastructure are associated with a higher prevalence of intestinal parasites.

Here, the research focuses on household environmental factors to help explain the significant disparities in parasite prevalence rates between Nicaraguan and Costa Rican study participants. Results presented in Chapter 8 show that households with unsanitary bathrooms were almost 10 times as likely to have at least one household member infected with intestinal parasites compared to households with sanitary bathrooms. Unsanitary bathrooms were typically characterized by insufficient or absent hand washing facilities, a lack of soap, and exposure to soiled toilet paper. This hygienic environment promotes fecal-oral transmission of intestinal parasites among household members by reducing frequent hand washing behaviors, especially if infected family members reside in the
household. Furthermore, exposure to dirty toilet paper can also serve as a source of infection for non-infected family members since it is common to place dirty toilet paper in the waste bin instead of disposing it directly in the toilet bowl.

Again, results presented in Chapter 8 show that households with unsanitary kitchens were 13 times as likely to have at least one household member infected with intestinal parasites compared to households with sanitary kitchens. Unsanitary kitchens were characterized by dirty countertops, dirty plates and utensils, a lack of soap, and the presence of vectors. It is widely accepted that improper food handling coupled with improper hand washing promotes fecal-oral transmission of intestinal parasites and other viruses and bacteria (Byers 2001). Dirty countertops and utensils can also serve as sources of infection when infected family members who do not routinely wash their hands inadvertently touch these and other surfaces. In addition, vectors such as flies and cockroaches can increase the transmission of intestinal parasites by transporting infected cysts of protozoa to inanimate objects which can then be transmitted when individuals inadvertently ingest the cysts from a contaminated source.

Epidemiological results show that household bathroom and kitchen conditions were particularly good indicators of parasite prevalence regardless of national origin. However, the data show that Nicaraguan households were 8 times as likely to have an unsanitary bathroom; 4 times as likely to have an unsanitary kitchen; and 3 times as likely to have had vectors present in their home compared to Costa Rican households. The difference in bathroom and kitchen conditions is significant because it is linked, in part to disparities in prevalence rates of parasites at the household level. What factors explain the significant inequalities in household conditions?

The best explanation of inequalities relating to household conditions between Nicaraguan and Costa Rican households is home ownership; (i.e., whether the home is owned or rented). Data from household surveys demonstrate a significant association between rental homes and unsanitary bathroom and kitchen conditions. For example, 75% of rented homes had unsanitary bathrooms and 90% had unsanitary kitchens. These results also show a significant association between household ownership and parasite
prevalence; households that rented their home were almost 10 times as likely to have at least one household member test positive for intestinal parasites.

In this study, rental homes were characterized by small and cramped living spaces, a limited number of faucets and hand washing facilities, limited and inadequate food storage space, limited countertop space, limited protections from the outside environment, and other infrastructural inadequacies. For example, bathrooms in rental homes often had few faucets which discouraged hand washing, while kitchens lacked space for food storage and preparation. To provide the reader with an example of household conditions, the following is an excerpt from my field notes written after a visit to a rented Nicaraguan home. The living conditions presented here were common among Nicaraguan households that participated in this study.

February, 18th 2004 – Santa Elena – Initial visit to household 41.0

I entered into a tiny dark room with a low hanging ceiling were a young women sat at a sewing machine and where another young woman was lying on the bed. There was just enough room between the bed and sewing machine and the wall made of corrugated tin to pass into the next room which was smaller than the first. In the second room there was just enough room for a bed and a couple chairs and a crib shared by two babies! And there were three people sitting on the bed. This room then connected to the kitchen which was dark, dirty, extremely cluttered and extremely small. The makeshift countertops were dirty and covered with dirty kitchen items and food. A refrigerator was noticeable missing from the kitchen; instead there was a small wooden shelf to store food. The kitchen sink was also used to wash clothes; it was very dirty and there were pots and pans hanging around but there was no storage space and you could see through the walls to the outside. Behind the kitchen was the bathroom which was barely big enough for the toilet. It was dark and dirty with dirty toilet paper piled in the corner. Needless to say, my urge to pee subsided after taking a look at the bathroom! In all, I counted 8 or 9 people living in the house with another baby due in April.

This home was an obvious departure from the previous Costa Rican households I have visited; a fact that reconfirmed my decision to include Nicaraguan households in the study. From this visit, it is clear that another world existed apart from that of the [Costa Ricans]; one similar to that of immigrant families all over the world. A world where they lived in substandard housing, poverty, crowded living conditions, lacked access to basic services, and where fear of deportation create a sense of uncertainty and helplessness. It was in stark contrast to the commercial pictures of the beautiful, peaceful, and ecologically conservative Monteverde. In many ways it was the antithesis of Monteverde.

While the conditions of rental homes were similar despite nationality, the data show that Nicaraguans were more than 4 times as likely to rent their home compared to
Costa Rican households. These data are supported by a recent study from Marquette (2006) who reports that 40% of Nicaraguans live in inadequate living conditions compared to only 13% of Costa Ricans. What factors help explain the inequalities in home ownership and living conditions?

One explanation is the shortage of affordable housing in the Monteverde region. Every year, some 250,000 international tourists visit Monteverde in addition to a sizable foreign community that lives in the region. The influx of tourists and foreign nationals has, in part, contributed to a housing shortage; a factor that has even driven up the price of substandard housing. For many Nicaraguan families, underemployment and immigration status leave them with no other choice but to rent substandard housing which almost always have inadequate sanitation infrastructure; often times from absentee landlords who charge excessive rent. It should also be mentioned that the Nicaraguans households who owned their own home had adequate kitchen and bathroom sanitation conditions just like Costa Rican counterparts who owned their own home.

Another explanation, based on ethnographic interviews, suggests that Nicaraguans have very limited access to formal lines of credit compared to Costa Ricans, while the reasons for this are varied. First, Nicaraguans who have irregular immigration status are automatically excluded from qualifying for any kind of formal loans. This was the case in approximately 5 out of the 11 Nicaraguan households that participated in this study. However, Nicaraguan immigrants who are legal residents in Costa Rica described how underemployment is the primary factor that prevents them from accessing bank loans for home mortgages. Only two Nicaraguan households that participated in this study owned their own homes and were able to do so because they paid cash for them, (with help from personal loans through other family members) attesting that they too were unable to acquire formal bank loans. In addition, it was no coincidence that Nicaraguan homeowners were all long time residence of Monteverde and Costa Rica in general, having lived in Monteverde for an average of 18 years.

In terms of access to credit, interview data suggests that low income Costa Ricans have an easier time securing quality housing compared to Nicaraguans. In 2003, a low income housing project called “La Colina” was developed and built along the road...
between Santa Elena and Los Llanos with help from a Canadian NGO consisting of approximately 27 units. At the time of this research all of the families living in La Colina were low income Costa Rican families who met certain financial criteria. Families were given a government housing subsidy to purchase the home with no interest and extremely low monthly payments. The homes themselves were simple, yet comfortable, complete with potable water and built-in graywater disposal systems.

Interestingly, no Nicaraguan families lived in La Colina. I later learned that government housing subsidies were only available to Costa Rican citizens, essentially excluding Nicaraguan families from living in La Colina and exemplifying the unequal access to quality, affordable housing between Nicaraguans and Costa Ricans.

Another important aspect of the household hygiene environment associated with parasite prevalence is household size and living with infected family members. Results showed that individuals who lived in a household with 6 or more family members were over 5 times as likely to have been diagnosed with intestinal parasites compared to individuals living in a household with 5 or fewer family members. Results presented in Chapter 8 show that Nicaraguan households were statistically larger than Costa Rican households and were more likely to have household members infected with parasites. Because intestinal protozoa are primarily transmitted through fecal-oral transmission, the combination of crowded living conditions, infected family members, and poor sanitation infrastructure provide the perfect socio-environmental conditions needed to sustain parasite transmission at the household level.

Similar to results reported by Marquette (2006), demographic data reveal that Nicaraguan households were larger because they were more likely to include both extended family members and unrelated individuals compared to Costa Rican households which tend to consist of nuclear families. One reason for this is that Nicaraguan families are tied into immigration networks whereby settled families offer short term shelter to extended family members and friends. Although it was beyond the scope of this research to test these individuals for parasites, these temporary household members can serve as a source of infection to the host family if they arrive from areas where parasites are endemic.
In conclusion, the researcher accepts the Alternative Hypothesis (H-6): Inadequacies in household hygiene infrastructure are associated with a higher prevalence of intestinal parasites. The data discussed here clearly indicate that parasite prevalence is significantly associated with household environmental conditions and accounts for the disparity in parasite prevalence between Nicaraguans and Costa Ricans.

This conclusion supports a large body of literature including McElroy (2009), Inhorn and Brown (1997) and Vecchiato (1997) claiming that human parasitoses is related to poor socio-economic conditions, deficiencies in sanitary facilities, poor personal hygiene, and substandard housing among other variables. However, the conclusions presented here contribute to the literature by going a step further in explaining housing inequalities and health disparities as higher level political economic phenomena relating to immigration status, access to credit, home ownership and underemployment. These conditions foster the transmission of intestinal parasites and help explain why Nicaraguans experience higher rates of intestinal parasite infections compared to their Costa Rican counterparts.

**Research Question (RQ-7): Is knowledge of intestinal parasites and prevention strategies associated with lower household rates of infection?**

*The Alternative Hypothesis (H-7) states: Significant knowledge of parasite etiology and prevention will be associated with lower prevalence rates at the household level.*

A common assumption of medical anthropology is that infectious diseases are not the result of simple host, parasite, and environmental relationships, but instead are complex and precipitated by deliberate and non-deliberate behaviors which are influenced by cultural knowledge, perceptions, and behaviors (Inhorn and Brown 1997).

As described in chapter 7, qualitative domain analysis revealed significant similarities between Nicaraguan and Costa Rican participants from both “infected” and “uninfected” households regarding their understanding of intestinal parasites, their source of infection/mode of transmission, treatment and prevention strategies. In terms of defining intestinal protozoa, both groups provided simplistic descriptions; using words like “bichos” and “microbes” that “live in your stomach or intestine”. In contrast, it was
easier for participants to define intestinal helminths, describing them as being larger, worm-like organisms that interfere with digestion and nutrition.

While participants were somewhat vague about their definitions of intestinal parasites, all participants exhibited a high degree of understanding of sources of infection and modes of transmission of both intestinal protozoa and helminths. When asked where parasites come from, Nicaraguan and Costa Rican participants from both “infected” and “uninfected” households explained that parasites primarily come from a lack of personal and household hygiene; from infrequent hand washing; from not washing food; from drinking contaminated water; and from walking barefoot in the dirt.

When asked how to prevent parasites, Nicaraguan and Costa Rican participants from both “infected” and “uninfected” households cited public health campaign slogans like “maintain good overall hygiene”; “wash your hands after you go to the bathroom and before you eat”; “wash fruits and vegetables”; “avoid contaminated water”; and “don’t walk around barefoot in the dirt”. These simple, primary health care messages have become the mantra of many mothers, although many admit that their children don’t pay attention to these rules and therefore are more likely than adults to get parasites.

Among this study population, knowledge about parasites did not differ between Nicaraguan and Costa Rican participants in spite of the fact that Nicaraguan participants had significantly less formal education compared to Costa Ricans. Qualitative data analysis revealed that the majority of participants were much more likely to obtain their knowledge about intestinal parasites from informal sources such as family, neighbors and first-hand experience, as they were from more formal sources of information. In fact, none of the participants interviewed in this study mentioned learning about parasites from school and only a few participants mentioned obtaining knowledge about parasites from their doctor or the local clinic. In many cases, knowledge of parasites among Nicaraguan and Costa Rican heads of household was a result of first-hand experience, either as children or as mothers. Many recounted stories of how they themselves, their siblings or their children had parasites. Knowledge of parasites based on experience and informal social sources was evident in their detailed knowledge of parasite symptoms and treatment pathways.
In terms of specific treatment pathways, Nicaraguan and older Costa Rican heads of household were much more familiar with alternative medicines; whereas knowledge of treatment pathways among younger Costa Rican heads of household were almost exclusively based on biomedical treatments. This phenomenon is best explained by greater access to health care services in Monteverde in the past 5 years. Nicaraguan participants along with older Costa Rican participants explained that in the past, doctors and medicines were not readily available, forcing them to deal with intestinal parasites using a variety of home remedies. Evidence for this exists in the vast ethno-botanical knowledge regarding treatments for intestinal parasites expressed by both Nicaraguan and older Costa Rican participants in this study. Qualitative analysis revealed at least eighteen different home remedies used to treat intestinal parasites. In contrast, younger heads of household noted that parasites can be treated with readily available medicine from the local clinic.

Another explanation based on qualitative analysis was that in the past, parasite infections were much more common because of poor sanitary conditions, a lack of prevention efforts and limited access to health care. As a result, older participants were more likely to have experience dealing with intestinal parasites. Similarly, Nicaraguan participants attested to the fact that parasite infections are much more common in Nicaraguan than they are in Costa Rica and noted that treating and diagnosing parasite infections was the norm rather than the exception.

