

HELMINTHIC INFECTION AND ANEMIA IN CHILDHOOD: A COMPARATIVE ANALYSIS OF WESTERN AND TRADITIONAL MEDICINE: TAMANCO JURISDICTION, NAPO RIVER, AMAZON

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It is estimated that of the 265,000 flowering species of known plants, only 1% have been thoroughly studied for their chemical composition and medicinal value thus far (Schultes et al. 1995). This medicinal value or chemical "richness" is the result of a long evolutionary process of development of specific host defense systems, or allelochemicals, which function to protect species from their predators – be it herbivore or microbe. Indigenous groups around the world have been aware of the medicinal applications of many of these chemically potent plants for centuries and it has only been in the last 50 years that a concerted effort has been made by the Western world to learn from their experience and knowledge. Modern advances in mechanisms of chemical analyses in the past few decades have made further detailed study of these potent secondary metabolites possible. It is from the extraction of such active organic molecules as alkaloids, non-protein amino acids, cyanogenic glycosides, glucosinolates, and amines that important drugs such as quinine, digitoxin, atropine, ipecac, morphine, and codeine have been discovered and applied towards the advancement of pharmaceuticals and "modern" medicine as we know it today.

Tragically, the Amazon basin, which has been estimated to have the greatest overall biodiversity in the world, now faces certain destruction as logging companies, the oil industry, and local "slash and burn" agriculturists destroy this unique habitat in acquisition of natural resources. Along with this gradual change in the environment, rapid cultural changes are occurring within the tributaries of the Amazon. With the push of government influence for "modern health care" in rural communities, the people of this region are abandoning traditional medical and religious practices. The twist to this introduction of "modern" Western medicine is the fact that the government "health promoters" stationed in the villages have little if any training and even less experience. This fact, compounded with the scarcity of even the most basic medicines, has brought many communities to a state of dependency on a system of medical provision that can often offer no more than aspirin and antibiotic ointment. In addition to this problem, the government reinforced ideology of the inferiority of local healers' abilities to provide medical care has pushed away prospective apprentices. Thus, with each shaman that

dies without an apprentice centuries of medical and botanical knowledge collected and passed down through oral tradition among this select group are lost forever.

The purpose of this paper is to analyze the conflicting roles of traditional and Western medical systems and the part that they have played in the case of childhood parasitosis and anemia in rural NW Amazonia. This will be achieved by first evaluating the relationship between helminth infection, specifically that of hookworms, and the rise of iron-deficient anemia in children. Secondly, an analytical description of the two primary systems of medical treatment – Western biomedicine and shamanic healing – will be made.

Intestinal parasitosis is indeed an important problem in rural areas of the tropics. There are multiple ramifications to undiagnosed and untreated helminthic infections, from increased morbidity and mortality to poor growth and developmental delay. During the span of a six-week research expedition in a rural region of the Peruvian Amazon in the summer of 1999, I had access to the past 6 months medical records from a small health clinic charged with the care of 11 villages. The total population of this health jurisdiction was 2,777 as of a January 1999 census. These records provide data for a cross-sectional analysis of treatment frequency for helminthic infection and anemia with Westernized medicines in children under the age of 15. Extensive interviews were conducted with two indigenous healers and 73 mothers distributed among 11 villages in an effort to assess the means of diagnosis and treatment of the aforementioned childhood ailments via use of the local forest flora. Hypotheses regarding the cultural mores and behaviors that influence the status of this long-standing endemic condition are suggested.

Significance

Chronic Parasitic infection affects millions of children in developing countries. Helminthes such as *Ascaris lumbricoides* (roundworm), *Strongyloides stercoralis*, *Trichuris trichuria* (whipworm), *Enterobius vermicularis* (pinworm), *Ancylostoma duodenale* (hookworm), and *Necator americanus* (hookworm) are endemic in human populations of the rural, humid tropics (Branwell et al. 1978). Transmission is facilitated in these rural regions by the lack of clean water supplies and sanitation management systems. Intestinal parasites can lead to such health problems as malnutrition, anemia, growth retardation, diarrhea, vitamin A deficiency, cognitive deficits, and immune compromise in developing children (UNICEF 1998).

Hookworms, which infect approximately 1 billion people worldwide, are closely associated with the development of anemia (Warren et al. 1993). The

development of iron-deficient anemia depends on daily iron intake, iron stress, and the intensity and duration of helminthic infection. Women and developing children comprise the group at greatest risk because they usually have the lowest iron stores (Layrisse et al. 1964). This condition leaves them more vulnerable to developing iron-deficiency anemia from chronic blood loss due to hookworm infection. For example, a moderate hookworm infection can deplete 2.3 mg of iron per day. This approximately doubles the iron intake requirement of a normal menstruating woman (FAO/WHO 1988).