While participants exhibited a high level of knowledge regarding the specifics of symptoms, source of infection, mode of transmission, treatment, and prevention of parasites, qualitative analysis showed that participants’ knowledge appeared to be categorized into separate and unconnected pieces of information. For example, many participants knew explicitly the symptoms and treatment pathways of hookworm infection; they also knew that one could prevent “parasites” by not walking barefoot in the dirt, but they did not specifically know that hookworm infection was caused by walking barefoot in infected soil. In another example of this disconnect, participants were unclear about the fecal-oral route of transmission. Participants were generally unaware
that transmission is contingent on infected individuals, believing instead that parasites are ever present in unhygienic environments.

The disconnect in knowledge about parasites and their specific source of infection and mode of transmission is most likely the result of what Nichter (2008) refers to as “message crossover”. Nichter observes that communities are exposed to an enormous amount of health education messages. Message crossover occurs when messages concerning one health problem influence or confound thinking about other health problems. An example of message crossover can be observed in health messages from both doctors and public health practitioners which are often isolated and de-contextualized. For example, public health messages often focus on preventive behaviors like consistent hand washing but rarely explain precisely how or why hand washing prevents the transmission of parasites.

In addition, doctors may tell parents that their child is infected with parasites but not tell them which specific parasite caused the infection or what they can do to prevent the parasite. Participants in this study complained about the fact that doctors at the clinic would withhold information about parasites after having received a positive diagnosis, claiming that doctors at the clinic would only prescribe anti-parasite medication and not say anything about the infection.

A possible explanation is that doctors withhold specific clinical information about parasites from patients because they feel that patients are incapable of understanding medical concepts and terminology. In this case, medical knowledge is the explicit domain of physicians, where patients are not privy to information concerning the clinical details of disease etiology and are only told what medication they can take to treat their infection. In fact, information regarding source of infection and prevention is often relegated to the ranks of public health practitioners. This relationship is specifically expressed in the organization of the Costa Rican health care system where the CCSS is in charge of providing health care and treatment, while the Ministry of Health is charged with prevention. As a result, information about disease etiology and prevention are learned from public health campaigns rather from ones primary physician.
Still, this disconnect in knowledge about parasite etiology does not appear to significantly affect parasite prevalence among study participants. It appears that almost all participants have significant knowledge about preventive behaviors such as maintaining general hygiene, frequent hand washing, proper food preparation, and wearing shoes. Whether participants always practice these behaviors is another question and outside the scope of this research.

In conclusion, the researcher rejects the Alternative Hypothesis (H-7): Significant knowledge of parasite etiology and prevention is associated with lower parasite prevalence rates at the household level. Instead, the data suggest that knowledge about parasites does not appear to be associated with lower parasite prevalence rates. This finding is significant because it suggests that political ecological factors best explain the intensity and prevalence of intestinal parasites among the study population than do culturally determined beliefs and knowledge as suggested in the medical anthropology literature.

These conclusions are important because they add a significant piece to the literature by suggesting that household environmental conditions may significantly influence the way in which participants implement preventive behaviors. For example, participants who live in households where kitchens are lacking in sanitary infrastructure may have a more difficult time putting into practice preventative behaviors; whereas participants who live in households with adequate infrastructure may have an easier time implementing preventative behaviors. As a result, it is hypothesized that household sanitary infrastructure has a greater impact on parasite transmission than does knowledge about preventative behaviors. This would explain why household sanitary conditions were significantly associated with disparities in parasite prevalence whereas critical knowledge concerning parasites does not appear to significantly differ among study participants.

Research Objective (O-4): Provide a general political ecological framework that explains the prevalence of intestinal parasites among the study population in Monteverde, Costa Rica.
The following chapter will attempt to contextualize the principal results of this dissertation using a political ecology of health framework. Political ecology, with its focus on macro and micro levels of analysis within a historical context provide an excellent framework for understanding parasite prevalence and transmission among the study population. Most importantly, this framework provides a means to go beyond the proximate causes of disease by examining macro level political economic and environmental phenomena which can be considered the ultimate causes of disease. Lastly, the political ecology approach to understanding disease transmission has significant potential for identifying interventions that point to political economic, social and environmental changes aimed at disease prevention that extend beyond a more traditional public health approach which focuses almost exclusively on the locus of infection.
Chapter Nine – Conclusions, Recommendations and Limitations

In this study, fecal samples were collected and analyzed for intestinal parasites among a small study population consisting of a group of Nicaraguan immigrants and a group of Costa Rican residents living in and around Santa Elena de Monteverde, Costa Rica. Without a doubt, the intense migration of Nicaraguans to Costa Rica over the past two decades has been one of the most contentious issues confronting modern Costa Rican society (Morales and Castro 2002; Sandoval-Garcia 2004a; 2004b). Among one of the most controversial issues has been the financial and social impact of Nicaraguan migrants on the national health care system (Segnini 1999). Thus, it is surprising that there are so few studies that have comparatively studied differential health outcomes among Nicaraguans and Costa Ricans.

At the time of this research, Costa Rican health institutions did not routinely collect data regarding the nationality of patients, making it difficult to assess health or other social inequalities experienced among Nicaraguans or other marginalized populations. As a result, there are very few studies that have comparatively examined the health of Nicaraguan immigrants living in Costa Rica. A case in point is that before this study, virtually nothing was known about the health or social conditions of the Nicaraguan population living in Monteverde. The decision to comparatively study the prevalence of intestinal parasites was an attempt to answer the call expressed by Marquette (2006) and the OIM report (2001) to compare health outcomes of Nicaraguans and Costa Ricans in order to determine whether significant health disparities exist.

While the parasite prevalence results of this research contradict those reported by the Monteverde Clinic and in part by those presented by the 1996 National Survey of Intestinal Parasites, they support a growing body of Costa Rican public health literature which indicate that parasites prevalence rates are high among marginalized populations (Abrahams-Sandí 2005; Blanco 2007; Cerdas 2003; Hernandez-Chavarria 2005; Hernández 1998; Pardo 1997; Sanchez 1999). One of the most significant results of this
current study was that Nicaraguan study participants suffered significantly higher rates of intestinal parasites compared to Costa Rican study participants. These results provide primary evidence to suggest that significant health disparities exist between Nicaraguans and Costa Ricans and thus support earlier reports from the OIM (2001), CCSS (2002), and Marquette (2006). The results of this research serve to fill a critical gap in the Costa Rican health literature by comparing rates of intestinal parasites between Nicaraguan immigrants and Costa Rican residents at the local level.

This research also answers the call by Inhorn and Brown (1997) in their book “The Anthropology of Infectious Disease” to examine infectious diseases as they manifest in different ecological and cultural settings. The authors express the need for researchers to explain how patterns of infectious diseases are not only influenced by local variables but also, how they are influenced by political-economic (or political-ecological) policies and processes of globalization. As such, this research lends itself to a political ecology framework as a way to explain disparities in parasite prevalence rates.

Toward a Political Ecology of Intestinal Parasite Infections in Monteverde, Costa Rica

For the most part, parasite prevalence studies, including the Costa Rican studies cited here do a good job at describing the distribution and intensity of parasites among the study population. These studies are also effective at identifying the most probable sources of infection and modes of transmission; often pointing to contaminated water, poor household and personal sanitation, low socioeconomic status, a lack of education and cultural behaviors as the primary causes of disease. Armed with this information, these studies then propose public health interventions aimed at reducing disease transmission. However, as noted by Goodman and Leatherman (1998), these studies have rarely “focused upstream” to the larger “macro” or “intermediate” level factors that influence parasite prevalence. For example, it is well known that inadequate household sanitation is often associated with increased parasite prevalence; however, it is rare that the origins of inadequate household sanitation are addressed in relation to disease transmission. As such, the political ecology of health framework goes beyond the
proximate determinants of disease transmission in order to identify and better contextualize the macro and intermediate level determinants of disease as a means to suggest structural changes and related strategies aimed at disease prevention.

As explained by Singer (2008), McElroy and Townsend (2009) and Mayer (1996) politics, economics and the environment play a major role in community health and must be considered in any health model. As such, the political ecology of health framework is similar to that of critical medical anthropology, but adds environmental factors to the analysis by understanding that poor health is a product of development and transformed environments that have roots in political economic policies and realities.

One of the principal concepts of political ecology is its focus on micro and macro level linkages (i.e. local, regional, and global interactions) with attention to historical processes in order to contextualize disease outcomes. This research follows the assertion by Singer (2003) that the political ecology of health framework gives attention to both the social and biological origins of disease. Specifically the model tries to understand the nature of the proximate (micro) causes of disease as well as the social, political-economic, and environmental relations that are the ultimate (macro) causes of disease. The following conclusions are an attempt to contextualize parasitic infections within a political ecology of health framework.

The Role of Water and Water Resource Management in Disease Transmission

One of the original objectives of this research was to determine whether community based water resources management was linked in any way with community health outcomes; specifically parasitic infections that are often caused by both water-borne and water-washed modes of transmission. Based on water quality analysis reported by the Santa Elena Aqueduct and the microscopic analysis of participant fecal samples, this research concluded that potable water was not significantly associated with parasite transmission among study participants. These findings are contrary to those reported by Peinador and Murillo (2000b), who found high prevalence of protozoan cysts in water treatment plants in several municipalities throughout Costa Rican; thus demonstrating that water may be a primary source of infection of intestinal parasites in those areas of
Costa Rica. However, as mentioned in the previous chapter, the Santa Elena Aqueduct is fortunate to have an excellent and adequate source of spring water that is accessible to the entire population. Thus, the source of water and its distribution in Monteverde is significantly different compared to those reported by Peinador and Murillo (2000).

Evidence from this research and from secondary data of water quality suggests that the primary mode of transmission is through fecal-oral contact at the household level rather than water-borne transmission at the community level. These conclusions serve to calm the fears of researchers at the USF-Globalization Research Center who initially suggested that the process of rapid economic development in Monteverde may have serious consequences to water quality and health. On the contrary, the results demonstrate that at the time of this research, water quality, graywater disposal, and wastewater disposal was not a significant source of intestinal parasite transmission or other common water-borne diseases. Second, water scarcity does not appear to significantly alter hygiene behaviors or water management behaviors that can contribute to common water-washed diseases. Third, while the contamination of local waterways from both household and small business waste is of environmental concern, there is no evidence to suggest that this type of contamination has a significant impact on human health. Finally, one of the major concerns in terms of water resources management in Monteverde is the ability of the Santa Elena Aqueduct to keep up with demand of the rapidly growing population while at the same time maintaining water quality. Based on secondary evidence from this research, the Santa Elena Aqueduct appears to be administered by a skilled group of technicians who are well aware of the future challenges. Moreover, at the time of this research, the Santa Elena Aqueduct was one of only 13 community aqueducts in Costa Rica to receive the “Sello de Calidad Sanitaria” (Seal of [Water] Quality Sanitation). The aqueduct continues to invest in evidence based evaluation of its water management infrastructure to ensure that the future water needs of the community are met.

**The Systematic Underreporting of Parasitic Infections as a Macro Cause of Disease**

The “political” in the political ecology of health model focuses on the idea that disease is often the ultimate result of social relations which, in this case, determine how
the knowledge, control, and production of critical health resources are distributed among the population in a way that has consequences on disease outcomes. Therefore, the unequal distribution in parasite prevalence between Nicaraguans and Costa Ricans reported in this research must be understood within the context of significant underreporting of intestinal parasites by the Monteverde Clinic. As described in the discussion, underreporting is likely the result of both inadequate laboratory testing procedures and selection bias that inadvertently discounts the uninsured population who are unlikely to get tested for intestinal parasites. Since the public health response to any disease is often based on its epidemiological profile within a certain population, the inverse is also true, where in this case the low reported prevalence of intestinal parasites is justification for public health inaction.

As Nichter (2008) points out, the collection of public health/epidemiological data and the production of knowledge about disease are not neutral, nor are they produced in a vacuum, but rather are the result of national health politics. Thus, the underreporting of intestinal parasites by the Monteverde Clinic has two consequences: 1) it forfeits the need of a community based public health response to address intestinal parasites; and 2) it ignores the fact that the Nicaraguan community suffers from significantly higher rates of parasite infections and justifies their continued exclusion from the medical system. This situation provides a good example of how the political economy of the Costa Rican medical establishment inadvertently ignores the high parasite prevalence rates among the Nicaraguan community in Monteverde.

Underreporting parasites, whether unintentional or not, influences the medical importance given to parasites, thus having a direct impact on the public health response in terms of diagnosis, treatment and prevention. Inhorn and Brown (1997) have implied that infectious diseases are likely to emerge or reemerge when public health measures slacken or break down. Though it is beyond the scope of this study, the evidence collected from this research introduces the hypothesis that the continued underreporting of parasites along with the systematic political economic barriers that prevent many Nicaraguans access to basic health services may result in a continued increase of parasite prevalence among the Nicaraguan community. As such, it is hypothesized that the
uninsured Nicaraguan community poses a permanent risk to the host community as a significant reservoir of intestinal parasites. That is to say, the high prevalence of parasites among the Nicaraguan community in Monteverde has serious implications for the potential re-emergence of parasites among the general population which currently exhibit low parasite prevalence. It is further hypothesized that the complacency in underreporting parasites can help explain, in part, the health disparities between Nicaraguans and Costa Ricans living in Monteverde.

Singer (2007) defines health disparities as disproportionate or excess morbidity or mortality among disadvantaged groups in society. The literature often points out that poverty is one of the principal predictors of health disparities. However, the findings of this research suggests that structural causes, including access to health care, immigrant status, and the inadvertent underreporting of intestinal parasites by the medical establishment provide a better explanation of disparities in parasite prevalence than does poverty. This hypothesis follows with Singer’s social structural view of health disparities which are seen as the product of social inequities and injustice; not merely the consequences of individual decisions and actions.

Within a political ecology of health framework, the systematic, albeit inadvertent underreporting of intestinal parasites is related to and perpetuated by denying access to basic health services based on immigrant status and the inability to pay for consultation fees and are hypothesized to be the ultimate or macro causes of health disparities exhibited between Nicaraguan and Costa Rican study participants. In turn, the absence of a public health response to address this community level health disparity is justified by continued underreporting. In this case, disparities in parasite prevalence among Nicaraguan immigrants are the result of ethnic discrimination, either conscious or unconscious, on the part of health care providers. Singer (2007) describes this as institutional racism in which health care providers see ethnic minorities as less worthy patients, an idea grounded in power imbalances between minorities and medical elites.
**Immigration as a Macro, Social Structural Cause of Disease**

The political ecology of health framework was also used to understand how macro level processes such as immigration are intrinsically linked to intermediate and proximate causes of disease. The movement of people and capital is perhaps the most obvious connection between globalization and infectious diseases. Inhorn and Brown (1997) and the IoM report (2006) state that migrant populations are among the most vulnerable to emerging and reemerging infectious diseases. Indeed, migrant health issues have become among the most contentious health issues in countries that receive migrants, not least in Costa Rica.

In terms of macro level analysis, disparities in parasite prevalence between Nicaraguan and Costa Ricans study participants must be understood within the context of large scale immigration of Nicaraguans into Costa Rica in general and specifically to the growth of the ecotourism sector in Monteverde. The conclusion that immigration status is connected to a set of consequences that make migrants more vulnerable to infectious disease is well accepted in the literature (Knobler 2006; Ministerio de Salud de Costa Rica 2002; Singer 2007). According to Knobler et al. (2006) migration is propelled by a complex and dynamic interplay of various push and pull factors indicative of a differential power hierarchy within and between nation states.

For Nicaraguans in general, the push factor is a result of civil unrest, high poverty, unemployment, and natural disasters, while the geographic proximity, political stability and continued demand for cheap labor in the agriculture and service sector economies of Costa Rica provide the pull factor. On the local level, the growing ecotourism economy in Monteverde has steadily attracted Nicaraguan migrants in order to meet growing demands for low-skill construction, service sector, and domestic service employment.

One of the significant findings of this research was that immigrant status has serious impacts and consequences on the social, political economic and environmental variables that were associated with an increased risk of parasitic infections. The consequences of immigrant status are, in many ways, analogous to what Singer (2003) describes as “a syndemic set of relationships” that, in this case, were found to influence
the distribution of parasitic infections. This research found the following syndemic set of relationships related to increased parasite infection: 1) immigrants faced significant barriers to health care which affected health seeking behavior such as screening and treatment of parasitic and other common illnesses; 2) immigrant workers had greater difficulty negotiating higher wages, basic work protections, and health benefits and as a result were more likely to be underemployed; 3) immigrants did not have access to formal credit or government housing subsidies because of their employment and or residency status which consequently posed a serious barrier to home ownership; 4) growth of the ecotourism economy increased the demand and price for quality housing as well as the prices of everyday goods and services; 5) job insecurity and barriers to credit force many immigrant families to rent substandard housing; 6) rental properties were significantly associated inadequate kitchen and bathroom sanitation infrastructure. This coupled with the fact that immigrant families tend to be larger than typical Costa Rican families create household ecologies that promote the fecal-oral transmission of parasites. Figure 9-1 demonstrates, in part, this syndemic set of relationships based on immigration status that is ultimately associated to disparities in health outcomes.

As Nichter (2008) points out, this set of syndemic relationships appeal to a political ecology of health framework because they emphasizes the interactions between health and social inequality within historical context while paying attention to modes of transmission that cluster among migrants. This research concluded that compromised household ecologies including sanitation infrastructure, household size, and the presence of infected individuals were all significantly associated with higher parasite prevalence rates. The importance of household ecology in terms of parasite transmission is treated as an intermediate cause of disease and is discussed in the following section.

**The Household Ecology as an Intermediate Cause of Disease**

A main concern of the political ecology of health framework is linking the macro or ultimate causes of disease to the micro or proximate causes of disease. It is the hypothesis of this research that the household ecology provides the primary link between both macro and micro level disease pathways. In this case for example, how immigration
status is linked to substandard household ecologies including inadequate bathroom and kitchen sanitation infrastructure, as well as household size, which in turn is associated with an increased prevalence of parasite infections through fecal-oral transmission (See Figure 9-1 for a graphic representation of these linkages). In the political ecology framework, the environment is understood in broad terms; from traditional ecological habitats including tropical rain forests to built environments that include human dwellings. For anthropologists, the household environment is important to the study of infectious disease because of how it intersects with biological, physical, and cultural characteristics to encompass an ecological system (Wilk 1991).

The political ecology of health framework proposed in this dissertation borrows from “the household ecology of disease transmission” model suggested by Coreil, Whiteford and Salazar (1996) in order to help explain how the household determinants of disease are linked to both macro and micro levels of analysis that help explain patterns of disease transmission. The household ecology model provides a link between both micro and macro level phenomena by means of defining the household ecology as an intermediate pathway of disease between larger political economic factors and the proximate determinants of disease including the exposure to pathogens (Millard 1994).

Coreil and colleagues (1996) propose that the household ecology of disease transmission framework consists of three basic components; the biophysical environment, the social environment, and the culturally constructed environment. In this study, the biophysical environment refers to poor household conditions, specifically unsanitary kitchens and bathrooms as well as the presence of vectors. In terms of kitchen conditions, inadequate or poorly positioned sinks create a barrier to frequent hand washing; a lack of quality counter space can compromise food preparation; and inadequate storage space for food and utensils encourages vector (flies and cockroach) contamination. All of these factors, especially infrequent hand washing, increase the risk of the fecal-oral transmission of intestinal parasites at the household level.

In terms of bathroom conditions, the absence or poor positioning of hand washing facilities creates a significant barrier to frequent hand washing. In addition, small, cramped and dark bathroom conditions increase the likelihood that fecal matter or other
pathogens are picked up and distributed throughout the household. When infected household members fail to wash their hands after using the bathroom they risk inadvertently infecting other household members. In addition, the storage of soiled toilet paper in the waste bin may also contribute to fecal-oral transmission in some cases. Both poor kitchens and bathroom conditions are good examples of intermediate household conditions that directly affect the proximate level of disease causation (See Figure 9-1 for a graphic representation of these linkages).

In this study, the household social conditions relating to parasite transmission were significantly associated with the presence of infected household members and increased household size. First, infected household members serve as hosts and are a necessary component of successful fecal-oral transmission. Furthermore, the probability of transmission increases with the presence of infected household members, especially when household hygiene infrastructure and practices are compromised. Household density, when coupled with a cramped living space increases the probability of person to person contact, a necessary condition of fecal-oral transmission. Finally, fecal-oral transmission is further exacerbated when inadequate sanitation infrastructure is compounded by large household size and the presence of infected family members.

One of the main conclusions of this research was that the household ecological factors mentioned here (i.e. inadequate household sanitation infrastructure) were not significantly associated with household income, but rather to variables such as immigrant status, underemployment, and access to credit. These connections demonstrate how household infrastructure is much more than just a result of household economics; but in fact must be understood within the context of more complex political economic relationships that result from social injustice. As such, the household ecology of disease transmission model proves to be adequate in terms of providing an intermediate explanatory link between the macro, political economic causes of disease and the micro level pathways (i.e. fecal-oral transmission) which represents the proximate levels disease causation.
**The Role of Knowledge, Beliefs and Behaviors on Parasite Transmission**

Within the household ecology of disease transmission framework, Coreil and colleagues (1996) refer to the shared household beliefs, knowledge and behaviors as the culturally constructed household environment. A host of medical anthropology literature points to the importance that beliefs, perceptions and knowledge has on risk and treatment seeking behaviors (Green 1999; Inhorn and Brown 1997; Nichter 2008; Vecchiato 1997). A critical finding of this research showed that, despite minor disconnects, heads of household have a high level of knowledge regarding the source of infection, mode of transmission and relevant prevention strategies regarding intestinal parasites. In fact, there was no discernable difference in knowledge about parasites concerning sources of infection, modes of transmission and prevention between Nicaraguans and Costa Ricans or between heads of household who lived in infected or uninfected households. Thus, it is not surprising that beliefs, knowledge regarding intestinal parasites was not associated with a lower prevalence of intestinal parasites among study participants at the household level.

This finding is significant because it indicates, at least among this study population, that political economic and ecological variables at both the macro and intermediate levels of analysis (i.e., access to health care, home ownership, inadequate household sanitation infrastructure, household size and the presence of infected household members) are better predictors of parasite prevalence than are culturally constructed beliefs and knowledge concerning parasite prevention.

The hypothesis ascertained from these conclusions suggests that both the physical and social domains of the household ecology may significantly influence the way in which prevention related behaviors are practiced. As a result, living in a household with inadequate sanitary infrastructure and crowded living conditions may significantly reduce the ability of household members to practice known preventative strategies. The following examples illustrate this point: 1) an absence of conveniently located sinks would likely decrease hand washing frequency among household members; 2) similarly, a lack of kitchen countertop and food storage space is likely to adversely affect proper food preparation; 3) old wooden countertops can provide an excellent source of infection
because they are more difficult to clean compared to countertops made with impervious materials found in higher quality homes; and 4) an household size increases the likelihood of spreading contaminated sources throughout the household, especially when the household sanitation infrastructure is inadequate to begin with.

In contrast, individuals who live in households with adequate sanitation infrastructure may have an easier time practicing known prevention related behaviors. For example, the presence of sinks where soap is present is likely to promote increased hand washing among household members; just as the presence of quality countertops and other kitchen infrastructure is likely to improve food handling methods. This hypothesis also supports previous conclusions that demonstrated a significant association between rented homes, poor sanitary infrastructure, crowded living conditions and an increased prevalence of parasite infections in spite of the fact that the head of household possesses significant knowledge regarding parasite prevention.

According to Inhorn and Brown (1997) one of the most important contributions of medical anthropology to the study of infectious disease has been its ability to produce an “infectious disease ethnography” noting that in most infectious disease studies, human behavior and cultural perceptions are decontextualized from larger political economic context (1996:20). Additionally, both Inhorn and Brown (1997) and Coreil et al. (1996) argue that by providing descriptions of cultural knowledge, perceptions and behaviors relating to infectious disease, anthropologists can point to the relevance of culture for public health interventions aimed at reducing the burden of those diseases. While the methodology employed in this research did not focus on observed human behavior in relation to disease transmission, the insights gained from interviews focusing on knowledge and perceptions provides valuable insights in terms of realistic public health interventions to reduce parasite prevalence in the study population. The results of these interviews coupled with a political ecology analysis suggest that educational messages or behavior change interventions aimed parasite prevention would not achieve its intended goals as long as the intermediate and macro level determinants of disease were not addressed first. Based on this conclusion, it is argued that changes to the macro and intermediate level determinants of disease (i.e., access to health care, home ownership,
inadequate household sanitation infrastructure, household size and the presence of infected household members) would do more to prevent parasite transmission at the micro level than would community based public health messages. Specific changes to both intermediate and macro level determinants will be discussed as recommendations.

**Implications of a Political Ecology of Health**

The political ecology of health framework provides critical information on how parasite prevalence is intertwined with macro, intermediate, and micro level political economic, cultural and environmental realities. The addition of the household ecology of disease transmission framework proposed by Coreil et al. (1996) provides the necessary focus on household level phenomena that are related to disease transmission. The political ecology of health model answers the call from Inhorn and Brown (1997) to look at how disease outcomes at the local level are connected to macro level political economic and environmental phenomena; and that of Goodman and Leatherman (1998) to “look upstream” and understand how social and political economic processes affect human biologies and health outcomes.

Figure 9-1 provides a graphic representation of the political ecology framework related to intestinal parasites and outlines the linkages between the macro, intermediate, and micro level determinants of parasite transmission based on the findings of this research. This model outlines how immigration status is linked to barriers in access to health care and to the systematic underreporting intestinal parasites which are ultimately associated with health disparities between Nicaraguans and Costa Ricans. Also, immigration status is linked to underemployment which is associated with a lack of access to formal credit and government housing subsidies. These factors are associated with household ownership and ultimately household sanitation infrastructure; specifically how renting is associated with inadequate bathroom and kitchen conditions. Finally, inadequate household sanitation infrastructure coupled with large household size and the presence of households with infected family members is associated with the fecal-oral transmission of intestinal parasites at the household level.
Figure 9-1. The Political Ecology of Intestinal Parasites Framework
The political ecology of intestinal parasites framework presented here is significant because it can be considered “an applied political ecology of health model” in that it identifies the macro, intermediate, and proximate determinants of disease which can then be targeted for public health interventions aimed at reducing the prevalence of intestinal parasites.