The transmission of hookworm is facilitated primarily through skin contact with contaminated soil. The extent of infection depends on three factors: concentration of fecal material in the soil, accessibility of a warm and humid environment for egg survival and larvae development, and the duration of contact with human skin. After the initial entry into the body, they migrate through the circulatory system to the lungs, pass through the alveolar system up the trachea, then are swallowed and deposited in the intestines where they can live for a period of 2-3 years (Banwell et al. 1978). Hookworm infection leads to anemia through chronic intestinal blood loss. Adult hookworms attach to the lining of the small intestine, feeding on tissue and blood. The parasite changes its feeding site roughly every 4-6 hours, leaving behind it sites for further blood loss from the damaged mucosal lining. Although people of all ages are susceptible to helminthes, the prevalence of infection is concentrated in school-age children who have frequent contact with soil during play.

Symptoms and signs of early infection may include inflammatory diarrhea, abdominal distension, and epigastric pain, which is commonly known as "colico" in the region under study. Iron-deficient anemia may result in hypoproteinemia, skin depigmentation, shortness of breath, and general weakness (Fauci et al 1998). Hookworms can be eradicated with several safe and highly effective antihelminthic drugs, including mebendazole and pyrantel pamoate. Severe hookworm disease with intestinal malabsorption and protein loss necessitates nutritional support, oral iron replacement, and deworming.

Description of Region

The Tamanco Jurisdiction consists of 11 rural villages located on the banks of the Napo River in Northeastern Peru (see map in Appendix). The Napo River region makes up one of the Amazon's largest tributaries and is known for its extensive span of flooded forests. Water levels undergo drastic change throughout the year and may contribute to the high incidence of seasonal malaria in this area. The majority of people living in this region does

not belong to a set tribal group and are largely identified as “riberenos”, or river people. Travel is by dugout canoe. The language spoken is a dialect mixture of Spanish and Quechua. The average number of children per household currently ranges from 6 to 7. Many of the younger women interviewed were either involved in or expressed interest in the government family planning programs and hoped to have a maximum of 2 to 3 children. The government population census for January 1999 shows a heavy concentration of school age children with low distribution in the youngest and oldest age groups (see Figure 1).

Homes are constructed as palm-thatched huts built on stilts near the river. Chickens, infant monkeys, and sloths are common household pets and are raised until maturity, then eaten. Food is acquired primarily through net fishing and farming of yuca, maize, banana, chickens, and some rice. Hunting for monkeys and capybara, large forest-dwelling rodent, is done occasionally as an alternative protein source. All but one village in the district lack latrines and sewage pits. Water is taken directly from the river and is generally never boiled or chlorinated for purification.

Each village has a government-established primary school and small pharmacy, or “botica” where Western medications such as aspirin, iron supplements, and antibiotic ointments may be purchased. The supply of in-stock medicines as well as the training of local health promoters varies greatly from village to village-though in general, medical supplies are limited and health promoters have minimal training and experience. In the first half of 1999, health records document that respiratory ailments affected 54% of children under the age of one year and were a major cause of infant mortality. Intestinal parasitosis is an endemic condition in all children aged two and older. According to parents, most children in this region are treated with an anti-helminthic such as mebendazole or albendazole once every 1 to 2 years. This treatment regime is quite hazardous to child health and development because deworming in this high-risk environment is actually needed every 4 months in order to interrupt the parasite transmission cycle, thus keeping the parasite load at an acceptably low level (Sanriso 1997). Most children in the region, however, actually maintain an extremely high parasite load as a result of inadequate treatment and are brought to the clinic for treatment only after acute signs of anemia and illnesses of immune compromise develop.

Subjects and Methods

I conducted my study from June, 3 – July 17, 1999. I began the project by interviewing approximately 7 mothers in each village of the Tamanco Jurisdiction (N=73), focusing on concerns they had for their children’s health.

From these interviews, I found a high frequency of diarrheal illness, respiratory ailments and an increased prevalence of malaria in late June and early July.