Another important public health implication to emerge from this framework is the significant disparity in parasite prevalence between the Nicaraguan and Costa Rican study participants. These disparities are, in part, the result of health and social inequalities that prevent many Nicaraguans from having access to basic health care and disease prevention programs. Following Inhorn and Brown’s (1997) claim, denying access to basic care and prevention services may promote the emergence of a reservoir of intestinal parasites that poses a risk to the host population. A similar case occurred in a northern region in Costa Rica after hurricane Mitch when Nicaraguan refugees from endemic malaria regions of Nicaragua settled in the region. Serving as reservoirs of the malaria parasite, the incidence of the disease subsequently started to rise among the Costa Rican host population (CCSS 2002). The case of increased prevalence of malaria eventually drove the CCSS to invest in early detection kits to prevent further dissemination of the disease.

In order to prevent the potential reemergence of intestinal parasite among the local Costa Rican community, health officials must take the initiative to ensure health care access to “irregular” immigrants and others who lack health coverage. By providing a mechanism through which immigrants and other can have easy and non discriminatory access to basic public health services, screening and timely treatment of intestinal parasites will help reduce risk of continued transmission among both populations. The following are various recommendations that outline action that should be taken from the national to the local level in order to prevent the reemergence of intestinal parasites in Monteverde.
Recommendations

The recommendations discussed here will be juxtaposed according to their corresponding level of analysis following the political ecology of health framework.

National Level Recommendations

One of the most pressing factors facing Nicaraguan immigrants in Costa Rica is access to health care services through the CCSS. At the time of this research, “irregular” immigrants did not have viable options to access basic health services through the CCSS system (exceptions only existed for emergencies and for children and pregnant women as long as it does not interfere with the health access of the insured population). In addition, it is estimated that approximately 50% of Nicaraguans living in Costa Rican do not have access to health care. Based on findings that found a significant association between access to health care and parasite prevalence, one of the principal recommendations of this research is to create a mechanism to integrate “irregular” immigrants into the CCSS system to ensure that they receive access to basic health care.

Because of the organizational and hierarchical nature of the CCSS, even the smallest changes to health policy require major political agreements. Unfortunately, passing health legislation to grant access to health care for illegal immigrants would most likely require a major shift in national level politics. One alternative recommended by this dissertation is to promote the establishment of both national and international level NGO’s that focus their attention on providing access to health care to immigrants. One successful program developed in Limon province called “consultorio para migrantes” (consultations for migrants) is a public/private collaboration between the Catholic Church and the CCSS which provides access to basic health services for migrants regardless of their immigration status.

Such a program is needed to ensure that Nicaraguans have their basic health care needs met which includes the screening and treatment of preventable infectious disease as well as appropriate care for women and children. Such a program would help prevent the spread of infectious agents between populations that come from areas of high endemicity and those of the host population.
At the time of this research, vital medical statistics did not include the patients’ nationality thus making it difficult to compare health outcomes of the Nicaraguan community compared to other groups. One recommendation this dissertation proposes is to develop standard medical registration procedures for hospitals, clinics, EBAIS and other health service providers to record patient nationality along with other vital statistics. This will allow better comparability of health outcomes between Costa Ricans and Nicaraguans and provide a more valid assessment of the health of the Nicaraguan community in Costa Rica. This measure would help in part to identify health disparities and help inform health practitioners where resourced need to be focused.

**Community Level Recommendations**

It must be acknowledge that many of the conclusions drawn from this dissertation, especially those relating to the underreporting of intestinal parasites and issues surrounding the access to health care of Nicaraguan immigrants may come off as being extremely critical of the Monteverde Clinic. It is likely that these conclusions would be sharply contested by the clinic staff and thus seriously obstruct any beneficial dialogue in terms of developing a public health intervention that would be beneficial to all stakeholders. One recommendation of this dissertation is to present the results and conclusions to the Monteverde Clinic in a way that encourages dialogue. One way would be to eliminate the accusatory tone of the conclusions, and to instead present the parasite prevalence data as simple epidemiological facts for the clinic to discern. For example, instead of placing blame on either the clinic or the Nicaraguan community, the results should be used as a means to promote the idea that the clinic must take up public health initiatives in order to prevent the re-emergence of intestinal parasites among the Costa Rican community.

At the community level, another recommendation if for the EBAIS to become active in addressing the health needs of the Nicaraguan community and other marginal groups, with the ultimate goal of identifying community health disparities. The EBAIS were created in the late 1990’s to address gaps in primary health care access for the rural population in general and their creation has significantly increased basic health care
coverage on a dramatically. Nationally, the EBAIS only provides services to “irregular” Nicaraguans in the case of emergencies. However, one way increase access to basic health care for immigrants and others without access to health care would be to expand EBAIS coverage to these populations. This action could provide an excellent alternative for Nicaraguans who have no other health care options while in theory could drastically improve health outcomes while at the same time reduce health care spending. Another effective measure would be to utilize the EBAIS as mechanism to implement target of outreach programs focusing on maternal and child health, family planning, immunizations, and intestinal parasites to the Nicaraguan community.

The community ASIS (Community Health Analysis Report) is a report produced every year that summarizes basic community health statistics and outcomes. This report, written by the local EBAIS, outlines both health outcome achievements and areas that need more attention. It is the recommendation of this dissertation that the local EBAIS should give special attention to community health disparities among the Nicaraguan community in Monteverde (or other marginalized populations). The ASIS should be used as a tool for reporting local health outcomes, especially those relevant to marginalized populations which can then be used to propose medical or public health strategies aimed at reducing health disparities and improving health outcomes.

Another recommendation at the community level is to modify the fecal sample collection procedures currently used at the Monteverde Clinic to collect stool samples for screening of intestinal parasites. As described in both the methods and discussion chapters, fecal samples collected at the Monteverde Clinic are not preserved, thus promoting the desiccation of samples which reduce the specificity of screening tests which ultimately lead to the significant underreporting of intestinal parasites. This dissertation recommends that the Monteverde adopt collection procedures that preserve fecal specimens in order to ensure the specificity of the results. Commercially available preservation solutions are currently available at very low costs; however, it is possible that similar preservation could be produced by the CCSS at an even lower cost.

Another related recommendation targeted at the Monteverde Clinic is to modify its suppressive drug therapy protocol which relies exclusively on the annual distribution
of Albendazole. The results of this research demonstrate that the global prevalence of intestinal helminths in the community is extremely low compared to the global prevalence of intestinal protozoa. Because Albendazole has been shown to be an ineffective drug therapy for treating intestinal protozoa, the Monteverde Clinic would significantly increase the efficacy of its parasite control measures by distributing more appropriate drugs such as Metronidazole and Iodoquinol which specifically target intestinal protozoa. Implementing this measure would significantly reduce the risk for a potential re-emergence of intestinal parasites in Monteverde.

**Limitations of the Research**

The conclusions drawn from this research are subject to several limitations. The snowball sampling methodology used for participant selection and the convenience sampling method for collecting fecal samples and interviewing household informants limits the ability to generalize the results from this study to the rest of the population in Santa Elena and Los Llanos. I attempted to address this concern by adhering to the selection criteria explained in the methods chapter in order to increase the comparability of the two study populations. An important characteristic for participation in the study was that: 1) each household receive their potable water from the Santa Elena Aqueduct; 2) that households be chosen to represent a cross section of neighborhoods in Santa Elena and Los Llanos; 3) that both an adult and a child from each household provide fecal samples for analysis; and 4) that selected households were of roughly the same socio-economic status. Based on findings presented in Chapter 8, the socio-demographic characteristics of the study population do not differ significantly in terms of age or gender and are similar to both local and national level data in terms of socio-demographic characteristics. This suggests that the results described for the two study populations provide a good proximate to the Monteverde community in terms of health outcomes at the time of the investigation.

The cross sectional study design limits the ability to ascertain if the onset of parasitic infection is the result of exposure variables described in this study. For this reason, the prevalence odds ratio is the preferred measure of association because it is not
dependent upon the onset or duration of disease. Still, it is impossible to determine whether any infection was the result of fecal-oral, water-born, or any other mode of transmission.

In most cases, this study relied on a single fecal sample to differentiate infected and uninfected study participants, which may introduce a misclassification bias. While the sensitivity of a single fecal sample is an accepted means of identifying infected individuals, it has been shown that analysis of multiple fecal samples collected on successive days increases the sensitivity to identifying infected persons (Price 1994). As a result, the global parasite prevalence reported in this study may be underreported because in most cases only one fecal sample was collected and analyzed for each participant.

One significant limitation in this study was ascertaining the parasite infection status on the household level. For example, households in which only 1 or 2 participants provided fecal samples for analysis are most prone to a misclassification bias as being an uninfected household. Thus, results indicating an association between exposure variables and household prevalence rates should be accepted with caution; whereas results demonstrating an association between exposure and the prevalence rates of individuals should be given more weight in terms of true associations.

Another limitation of this research was that temporary household residents were not included in the study and thus were not tested for intestinal parasites. As discussed earlier, it was common for Nicaraguan households to provide temporary shelter to family or friends for short periods of time. By not testing these temporary household residents, this research failed to ascertain whether or not these individuals played a role in household disease transmission. It is possible for individuals coming from areas of high disease endemicity to act as a reservoir host and thus increase the risk of transmission among a susceptible host population. This may especially be significant for Nicaraguan households.

Household health behaviors discussed in this dissertation are based on reported health behaviors captured in face to face interviews. Indeed, discrepancies in reported and observed health knowledge and behavior are well documented in both the
anthropological and public health literature. However, it was beyond the scope of this
dissertation to systematically study household health behavior. Instead, the objective of
the research was to capture a general picture of the principal discrepancies in knowledge,
perceptions and reported behaviors between Nicaraguan and Costa Rican study
participants in terms of their association to parasite prevalence rates.

A Suggestion for Future Research

Although it was beyond the scope of this research, the public health importance
given to intestinal parasites is often related to its co-morbidity status of other health
issues; specifically malnutrition, child growth, and immune suppression which was
pioneered by the work of Nevin Scrimshaw and colleagues (Scrimshaw et al. 1957). The
logical next step in this research would be to take a multidisciplinary approach and
examine whether or not intestinal parasite infections in Monteverde affect nutritional
status, growth trends, and rates of other infectious diseases like HIV/AIDS, and whether
these co-morbid trends differ significantly among Nicaraguans and Costa Ricans in
Monteverde.

Summary

Despite the limitations, the political ecology of health framework used to
understand parasitic infections in this research provides a theoretical and methodological
framework that transcends our understanding of the simple proximate causes of disease
by pointing to the social, political-economic and environmental determinants of parasitic
disease that can be used by both medical anthropologists and public health policy makers
to better identify and address health disparities in Costa Rica and in other settings.

Furthermore, the political ecology of health framework offers critical insights
regarding the implementation of public health interventions aimed at reducing the
transmission of infectious diseases that go beyond the proximate level determinants. The
results of this dissertation suggests that efforts to reduce health disparities in parasite
prevalence among Nicaraguan immigrants would be best accomplished by implementing
policy that would allow the Nicaraguan community access to critical primary health care
and other needed social services. It is hypothesized that doing so would reduce the burden of disease of the Nicaraguan community, reduce health care costs, and protect Costa Rican citizens from the potential reemergence of preventable infectious diseases.
References Cited

AAASE, Asociación Administradora del Acueducto de Santa Elena
2003 Sello de Calidad Sanitara. Santa Elena de Monteverde.

Abrahams-Sandí, Elizabeth, Mayra Solano, and Beatriz Rodríguez

Alland, Alexander Jr.

Amador, Edgar A.

Archer, E.

ASIS, Atención de la Situacion Integral de Salud
2002 Equipo Básico de Atención de la Salud (EBAIS), No.8 & 9 del Area 3. Santa Elena, Puntarenas: Clínica Monteverde, Caja Costarricense de Seguro Social.

Baer, Hans A.

Baer, Hans A., Merrill Singer, and Ida Susser  

Baer, Hans, and Merrill Singer  

Banta, James E.  

Baris, Enis, and Kari McLeod  

Barrett, Bruce  

Barrett, Ronald, Christopher W. Kuzawa, Thomas McDade, and George J. Armelagos  

Beaglehole, R., and D. Yach  

Bernard, Russell  
1996 Research Methods in Anthropology: Qualitative and Quantitative Approaches. 2nd ed. Walnut Creek, CA: AltaMira Press.

Bettcher, D.W., D. Yach, and G.E. Guindon  

Biesanz, Mavis H., Richard Biesanz, and Karen Z. Biesanz  
Blaikie, Piers


Blaikie, Piers, and Harold Brookfield

Blanco, Karol Andrea, and Olger Calderón Arguedas

Bossert, Thomas

Brown, Peter


Brown, Peter, Marcia C. Inhorn, and Daniel J. Smith

Bryant, Raymond L.

Bryant, Raymond L., and S. Bailey

Byers, Karin E., Richard L. Guerrant, and Barry M. Farr

Cash, Richard A., and Vasant Narasimhan

CCSS, Caja Costarricense del Seguridad Social

CCSS, Caja Costarricense del Seguridad Social

CDC, Centers for Disease Control and Prevention
2002 Protecting the Nation's Health in an Era of Globalization: CDC's Global Infectious Disease Strategy. Atlanta, GA.

Cerdas, Carlos, Edna Araya, and Susana Coto

Chandrasekhar, C.P., and J. Ghosh

Charmaz, Kathy
CIA, Central Intelligence Agency


Clark, Mary A.


Cleveland, David A.


Coreil, Jeannine, Linda Whiteford, and Diego Salazar


Cornia, Giovanni Andrea


Craun, Gunther F.


Davis, Jonathan R., and Joshua Lederberg, eds.


Daltabuit, Magali, and Thomas Leatherman

de Camino, Ronnie, Olman Segura, Luis Guillermo Arias, and Isaac Perez

DeWalt, Billie R.
1998 The Political Ecology of Population Increase and Malnutrition in Southern
Honduras. In Building a New Biocultural Synthesis: Political-Economic
Perspectives on Human Biology. Alan H. Goodman and Thomas L.

Dollar, David
Organization 79:827-833.

Dunn, Frederick L.
1979 Behavioural Aspects of the Control of Parasitic Diseases. Bulletin of the

Dunn, Fredrick L., and Craig R. Janes
1986 Introduction: Medical Anthropology and Epidemiology. In Anthropology
and Epidemiology: Interdisciplinary Approaches to the Study of Health
and Disease. Craig R. Janes, Ron Stall and Sandra M. Gifford, eds. Pp. 3-
34. Dordrecht: D. Reidel.

Ennis-McMillan, Michael C.
2001 Suffering from Water: Social Origins of Bodily Distress in a Mexican

Esrey, S.A., J. B. Potash, L. Roberts, and C. Schiff
1991 Effects of Improved Water Supply and Sanitation on Ascariasis,
Diarrhoea, Dracunculiasis, Hookworm Infection, Schistosomiasis, and

Farmer, Paul
1996 Social Inequalities and Emerging Infectious Diseases. Emerging Infectious
Diseases 2(4):259-269.

1999 Infections and Inequalities: The Modern Plagues. Berkeley: University of
California Press.


Faulkner, Charles T., Benito Borrego Garcia, Michael H. Logan, and John C. New

Faust, Ernest C.

Feachem, Richard G.A.

Feoli Boraschi, Hector, and Darner Mora Alvarado

Fidler, David P.

Frumkin, Howard, ed.
2005  Environmental Health: From the Global to the Local. San Francisco: Jossey-Bass

Gatrell, Anthony C.

Geissler, P. Wenzel

Giddens, Anthony
Girges, Rameses
1949 Entamoebiasis and its Treatment. Basle, Switzerland: CIBA.

González, J., and C. Umaña

Goodman, Alan H., and Thomas L. Leatherman, eds.

Green, Edward C.
1999 Indigenous Theories of Contagious Disease. Walnut Creek, CA: AltaMira Press.

Greenberg, James B., and Thomas K. Park

Guest, Greg, ed.

Gwatkin, D.J.

Haber, William A., Willow Zuchowski, and Erick Bello

Hackenberg, Robert A.

Hackenberg, Robert A., and Beverly H. Hackenberg
Herman, Elizabeth, and Margaret Bentley  

Hernandez-Chavarria, Francisco, and Maria Fernanda Matamoros-Madrigal  

Heyneman, D.  

Hill, Carole E.  

Himmelgreen, D., N. Romero-Daza, M. Vega, H. Cambronero, and E. Amador  

Honey, Martha  

Howson, Christopher P., Harvey V. Fineberg, and Barry R. Bloom  

Hunter, C., and H. Green  

ICEA, Ingenieros Consultores y Ejecutores de Acueductos  
1998 Evaluación del Acueducto de Santa Elena y Cerro Plano de Monteverde, Puntarenas. Santa Elena de Monteverde: Asociación Administradora del Acueducto.
Inhorn, Marcia C., and Peter J. Brown

Inhorn, Marcia C., and Peter J. Brown, eds.

Jaramillo Antillón, Juan

Kearney, M.

Kendall, Carl

Kim, Jim Yong, Joyce V. Millen, Alec Irwin, and John Gershman, eds.

Kinnear, Paul R., and Colin D. Gray

Knobler, S., A.A.F. Mahmoud, and S.M. Lemon, eds.

Kocasoy, G.

Kombe, Gilbert C., and Danielle M. Darow

Lang, Tim

LeChevallier, Mark W., Richard W. Gullick, Mohammad R. Karim, and James E. Funk

LeCompte, Margaret D., and Jean J. Schensul
1999 Designing and Conducting Ethnographic Research. Walnut Creek, CA: AltaMira Press.

Lee, K.


Lee, K., Sue Collinson, Gill Walt, and Lucy Gilson
Levine, Myron M., and Orin S. Levine  

Lewellen, Ted  

Lind, Jason D., Santiago Ruiz, and Heidi Heuchan  

Little, Peter D., and Michael Horowitz  

Loewenson, Rene  

Madrigal, Lorena  

Manderson, Lenore  
1998 Applying Medical Anthropology in the Control of Infectious Disease. Tropical Medicine and International Health 3(12):1020-1027.

Manderson, Lenore, and Linda M. Whiteford  

Markell, Edward K., David T. John, and Wojciech A. Krotoski  
Marquette, Catherine M.  

Mata, Leonardo, and Luis Rosero-Bixby  

Mata, Leonardo, F. Hernandez, and V. Pardo  

May, J.M.  

Mayer, Jonathan D.  


Miller, M.L., and J. Auyong  

Miranda, Guido  

McElroy, Ann, and Patricia K. Townsend  

McMichael, Anthony J., and Bert Bolin  

McMichael, Anthony J., and C.D. Butler  

Meade, Melinda S., John W. Florin and Wilbert M. Gesler  

Millard, A.V.  

Ministerio de Salud de Costa Rica  

Mintz, Sidney W.  

Moffat, Tina  

Mohs, Edgar  
1983 *La Salud en Costa Rica.* San José: Editorial UNED.

Monge, R., M. Chinchilla, and L. Reyes

Mora Alvarado, Darner

Mora Alvarado, Darner, and Carols Felipe Portuguez


Morales, Abelardo, and Carlos Castro

Morera, Carlos Manuel

Morgan, Lynn M.

1989 The Importance of the State in Primary Health Care Initiatives. Medical Anthropology Quarterly 3(3):227-231.

Morse, Stephen S. 

Munoz, Carlos, and Nevin Scrimshaw, eds. 

Nadkarni, Nalini M., and Nathaniel T. Wheelwright 

Nations, Marilyn K., and L.A. Rebhun 

Navarro, Vicente 

Nichter, Mark 

OIM, Organización Internacional para los Migrantes 

PAHO, Pan American Health Organization 

PAHO, Pan American Health Organization 

Pardo, Veko, and Francisco Hernandez 
Peinador, Mariano, and José Quirós

Peinador, Mariano, and Juan Murillo

Peet, R., and M. Watts

Price-Smith, Andrew T.

Price, Donald L.

2003 Sources of Infective Stages and Modes of Transmission of Parasites (Unpublished Document): Dr Donald L. Price Center for Parasite Repository and Education, College of Public Health, University of South Florida.

Proyecto Estado de la Nación

Purcell, Trevor, Edgar Amador, and C. Sophia Klempner

Redclift, Michael
Rodríguez Herrera, Adolfo
2006 La Reforma de Salud en Costa Rica. In Serie Financiamiento del Desarrollo. Santiago de Chile: Naciones Unidas, CEPAL.

Rosenberg, Mark

Rosero Bixby, Luis


Roses, Mirta

Sáenz, Lenin

Saker, Lance, Kelley Lee, Barbara Cannito, Anna Gilmore, and Diarmid Campbell

Sanchez, Antonio, Juan Mora, and Francisco Hernandez

Sandoval-Garcia, Carlos

Satcher, David

Schensul, Stephen L., Jean J. Schensul, and Margaret D. LeCompte
1999 Essential Ethnographic Methods: Observations, Interviews, and Questionnaires. Walnut Creek, CA: AltaMira Press.

Schmink, Marianne, and Charles H. Wood

Schmunis, Gabriel A.

Schwartz, Ronald A.

Scrimshaw, Nevin S., Carl E. Taylor, and John E. Gordon

Scrimshaw, Susan, and Elena Hurtado


Segnini, Giannina
Sheridan, Thomas E.  

Singer, Merrill, and Hans Bear  

Spradley, James P.  

Stonich, Susan C.  


Stonich, Susan C., Jerrel H. Sorensen, and Gus W. Salbador  

The Groundwater Foundation  

The Nature Conservancy  

TIES, The International Ecotourism Society  

Tomianovic, D., L. Choi, and K. Barrantes  
Trostle, James A., and Johannes Sommerfeld  

Tsing, Anna  

Turshen, M.  


UNFPA, United Nations Population Fund  

Utarini, A., A. Winkvist, and G.H. Pelto  

Valiente, Carmen  

Valiente, Carmen, and Darner Mora  

Vargas, William  

Vecchiato, Norbert L.  

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Wallerstein, I.

Waters, William F.

Weiss, William., P. Bolton, and A.V. Shankar

Whiteford, Linda, and Lenore Manderson, eds.

Whiteford, Linda, and Graham Tobin

Whiteford, Linda, and Scott Whiteford, eds.

Whiteford, Linda M., and Beverly Hill

Whiteford, Scott, and Alfonso Cortez-Lara
WHO, World Health Organization  

Wilk, R. R.  

Wolf, Eric R.  

Woodward, David, Nick Drager, Robert Beaglehole, and Debra Lipson  

Yach, Derek, and Douglas Bettcher  


Appendices
Appendix A: Combined Informed Consent (Spanish)

Documento de Consentimiento para Adultos y Padres
Ciencias Sociales y del Comportamiento
Universidad del Sur de la Florida y El Instituto Monteverde

Información para adultos e hijos a quienes se les ha pedido tomar parte en un estudio de investigación

Los investigadores en la Universidad del Sur de la Florida (USF) estudiamos enfermedades y otros problemas relacionados con la salud. De esta forma, queremos encontrar las mejores formas de tratar estos problemas. Por ello, necesitamos la ayuda de gente que esté de acuerdo en participar en estudios de investigación. La siguiente información se le presenta para ayudarla a decidir si quiere o no participar y que su hijo/a tome parte en un estudio de investigación de riesgo mínimo. Por favor, lea esta información cuidadosamente; si hay algo que no entienda, pregúntele a la persona a cargo del estudio al respecto.

Título del estudio de investigación: Estudio de Prevalencia de Parásitos Intestinales en Monteverde, Costa Rica.

Persona a cargo del estudio: Jason Lind

Sitio del estudio: Zona de Monteverde, Costa Rica

Quién va a pagar por el estudio: USF Facultad de Salud Publica y Globalization Research Center

¿Por qué se está llevando a cabo esta investigación?
El propósito de este estudio es saber que tan comunes son los parásitos intestinales en las personas y en las/os niñas/os de la zona de Monteverde y hallar su origen y la ruta de transmisión. Este estudio también buscará compartir información y materiales educativos con las familias acerca de cómo prevenir las infecciones de parásitos intestinales.

¿Por qué se le ha pedido su participación?
Le hemos pedido que usted o miembros de su familia participe en este estudio porque vive en la zona de Monteverde y porque muchas personas han expresado su preocupación acerca de infecciones parasitàicas.

¿Cuánto tiempo se le pedirá permanecer en el estudio?
El estudio durará seis meses. En el transcurso de ese tiempo, se les pedirá dos muestras de materia fecal a usted y a los miembros de su familia. También se le pedirá unas entrevistas para obtener información familiar e información relacionada con infecciones y su conocimiento que les haya ocurrido.
Appendix A (Continued)

Combined Informed Consent (Spanish)

Plan de Estudio: El investigador visitará su hogar varias veces, con previo aviso. Puede ser que le pida una breve entrevista durante cada visita. En la primera, el investigador le explicará el estudio y recogerá información básica acerca de su hogar. También el investigador le explicará cómo recolectar su muestra de materia fecal. Se le dará un frasquito y palillos para que recoja la muestra. El frasquito donde usted depositará la muestra está esterilizado. Usted realizará este procedimiento en su propio tiempo. En la segunda visita, el investigador recogerá los frasquitos con las muestras. Las muestras serán analizadas por el investigador principal. Si las muestras resultan positivas, serán confirmados por el Colegio de Microbiología de la Universidad de Costa Rica. En la tercera visita, el investigador le dará los resultados del test. Si su resultado o el de alguno de los miembros de su familia es positivo, es posible que la persona sea entrevistada con más detenimiento ese mismo día u otro que sea de su conveniencia. Finalmente, en caso de que haya miembros de su familia infectada con parásitos, el investigador visitará su hogar para brindarle información y educación acerca del origen, cómo se transmite y de cuáles medidas de prevención puedan tomar. Este proceder será repetido aproximadamente dos meses más tarde. Si su infección o la de un miembro de su familia es de naturaleza seria, la información acerca del estado de la infección puede ser pasada a su médico de la Clínica de Monteverde, con su consentimiento para que tomen medidas apropiadas de tratamiento.