My two primary informants in the collection of data from January July, 1999, were Senor Vargas, the government "sanitario", or health official for the Tamanco jurisdiction and Don Antonio Montero Pisco, an "auahuasquero" or indigenous healer. Although Senor Vargas has limited medical training and is lacking in the supply of many necessary medicines and diagnostic equipment, he is an excellent record keeper and devoted to providing all of the medical care that he can offer. As the primary medical provider in the region, he stays busy with a heavy daily load of patients and keeps detailed hand-written records for each person seen. In my initial review of his records, I found that people living closer to his clinic visited more frequently. For some villages, it is an exhausting 3 to 4 hour canoe trip to reach the clinic. People from these villages generally make the trip only for acute emergencies. Thus, most cases of intestinal parasites and anemia are left untreated in these villages until the condition becomes acute. My data set for the use of a Westernized medical system is therefore somewhat biased towards those individuals with easier access to the clinic.

Don Antonio is employed by the Amazon Center for Environmental Education and Research (ACEER), the research organization through which my study was conducted. Most of his time is devoted towards the care and maintenance of his large medicinal garden and the education of visiting scientists and tourists on the uses of plants in traditional healing. His training and education in this field began at the age of 7 under his family's strict tutelage. Now in his mid-50's, Don Antonio is working to preserve the ethnomedical knowledge passed down to him by his parents by teaching his own children. Unfortunately, he spends little time actually practicing medicine in the nearby villages both due to restrictions imposed by his employers and the disappointing trend of local community reliance on the small government medical stations. Data acquired from interviews with this informant are descriptive in nature and include information regarding traditional shamanic healing practices, modes of diagnosis, and treatment of parasitosis and anemia by use of medicinal plants.

Results

Figure 2 presents data on the number of individual children who went to the main health clinic and were diagnosed with intestinal parasites and/or anemia during January – July 1999. Diagnosis of intestinal parasites was high during January – April, falling in May for children aged 1-4 years. Di-

agnosis of anemia, on the other hand, was low January – March, peaking in April for this younger age group. Diagnosis of intestinal parasites was high January-April; peaking in March, and falling in April for children aged 5-14 years. Diagnosis of anemia was high January – April falling in May for this older age group.

Table 1 demonstrates that no infants under the age of 1 were diagnosed with either anemia or intestinal parasites. During this six-month period, 2.7% and 16% of children ages 1-4 were diagnosed with anemia and intestinal parasites, respectively. Whereas, 11.2% and 24.8% of children ages 5-14 were diagnosed with anemia and intestinal parasites, respectively.

Discussion

The results well illustrate cyclic environmental change. Documented monthly flux of disease may reflect the changing water levels of the region (see Figure 2): the high water season, which results in mass flooding of many of the villages, occurs during the months of February through May. An observable decline in the treatment of helminthes and anemia is shown from the end of May through July as the water levels begin to recede. The patterns may well reflect an increase in transmissions of helminthes due to the sanitation hazards of water heavily contaminated with fecal material that floods huts and is used in cooking and drunk without prior purification. In addition an increase in canoe travel to the clinic is probable as the high water opens up small streams through the forest that are otherwise dry during the low water season. The relationship shown here between hookworm parasitosis and iron-deficient anemia has been well documented by case studies in areas such as Kenya, Sri Lanka, India, and Venezuela (Layrisse et al. 1964; Stephenson et al. 1998; Tshikuka et al 1997). In my evaluation of the public health condition of the Tamanco Jurisdiction in Peru, I found a high prevalence of both endemic helminthiasis and anemia in the pediatric population, particularly in children aged 5-14, but not in infants < 1 year old. In addition to this, chronic health problems such as respiratory ailments, throat infections, and dermatitis were common. While the temporal associations found here do not indicate a casual link between parasitosis anemia, and developmental delays, they do support consideration of the importance of parasitosis treatment in the health and well being of children in developing countries. Specifically, these data provoke reconsideration of the effects of Western medical intervention into indigenous health.

Local Historical Perspective

Many of the problems that contribute to this high frequency of hookworm transmission in the Tamanco district are due to social factors that have developed as a result of Western influence in the area. In the past, medicinal plants were used and obtained from local medicine men, or shaman, in the region. Plants such as "oje", or *Ficus insipida*, were readily available in each village for the treatment of intestinal parasitosis. This method of medical provision was quite beneficial in the aspect that people had easy, predominantly cost-free access to medical care near home. Thus, with higher frequency of treatment, the parasite load intensity was kept low in children and effectively prevented the development of extreme cases of iron-deficient anemia.