Pago por su participación
No hay pago por su participación. Su participación es voluntaria y no se le pagará por el tiempo que usted de a este estudio.

Beneficios por tomar parte en este estudio investigativo
Al participar en este estudio, usted contribuirá a un mejor entendimiento de cómo los parásitos intestinales afectan la salud de las personas, también usted brindará información que permita prevenir esas infecciones en el futuro con respecto a su familia y a su comunidad.

Riesgos relacionados con su participación en este estudio
Este estudio presenta riesgos mínimos para ustedes y/o sus hijos. Pueden haber preguntas en las entrevistas que le sean incómodas, si es así entonces está en libertad de no contestarlas. Asimismo, usted está en libertad de abandonar este estudio si así lo desiera.

Confidencialidad de los archivos de su hijo/a
Su privacidad y la de sus hijos/as, así como los archivos de la investigación serán mantenidas en la más estricta confidencialidad, según lo exige la ley. Los archivos de este proyecto de investigación pueden ser revisados por personal investigativo autorizado, empleados del Departamento de Salud y Recursos Humanos y el Comité Institucional de Ética de la Universidad del Sur de la Florida, pero ellos no tendrán acceso a los nombres...
Appendix A (Continued)
Combined Informed Consent (Spanish)

de las participantes. Los resultados generales de este estudio podrán ser publicados. Los resultados publicados no incluirán sus nombres ni cualquier tipo de información personal que los pueda identificar, se usarán códigos para identificarlos. Se dejarán copias de toda la información y sus muestras en el Instituto Monteverde. Estos pueden ser vistos sólo por el investigador principal y su médico.

Su participación es voluntaria
La decisión de que sus hijos/as participen en este estudio es completamente voluntaria. Asimismo, usted es libre de retirarse o retirarlos/las en el momento deseado. Si decide no participar o que sus hijos/as no participen o si se retira o los/las retira durante el transcurso del estudio, no habrá consecuencia alguna por ello. Ustedes recibirán los beneficios establecidos previamente.

Preguntas y contactos
• Si tiene alguna pregunta acerca de este estudio, por favor, comuníquese con Jason Lind, Investigador Principal, al teléfono 645-5053 - Extensión 120 en el Instituto Monteverde o en su casa al 645-6685.
• Si tiene preguntas acerca de sus derechos como participante en un estudio investigativo, puede comunicarse con CEC-IRET de la Universidad Nacional Autónoma de Costa Rica al 277-3584 o 262-2073.
• También se puede comunicarse con la División de Conformidad con la Ley de los Estudios Investigativos de la Universidad del Sur de la Florida, teléfono (813) 974-5638.

Consentimiento para participar en este estudio de investigación
Al firmar este formulario, estoy de acuerdo con que
He leído completamente o me han leído y explicado este formulario de consentimiento.
He tenido la oportunidad de hacerle preguntas a uno/a de los responsables de esta investigación y he recibido respuestas satisfactorias.
Entiendo que se me ha pedido participar en esta investigación. Comprendo los riesgos y beneficios que esto trae, y libremente doy mi consentimiento para participar en la investigación que ha sido presentada en este formulario, bajo las condiciones indicadas en el mismo.
Se me ha entregado una copia firmada de este formulario de consentimiento para mi uso personal.

Consentimiento para que su hijo/a participe en este estudio investigativo
Libremente doy mi consentimiento para que mi hijo/a participe en este estudio. He recibido una copia de este formulario de consentimiento.
### Appendix A (Continued)

**Combined Informed Consent (Spanish)**

<table>
<thead>
<tr>
<th>Firma del participante/ padre</th>
<th>Nombre del participante en letra imprenta</th>
<th>Fecha</th>
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</table>

<table>
<thead>
<tr>
<th>Firma del padre del niño/ participante</th>
<th>Nombre del padre/participante en letra imprenta</th>
<th>Fecha</th>
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**Declaración del investigador**

Le he explicado cuidadosamente a la persona este documento. Por lo tanto, reconozco que a mi juicio la persona que firma este formulario de consentimiento comprende la naturaleza, exigencias, riesgos y beneficios que este estudio incluye.

<table>
<thead>
<tr>
<th>Firma del investigador o persona autorizada por el investigador principal</th>
<th>Nombre del investigador en letra imprenta</th>
<th>Fecha</th>
</tr>
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</table>
Appendix B: Instructions for Collecting Fecal Specimens (English)

INSTRUCTIONS FOR COLLECTING FECAL SPECIMENS
(The solution is for diagnostic use only. Do not take internally. Avoid contact with eyes or skin. Keep out of reach of children.)

THESE INSTRUCTIONS ARE DESIGNED TO HELP YOU PROPERLY COLLECT A FECAL SPECIMEN SUITABLE FOR LABORATORY PERSONNEL TO EFFECTIVELY PERFORM THE LABORATORY TESTS YOUR PHYSICIAN ORDERED.

1. SUPPLIED ARE: A screw cap collection vial containing the colored collecting solution, a spatula for picking up the specimen, and three wooden applicator sticks for mixing it with the solution. 

   2. Collect the Fecal Specimen:
   Collect the fecal specimen (bowel movement) in a clean, dry container such as a plastic cup or bowl, the bottom half of a waxed juice container, or a clean, dry sheet of plastic. The specimen should not fall into a toilet bowl, where it will get wet, or be contaminated with urine. Cover the container if is to be transported to a laboratory or physician’s office.

3. Add the Specimen to the Vial:
When you have the specimen, remove the cap from the vial containing the red solution and use the spatula to pick up a portion of the fecal specimen and place it in the vial until the solution level reached the red arrow. Do not over fill or under fill the vial. The amount should be about the size of a marble or the first joint of your little finger. (See Drawing 1)

4. Mix the specimen well:
   Use the three applicator sticks to mix the specimen with the solution in the vial. This can be done by pressing the fecal lumps against the sides of the vial with the applicator sticks and smearing the feces against the sides of the vial until there are no more lumps.

5. Close and Shake the Specimen Vial:
After the fecal material is thoroughly broken up, replace the cap tightly and shake the vial back and forth vigorously to further mix the feces with the solution. The better the specimen is mixed with the solution, the better the results.

6. Identify the Specimen:
Write the patient’s name, date, and time of collection on the label of the vial.

7. Shake the Specimen Again:
After 10 minutes, make certain the cap is tight and shake the vial vigorously again.

8. Return Specimen to Laboratory:
Make certain the cap is tight and transport the preserved specimen to the laboratory or place designated.

FIRST AID: The Red Solution contains Formalin, Alcohol, and Eosin Dyes. Flush skin and eyes with water. If ingested (swallowed), give milk. Call your poison control center and your physician.

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Appendix C: Costa Rican Household Demographic Interview (Spanish)

Código del Hogar: _____________ Comunidad: __________________________
Persona a Cargo: __________________________
Persona Entrevistado: ___________________
Fecha: __________ Hora Empezado: __________ Hora Terminado: __________

Hogar:
La vivienda donde usted habita actualmente es:

Por tipo:
   a. Individual _____
   b. Colectiva _____  b1. Número de familias _____
       b2. O personas sin vínculo familiar que reside _____

Por su forma de tenencia:
   c. Propia ya pagada _____
   d. Propia con hipoteca _____
   e. Alquilada viviendo sólo con familiares _____
   f. Alquilada compartida con no familiares _____
   g. En precario _____
   h. Otra (prestada, cedida) _______________________________

El dueño es...
   a. Costarricense residente de la zona de Monte Verde [1]
   b. Costarricense no residente de la zona de Monte Verde [2]
   c. Extranjero residente de la zona de Monte Verde [3]
   e. Extranjero no residente de Costa Rica [5]
   f. Otro [0] ______________________________

Indicar el número total de personas residentes en la vivienda _____, cuántas de ellas son familiares _____, así como el número total de aposentos en la vivienda _____, y el número de ellos que se utiliza sólo para dormir _____.

¿Todos los residentes de esta casa viven aquí por todo el año?:

¿Si no, cuantos residentes de la casa no viven aquí todo el año?:

¿Durante cuales partes del año no viven aquí?: ______________________________

Las personas que no residen aquí todo el año, ¿en qué otra parte residen?: ______________________________

¿Por qué residen algunos en dos o más lugares?:

¿Ha vivido en la zona Monteverde desde su nacimiento?:
Appendix C (Continued)
Costa Rican Household Demographic Interview (Spanish)

Si no, ¿cuál fue la última comunidad/país en que Ud. vivió?: _____________________________________
______________________________________________________________________________________
¿En qué año llego? Historia: _______________________________________________________________
______________________________________________________________________________________
______________________________________________________________________________________
¿Por qué decidió venir a esta comunidad en particular?:
Amigos [4]       Otro [0] _______________________
______________________________________________________________________________________
______________________________________________________________________________________
______________________________________________________________________________________

Perfil socio-laboral:
Desde el punto de vista laboral, actualmente está:

Ocupado _____
Desocupado, buscando trabajo _____ ---- pase a la pregunta 10.
Dedicado a actividades no laborales (inactivo) _____ --- pase a 10.

Ocupación que desempeña el trabajador principal: _____________________________________________
Actividad de la empresa o lugar donde trabaja: _____________________________________________
El número total de horas que trabaja por semana es: ____________________________________________
El salario o ganancia (monto en colones) que recibe es:
a. por semana __________
b. por quincena __________
c. por mes __________
¿Tiene otras fuentes de ingresos? (periodicidad)
______________________________________________________________________________________
______________________________________________________________________________________
¿Cómo ganan la vida los residentes de su casa?

<table>
<thead>
<tr>
<th>Código</th>
<th>Trabajo</th>
<th>Sitio de trabajo</th>
<th>Salario por empleo específico (por mes)</th>
<th>Variación estacional del empleo</th>
<th>Esta Asegurado por el INS o CCSS</th>
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<tbody>
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<td>1.</td>
<td>1.</td>
<td>1.</td>
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<td>2.</td>
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</table>
Costa Rican Household Demographic Interview (Spanish)

Durante el último año, ¿alguien en la casa ha estado desempleado?

Sí: _____   No: _____

<table>
<thead>
<tr>
<th>Código</th>
<th>¿Cuándo?</th>
<th>¿Por Cuánto Tiempo?</th>
<th>Razones</th>
</tr>
</thead>
</table>

Hace cinco años, a que actividades económicas principales se dedicaba su familia:

______________________________________________________________________________________
______________________________________________________________________________________

Acceso a Servicios Comunitarios:
¿Hay personas en la casa que no tienen seguro por el INS o la CAJA?  -Si -No

¿Quién? ________________________________________________________________
¿Por qué no están asegurados? _______________________________________________
¿Cuánto tiempo han estado sin seguro? _______________________________________
¿Cómo les afecta? ___________________________________________________________

¿Cómo clasificaría los servicios de salud en la comunidad? ______________________

Cosas positivas: ___________________________________________________________

Cosas Negativas: ___________________________________________________________

Experiencias: ______________________________________________________________

¿Ud. o alguien de su familia está involucrada o participa en algún servicio público?:


¿Qué tipo de transporte tiene acceso Ud.?

Appendix C (Continued)

Costa Rican Household Demographic Interview (Spanish)

De las instituciones costarricenses con las que ha tenido contacto o de las que tiene referencias…

¿Cuál le tiene mejor confianza y credibilidad? 
______________________________________________________________________________________
______________________________________________________________________________________

¿Cuál no le tiene confianza? 
______________________________________________________________________________________
______________________________________________________________________________________

¿Qué tipo de apoyo o servicios le gustaría recibir o ver para mejorar su situación actual?
   a. Crédito: _____
   b. Capacitación para el trabajo: _____
   c. Vivienda: _____
   d. Salud: _____
   e. Seguro social: _____
   f. Asesoría legal: _____
   g. Orientación religiosa: _____
   h. Otra: __________________________________________________________

Percepciones del Turismo:

¿Qué es su opinión en general sobre cómo el turismo afecta la zona de Monte Verde?:

______________________________________________________________________________________
______________________________________________________________________________________

¿Qué beneficios (si hay) ha traído el turismo a su familia?:

______________________________________________________________________________________
______________________________________________________________________________________

¿Qué han sido los efectos positivos del turismo en esta área?: ______________________________
______________________________________________________________________________________

¿Qué han sido los efectos negativos del turismo en esta área?: ______________________________
______________________________________________________________________________________
Appendix D: Nicaraguan Household Demographic Interview (Spanish)

Código del Hogar: _____________ Comunidad: _______________________________
Nombre de Persona a Cargo: _______________________________________________
Nombre del Entrevistado: __________________________________________________
Fecha: __________ Hora Empezado: __________   Hora Terminado: __________

**Hogar:**

Código y Lugar de Nacimiento de los miembros de la casa:

<table>
<thead>
<tr>
<th>CÓDIGO</th>
<th>LUGAR DE NACIMIENTO</th>
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4. La vivienda donde usted habita actualmente es:

Por tipo:
- a. Individual _____
- b. Colectiva _____
- c. Propia ya pagada _____
- d. Propia con hipoteca _____
- e. Alquilada viviendo sólo con familiares _____
- f. Alquilada compartida con no familiares _____
- g. En precario _____
- h. Otra (prestada, cedida) ____________________________________________

El dueño es. . . __________________________________________________________________________

Indicar el número total de personas residentes en la vivienda _____, cuántas de ellas son familiares _____, así como el número total de aposentos en la vivienda _____, y el número de ellos que se utiliza sólo para dormir _____.

¿Todos los residentes de esta casa viven aquí por todo el año?: Sí [1] No [2]

¿Si no, cuantos residentes de la casa no viven aquí todo el año?: ________________________________

¿Durante cuales partes del año?: ____________________________________________________________

Las personas que no residen aquí todo el año, ¿en qué otra parte residen?: _______________________

¿Por qué residen algunos en dos o más lugares?: Trabajo [1] Pasatiempo [2] Otro [0]
Perfil socio-laboral:
Desde el punto de vista laboral, actualmente está:

Ocupado _____
Desocupado, buscando trabajo _____ ---- pase a la pregunta 10.
Dedicado a actividades no laborales (inactivo) _____ --- pase a 10.

Ocupación que desempeña el trabajador principal: ____________________________
Actividad de la empresa o lugar donde trabaja: ______________________________

El número total de horas que trabaja por semana es: _____
El salario o ganancia (monto en colones) que recibe es:
   a. por semana _________
   b. por quincena _________
   c. por mes _________

Indicar si tiene otras fuentes de ingresos (periodicidad)
____________________________________________________________________________________
____________________________________________________________________________________

¿Cómo ganan la vida los residentes de su casa?

<table>
<thead>
<tr>
<th>Código</th>
<th>Trabajo</th>
<th>Sitio de trabajo</th>
<th>Salario por empleo específico (por mes)</th>
<th>Variación estacional del empleo</th>
<th>Estaba Asegurado por el INS o CCSS</th>
</tr>
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Durante el último año, ¿alguien en la casa ha estado desempleado?

Sí: _____     No: _____

<table>
<thead>
<tr>
<th>Código</th>
<th>¿Cuándo?</th>
<th>¿Por Cuánto Tiempo?</th>
<th>Razones</th>
</tr>
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</table>

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Appendix D (Continued)
Nicaraguan Household Demographic Interview (Spanish)

Hace cinco años, a que actividades económicas principales se dedicaba su familia: ____________________
______________________________________________________________________________________
______________________________________________________________________________________

Acceso a Servicios Comunitarios:
¿Hay personas en la casa que no tienen seguro por el INS o la CAJA? -Sí -No
¿Quién? _______________________________________________________________________________
¿Por qué no están asegurados? _______________________________________________________________________
¿Cuánto tiempo han estado sin seguro? _______________________________________________________________________
¿Cómo les afecta? _______________________________________________________________________

¿Cómo clasificaría los servicios de salud en la comunidad? _________________________________

Cosas positivas: _______________________________________________________________________
Cosas Negativas: _______________________________________________________________________
Experiencias: _______________________________________________________________________

¿Ud. o alguien de su familia está involucrada o participa en algún servicio público?:


¿Qué tipo de transporte tiene acceso Ud.?


¿Cuántos de cada uno tiene? _______________________________________________________________________

De las instituciones costarricenses con las que ha tenido contacto o de las que tiene referencias…
¿Cuál le tiene mejor confianza y credibilidad? _______________________________________________________________________

¿Cuál no le tiene confianza? _______________________________________________________________________

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¿Qué tipo de apoyo o servicios le gustaría recibir o ver para mejorar su situación actual?

a. Crédito: 

b. Capacitación para el trabajo: 

c. Vivienda: 

d. Salud: 

e. Seguro social: 

f. Asesoría legal: 

g. Orientación religiosa: 

h. Otra: ___________________________________________________________

Percepciones del Turismo:
¿Qué es su opinión en general sobre cómo el turismo afecta la zona de Monte Verde?:
______________________________________________________________________________________
______________________________________________________________________________________

¿Qué beneficios (si hay) ha traído el turismo a su familia?:

______________________________________________________________________________________
______________________________________________________________________________________
______________________________________________________________________________________

¿Qué han sido los efectos positivos del turismo en esta área?:_____________________________________
______________________________________________________________________________________
______________________________________________________________________________________
______________________________________________________________________________________

¿Qué han sido los efectos negativos del turismo en esta área?:___________________________________
______________________________________________________________________________________
______________________________________________________________________________________
______________________________________________________________________________________

Sobre la Migración a Costa Rica y a Monteverde:
¿Cuándo fue la primera vez que vino a Costa Rica a trabajar-buscar trabajo, de qué parte de Nicaragua vino, y dónde se quedó residiendo?

a. Mes y año: 

b. Lugar de residencia en Nicaragua: 

c. Lugar de residencia inicial en Costa Rica: 

¿Por qué motivo o motivos principales se vino para Costa Rica?_____________________________________
______________________________________________________________________________________
______________________________________________________________________________________

La primera vez que vino a Costa Rica, lo hizo: (solo, con familia) ________________________________
______________________________________________________________________________________
______________________________________________________________________________________
Appendix D (Continued)

Nicaraguan Household Demographic Interview (Spanish)

¿Estaba asegurado? Sí: _____ No: _____

Desde esa fecha hasta ahora: ¿Cuántas veces ha regresado a Nicaragua, y cuánto tiempo ha permanecido allí (en promedio por vez)?
   a. Número de veces: __________
   b. Estadía promedio: __________

¿En qué mes y año se trasladó a Monteverde para establecer residencia o trabajar?
   a. Mes y Año: __________

¿Por qué motivo o motivos se vino para Monteverde?
   a. Trabajo: _____
   b. Reunificación Familiar: _____
   c. Otro: _______________________________________________________

La primera vez que vino a Monteverde, lo hizo: (solo, con familia) ______________________________
____________________________________________________________________________________

¿En que trabajó cuando llegó a Monteverde por primera vez? ____________________________________
____________________________________________________________________________________

¿Estaba asegurado? Yes: _____ No: _____

Estructura Familiar y Remesas:
Detalle cuáles familiares dependen económicamente de usted. Incluya tanto a quienes residen en Costa Rica como a quienes viven en Nicaragua u otro país.

<table>
<thead>
<tr>
<th>Código</th>
<th>País de residencia</th>
<th>Si reside en CR</th>
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¿Envía usted o su familia ayudas económicas (remesas) a familiares en Nicaragua?
   a. Sí: _____   b. No: _____    ---- pase a la pregunta

¿Cuál fue el monto (en dólares) de la última ayuda en dinero enviada? __________
¿Cuál es el monto promedio enviada por mes? __________

¿Cada cuánto tiempo envía dinero a Nicaragua (del último año)? ________________________________
Appendix D (Continued)
Nicaraguan Household Demographic Interview (Spanish)

¿Cuál es el principal uso que tiene esa ayuda económica para sus familiares? ________________
____________________________________________________________________________________
____________________________________________________________________________________
¿Cuál es la forma “principal” que utiliza para enviar dinero? (Empresa remesadora, personal): ______
____________________________________________________________________________________
____________________________________________________________________________________
¿Ha enviado otro tipo de ayuda que no sea dinero? -Sí -No -Que cosa: ________________
____________________________________________________________________________________

Percepciones del Estatus Social:
Si usted compara su situación actual con la que tenía en Nicaragua anteriormente, piensa que:
____________________________________________________________________________________
____________________________________________________________________________________
¿Ha sentido usted un trato diferente a los costarricenses en el ámbito del:
Trabajo: __________________________________________________________________________
____________________________________________________________________________________
Salarios: __________________________________________________________________________
____________________________________________________________________________________
Servicios: __________________________________________________________________________
____________________________________________________________________________________
¿Siente usted que la sociedad tica respeta las tradiciones, costumbres y prácticas culturales del pueblo
Nicaragüense? -Sí -No: ¿por qué? __________________________________________________________________________
____________________________________________________________________________________
¿Piensa permanecer en Costa Rica?  Sí: _____  No: _____
Código del Hogar: _____________ Comunidad: ______________________________
Nombre de Persona a Cargo: ___________________________________________
Nombre del Entrevistado: ______________________________________________
Fecha: __________ Hora Empezado: __________ Hora Terminado: __________

Servicio de Agua:
¿Cuál es la fuente de su agua?:
Otros [0] __________________________________________________________

¿Qué tipo de sistema de agua tiene?:
   Acueducto (público) [1]   Sistema privada (grupo) [2]
   Sistema privada (individual) [3]   No se [4]
   Otros [0] __________________________________________________________

¿Cómo clasificaría Ud. su suministro de agua?:

¿Quién es responsable por la reserva de agua y su mantenimiento en su comunidad? __________________

¿Cuánto paga por promedio por mes para el agua que consuma su familia? __________________________

En su opinión el monto mensual que paga para agua es:
   No hay costo (privado) [4]

Calidad del Agua:
¿Cómo es el agua que Ud. usa/o de su casa? Describala. ____________________________________________

¿Qué es agua potable? _________________________________________________________________________

¿Cree que el agua de esta comunidad es buena y segura para consumirla? ____________________________

¿Hay veces cuando recibe agua de mala calidad?:
   Frecuentemente [3] Explique. __________________________________________________________________

b) Si recibe agua de mala calidad, ¿la trata con cloro o la hierve en la casa? ¿Qué Hace?:
   Frecuentemente [3] Explique. __________________________________________________________________

¿Ud. toma el agua de la llave?:

¿En su opinión, cuál es la diferencia entre agua de buena calidad y agua de mala calidad?
   • Agua de buena calidad: ___________________________________________________________________
Appendix E (Continued)
Household Water Management Interview (Spanish)

- Agua de mala calidad:

¿Qué hace al agua insegura para….?  
- Beber: ..................................................
- Cocinar: ..................................................
- Lavar: ..................................................

Mencione algunas cosas que pueden afectar la calidad de su agua potable.

En el futuro, ¿Piensa que habrán riesgos potenciales para la reserva de agua de la comunidad? Enumere – Explique.

¿Se ha contaminado la reserva de agua de la comunidad alguna vez? Pregúntele ¿cuándo, cómo, qué ocurrió y qué se hizo al respecto?

Cantidad de Agua:
¿Ha tenido escasez de agua o le han cortado el agua?
  a. Cuando: ..................................................
  b. Por cuánto tiempo: ..................................................
  c. Qué pasó, cómo y por qué ocurrió: ..................................................
  d. Cree que puede pasar de nuevo: ..................................................


¿Cuáles son algunas razones de que pasa la escasez o que hay cortes de agua? ¿Avisan?

¿Cuáles factores contribuyen a la escasez o cortes de agua? (Como malas tuberías, conexiones).

¿Hay algunas personas en la comunidad que tienen mejor acceso al agua que otras?

¿Hay algunas personas en la comunidad que usan demasiada agua?
  a) ¿Quiénes?
  b) ¿Por qué?
¿Cuáles son las consecuencias de esto?

Características del Manejo de Aguas Grises:
¿Adónde van sus aguas grises?:

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Appendix E (Continued)

Household Water Management Interview (Spanish)

¿A veces tiene problemas con su sistema de aguas grises?:
- Nunca [1]
- A veces [2]
- No sé [3]
- Frecuentemente [4]
Explique. ________________________________________________________________

¿Cree usted que es necesario que haya un servicio de aguas residuales?:
- Sí [1]
- No [2]
- No sé [3]

¿Causan las aguas grises problemas para la comunidad? (En términos de salud o medio ambiente).
__________________________________________________________________________
__________________________________________________________________________

Pida a la persona que le muestre cómo funciona el sistema de aguas grises.

a. Cómo funciona: ____________________________________________________________
b. Tiene que hacerle mantenimiento: ___________________________________________
c. Cómo le hace: _____________________________________________________________
d. Quién le hace: _____________________________________________________________
f. Pregunta de qué cosas van o que son eliminadas en las aguas grises: _______________

Características del manejo del tanque séptico:

¿Tiene tanque séptico?  Si  No  Otro: _____________________________________________

¿Qué hace cuando su tanque séptico está lleno?:
- Lo vacían con bomba [1]
- Instalamos otro tanque [3]
- Otro [0]
- Lo vaciamos nosotros mismos [2]
- No sé [4]

a. Si es así, con que regularidad: _______________________________________________
b. Quién lo hace: _____________________________________________________________
c. Cuánto cuesta hacerlo: _____________________________________________________

¿Cuántos servicios sanitarios hay en la casa/edificio?:
- 1 [1]
- 2 [2]
- 3 [3]
- más [4]

¿Qué tipo de servicio sanitario tiene?:
- Inodoro con agua [1]
- Mezclado [4]
- Letrina [2]
- De compost [3]

¿Qué hace con su papel higiénico? _____________________________________________

¿Qué si los tanques sépticos son mejores con lo que tenían antes? (baño de hueco, madera)
__________________________________________________________________________
__________________________________________________________________________

¿Ud. tiene preocupaciones sobre la salud de su familia relacionada a su suministro de agua o sus sistemas de saneamiento?:
__________________________________________________________________________
Appendix F: Semi-Structured Interview Guide - Parasite Perceptions and Knowledge (Spanish)

Código #____________________  Comunidad: _______________________________
Entrevistador:________________________   Entrevistado/a: ______________________
Persona a Cargo:_________________________________________________________
Fecha y Hora de la Entrevista:_______________________________________________

PREGUNTAS BASICAS SOBRE LOS PARASITOS – TRANSMISION Y PREVENCION

Hábleme de lo que sabe sobre los parásitos. ¿Qué son?
______________________________________________________________________________________
______________________________________________________________________________________
______________________________________________________________________________________
______________________________________________________________________________________

¿De dónde vienen? O ¿Qué causa tener parásitos? ¿Por qué uno se tiene parásitos? ¿Si sabe si vienen del agua, comida, animales, la tierra, o la suciedad?
______________________________________________________________________________________
______________________________________________________________________________________
______________________________________________________________________________________
______________________________________________________________________________________

¿Cómo se agarran los parásitos? ¿Cómo nos dan parásitos?
______________________________________________________________________________________
______________________________________________________________________________________

¿Cómo se sabe si uno tiene parásitos?
______________________________________________________________________________________

¿A Quiénes tienen/o les dan más parásitos? (niños, adolescentes, adultos, o ancianos)
______________________________________________________________________________________

¿Las personas tienen más parásitos en ciertas épocas del año?
______________________________________________________________________________________

¿Qué haría o que podría hacer para sacarse/quitar los parásitos del cuerpo? Incluye remedios caseros, clínica, medicinas.
______________________________________________________________________________________
______________________________________________________________________________________

¿Qué se puede hacer para prevenir/evitar las infecciones con parásitos?
______________________________________________________________________________________

¿Sabe qué son las Amebas o los Lombrices?
______________________________________________________________________________________
¿Cuáles enfermedades/ males son causados/ le dan uno por parásitos?
   a. ______________________________________________________________________
   b. ______________________________________________________________________
   c. ______________________________________________________________________

Síntomas conocidas: ¿Qué la da a una persona cuando tiene parásitos?
   a. ______________________________________________________________________
   b. ______________________________________________________________________
   c. ______________________________________________________________________

¿Es una enfermedad seria? - ¿Cómo lo sabe?
   a. ______________________________________________________________________
   b. ______________________________________________________________________
   c. ______________________________________________________________________

¿Qué haría o que podría hacer para tratarla/ Curarse? Incluye remedios caseros, clínica, medicinas.
   a. ______________________________________________________________________
   b. ______________________________________________________________________
   c. ______________________________________________________________________

PREGUNTAS ACERCA DE LOS PARÁSITOS EN LA COMUNIDAD:

¿Son los parásitos comunes en esta comunidad? ¿Es común tener parásitos por acá?
   _____ Sí   _____ No   _____ N/S   Otro _______________________________

¿Cuáles son los más comunes?

________________________________________________________________________

¿En cuál temporada?

________________________________________________________________________

¿A Quiénes las da más parásitos?

________________________________________________________________________

¿Cómo se curan las personas de los parásitos? ¿Cómo se los sacan?

________________________________________________________________________

¿Qué hacen para evitar los parásitos? ¿Qué hacen la Clínica o las Escuelas?

________________________________________________________________________
Appendix F (Continued)
Semi-Structured Interview Guide: Parasite Perceptions and Knowledge (Spanish)

PREGUNTAS DE LA HISTORIA FAMILIAR SOBRE LA MORBIDIDAD CON PARASITOS:

Historia de Morbilidad de Infecciones con Parásitos dentro del Hogar.
En los últimos 6 meses (o si no, cuando sea) quien/quienes han tenido problemas del estomago, diarrea, o parásitos.

<table>
<thead>
<tr>
<th>Quien</th>
<th>Enfermedad</th>
<th>Causa</th>
<th>Síntomas</th>
<th>Duración</th>
<th>Tratamiento</th>
<th>Quien decidió como tratarla</th>
<th>Prevención</th>
</tr>
</thead>
</table>

PREGUNTAS PARA VERIFICAR EL CONOCIMIENTO:

¿Podemos agarrar parásitos por el agua?
_____ Si _____ No _____ N/S
Explique: ________________________________________________

¿Podemos agarrar parásitos cuando hay poco agua o cuando la corten?
_____ Si _____ No _____ N/S
Explique: ________________________________________________

¿Se puede agarrar parásitos por los alimentos?
_____ Si_____ No _____ N/S
Explique: ________________________________________________

¿Se puede agarrar parásitos por los animales o por tocarlos?
_____ Si_____ No _____ N/S
Explique: ________________________________________________

¿Se puede agarrar parásitos por la suciedad o la mala higiene?
_____ Si_____ No _____ N/S
Explique: ________________________________________________

¿Se puede agarrar parásitos por las heces o caca de otra persona?
_____ Si_____ No _____ N/S
Explique: ________________________________________________

¿Se puede agarrar parásitos por los insectos?
_____ Si_____ No _____ N/S
Explique: ________________________________________________

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Appendix F (Continued)

Semi-Structured Interview Guide: Parasite Perceptions and Knowledge (Spanish)

PREGUNTAS SOBRE EL USO DE MEDICAMENTOS CONTRA LOS PARASITOS:

¿Hay alguien que esté tomando medicina o remedios contra parásitos en este hogar?

¿Quién? ________________________________________________________________
¿Cuál Medicina Tomó? ____________________________________________________
¿Dónde lo Consiguió? _____________________________________________________
¿Cuánto Costó? __________________________________________________________
¿Resultados? ____________________________________________________________

¿Hay alguien que esté tomando un purgante o antiácido en este hogar?

¿Quién? ________________________________________________________________
¿Cuál Medicina Tomó? ____________________________________________________
¿Dónde lo Consiguió? _____________________________________________________
¿Cuánto Costó? __________________________________________________________
¿Resultados? ____________________________________________________________

¿Hay alguien que haya tomado algo contra los parásitos durante los últimos dos meses en este hogar?

¿Quién? ________________________________________________________________
¿Entre Cuáles Fechas? ____________________________________________________
¿Cuál Medicina Tomó? ____________________________________________________
¿Dónde lo Consiguió? _____________________________________________________
¿Cuánto Costó? __________________________________________________________
¿Resultados? ____________________________________________________________

¿Cuándo fue la última vez que alguien tomó algo contra los parásitos en este hogar?

¿Quién? ________________________________________________________________
¿Entre Cuáles Fechas? ____________________________________________________
¿Cuál Medicina Tomó? ____________________________________________________
¿Dónde lo Consiguió? _____________________________________________________
¿Cuánto Costó? __________________________________________________________
¿Resultados? ____________________________________________________________
Appendix G: Parasite Education Handout for Study Participants (Spanish)

ACERCA DE LOS PARASITOS

POR UNA VIDA SALUDABLE PARA USTED Y PARA SUS HIJOS
PRACTIQUE LA BUENA HIJIGNE Y PREVENGA LOS PARASITOS

Jason Lind
Universidad del Sur de la Florida
Facultad de Salud Pública
Investigación de Enfermedades Parasitarias Intestinales

¿QUE SON LOS PARASITOS?

Son organismos microscópicos, algunos no se pueden ver a simple vista, que viven en los intestinos donde se aprovechan de los nutrientes del cuerpo humano. Vienen de las heces de personas o animales que están ya infectadas. Estas heces pueden contaminar agua, tierra, objetos y alimentos por razones de falta de higiene. Tenga en cuenta lo siguiente para su prevención:

¿COMO INGRESAN A NUESTRO CUERPO?

1. Los parásitos entran por nuestra boca:
   a. Al tocar alimentos para comer o cocinar con las manos y uñas sucias
   b. Al comer a elementos como las verduras y frutas mal lavados o sucios
   c. Al tomar agua contaminada. d. Al comer carnes crudas o mal cocidas.
2. También ingresan a nuestro cuerpo cuando caminamos descalzos y pisamos heces humanas o de animales.
3. Cuando las moscas, cucarachas, ratones u otros animales pisan materia fecal humana o animal y la traen en sus patas a las casas, contaminando los alimentos que toquen.

¿QUE DAÑOS PRODUCEN LOS PARASITOS?

1. Pueden producir enfermedades graves como la anemia.
2. Impiden que nuestro cuerpo aproveche bien los alimentos que consumimos lo que conlleva a desnutrición.
3. Retardo en el crecimiento y desarrollo.
4. Incapacidad para aprender.

¿CUALES SON LOS SINTOMAS DEL CONTAGIO CON PARASITOS?

1. Estómago inflado.
2. Mareos.
3. Náusea y vómito.
4. Falta de apetito.
5. Dolor de estómago.
6. Dolor de cabeza.
7. Sueño.
8. Cansancio y falta de fuerzas.
9. Comezón en el ano.
10. Diarrea.
Appendix G (Continued)
Parasite Education Handout for Study Participants (Spanish)

¿COMO PODEMOS EVITAR LOS PARASITOS?

PRACTIQUE LA HIGIENE PERSONAL - La
1. Lávese las manos con agua y jabón:
   a. Antes y después de preparar la comida.
   b. Antes de comer.
   c. Después de usar el servicio sanitario o la letrina y después de lavar o cambiar un pañal.
   d. Después del trabajo en el campo en la tierra o con los animales.
   e. Córtese las uñas cada semana.
   f. Báñese todos los días.
   g. Ande calzado, con chanclas o zapatos todo el tiempo.
   h. Use siempre la letrina o el servicio sanitario.
   i. No haga deposición al aire libre.
   j. La letrina o servicio debe estar siempre limpia y tapada. Los papeles se deben tirar en un basurero. Nunca se deben tirar en el área del agua del consumo del hogar.
   j. Limpiarse bien con papel higiénico.
   k. Tenga mucho cuidado cuando recoja el papel higiénico para botarlo.

Para lavarse las manos:

   a. Use jabón y agua.
   b. Frótese las manos tantas veces como sea posible.
   c. Abra la llave de la pila con la mano que no haya empleado para limpiarse, para que los microbios de la mano sucia no contaminen la llave y se propaguen los parásitos a otras personas.
   d. Use un trapo limpio después de lavadas o dejarlas secar al aire (no use su ropa para secarlas).

AGUA SEGURA

Es importante proteger el agua de la contaminación:
1. Utilice agua segura, del tubo, clorada o potable
2. Hierva el agua para beber, cocinar y lavar los alimentos, si no es potable porque aunque se vea limpia y clara puede tener microbios.
3. Mantenga la limpieza del agua.
4. Si recoge y guarda agua, hágalo en recipientes limpios y bien tapados
5. Si sospecha que no es segura, la puede purificar hirviéndola por dos minutos o agregándole una cantidad muy pequeña de cloro. Por cada litro de agua agregue dos gotas de cloro. Utilice esta agua para beber o lavar las frutas y verduras que se van a comer crudos.

*Recuerde también que el cloro NO mata toda clase de parásitos.
*Deje correr el agua por unos minutos antes de usarla después de que la hayan cortado.
Appendix G (Continued)
Parasite Education Handout for Study Participants (Spanish)

HIGIENE CON LOS ALIMENTOS:

a. Lave bien los alimentos, las frutas y las verduras con agua segura.
b. Si los alimentos no se van a comer inmediatamente, tápelos y manténgalos en un lugar fresco y ventilado. Si tapamos los alimentos, evitaremos que las moscas u otros insectos se paren en ellos ya que las patas de los insectos están contaminadas con microbios.
c. Si un alimento se guarda por más de cuatro horas después de preparado, éste ya contiene microbios; por lo tanto, el alimento debe hervirse de nuevo antes de comerlo, especialmente si se le va a dar a un niño menor de 2 años.
d. Comer carne bien cocida.

¿QUE HACER SI SOSPECHA QUE TIENE PARASITOS?
Consulte a su médico de inmediato para que le hagan un examen de materia fecal.
Si ya sabe que tiene parásitos consulte con su médico o farmaceuta para que le receten el medicamento adecuado.
About the Author

Jason D. Lind grew up in Little Falls, Minnesota and attended Minnesota State University – Mankato where he earned a Bachelor’s Degree in Spanish and Latin American Studies in 1996. After graduation, Mr. Lind traveled extensively throughout Latin America and later worked as a field anthropologist for a CDC funded program aimed at reducing childhood diarrhea through the implementation of a community-based clean water project in Eastern Bolivia. Upon returning to the U.S., Mr. Lind completed a Master’s Degree in Anthropology from Minnesota State University – Mankato in 2000.

While in the Ph.D. program in Applied Anthropology and the M.P.H. program in Global Communicable Diseases at the University of South Florida, Mr. Lind worked as a Graduate Research Assistant for the USF-Globalization Research Center. After completing his dissertation research in Monteverde, Costa Rica, Mr. Lind moved to Bucaramanga, Colombia, South America, where he collaborated on several community-based health projects and worked as an Assistant Professor at the Universidad Industrial de Santander teaching classes in educational research.

Upon returning to the U.S., Mr. Lind was a Research Associate at the Florida Prevention Research Center at University of South Florida where he collaborated on the Partnership for Citrus Worker Health; a community based social marketing project that focused on reducing eye injuries among Mexican citrus pickers in Florida. Currently, Mr. Lind is employed at the James A. Haley VA Medical Center, HSR&D/RR&D Center of Excellence in Tampa, FL where he works as a qualitative health researcher.