When the Peruvian government Ministry of Health took action to "improve" the system of medical provision in its rural regions, they also introduced a stigmatic belief in the inferiority of the local shaman to the government health promoters. In the beginning of this governmental program, the village clinics were well supplied with medicines. However as time went on, these supplies were depleted and a lack of further government support has left many villages with nothing more than a few oral rehydration therapy packets. Unfortunately, during this period of transition, the once respected shamans were unable to find apprentices to pass on their extensive knowledge of the local medicinal flora. With time, these natural pharmacists and health providers have died and centuries of knowledge have gone with them. Thus, the well-intentioned government plan for the improvement of rural health has actually accomplished the opposite effect. It has led thousands in this region alone to dependency on a system of medical provision that is severely lacking in both medicines and trained health providers. The jurisdiction clinic is difficult for many to reach and access to a hospital is impossible for most.

Goals in Global Infection Control & Management

The eradication of hookworm infection is a long-term goal for countries and regions where the parasite is endemic. However, past community efforts to permanently rid hookworm from the area have failed due to frequent reunification. These past failures have contributed to a decline in funding and support for eradication programs in the last twenty years (Mascie-Taylor et al 1999).

More recently, the programmatic focus has shifted from eradication to control. Due to the intensity-dependent relationship between iron-deficiency anemia and parasite load, a reduction in the intensity of infection alone will help control the development of anemia and other disorders resultant to this problem. Current control efforts are now focused on reducing infection load and transmission potential in an effort to reduce morbidity associated with the disease (Giles, 1985). Such efforts employ a combination of antihelminthic drug therapy and education programs for safe sanitation management.

The most commonly used antihelminthic drugs for these control efforts are the benzimidazoles (albendazole and mebendazole) which cover a broad-spectrum of helminthes and can reduce prevalence and intensity of hookworm with >90 % effectiveness (Fauci et al. 1998). Studies with Kenyan preschool children have shown that treatment with antihelminthus drugs are associated with measurable improvements in physical growth and fitness (Stephenson et al. 1989). In addition to chemotherapeutic management, sanitation programs provide latrines along with education programs for the use of the facilities and treatment of human waste prior to agricultural use as fertilizer. The use of footwear is also promoted through these programs and can reduce the intensity of infection by decreasing the frequency and duration of skin contact with contaminated soil.

Recommendations for Local Helminthes Control

As with other globally implemented programs for helminthes control and management, a multifaceted system of education, chemotherapy, and iron supplementation is necessary. Behavioral changes must be made in order to make a significant difference in the frequency of transmission. Such health-promoting behaviors would include the use of safe human waste disposal systems, purification of all water ingested by either boiling or chlorinating, and the use of protective footwear. Unfortunately, these changes will most likely not be made with ease. Approximately 90% of the mothers I interviewed were quite aware of the risks associated with providing raw, unpurified, water for consumption to their families. While all initially claimed to purify their water, further questioning revealed that they do so "some" of the time, complaining of the inconvenience of the task and dislike for the taste of purified water.

In addition to these changes in health-related behavior, two options that emerge from efforts to combine Western and traditional medical systems: One option, which could make use of the existing government rural health program, would be a scheduled whole village deworming every 4 months. This could be accomplished by having the sanitatio travel to each village on a

scheduled date to deworm all children and adults suffering from intestinal parasitosis. A broad-spectrum antihelminthic such as mebendazole would be most appropriate as it can be provided at the low cost of \$ 0.03 per dose (Mascie-Taylor et al. 1999). This would enable treatment of a large proportion of the population who could not otherwise afford to make the long trip to the district clinic. In addition to this mass deworming, ferrous sulfate should be provided to the village "boticas" to assist in the maintenance of sufficient iron levels specifically in women and children with low-intensity helminthiasis.

A second option, which could possibly function to bring traditional medicine back into practice in many villages, would be to utilize local plants such as Oje and Papaya for annual treatment of parasitosis. This regimen would, like the western program, need to follow a four-month treatment cycle in order to disrupt the parasite life cycle. Both Oje and Papaya have proven to serve as reliable and effective regimens for treatment of this ailment. In addition to this, both plants are fast growing and sustainable harvest of their resin and are carried out for several years. This program, which should be lead by local healers knowledgeable about the correct dosages of the plant resin, would be available at an extremely low cost and supply of the medicine would be ample. The only disadvantage to this option is that it is not as safe a treatment as the benzimidazoles for young children under the age of four.

These data illustrate the dramatic effects that well-meaning international efforts have had on health in the developing world. The rise in parasitic infections among children in this region, coupled with the rise in malarial incidence recently documented by the World Health Organization, result in 1 in 4 children with anemia. The significant negative effects that anemia has on behavioral and cognitive development have been well documented and the statistics are concerning in terms of the long term effects of the functional capacity of adolescents and adults in this region. Future healthcare efforts that partake of indigenous practices and beliefs together with modern approaches may be the next generation's best hope for health. This observation illustrates the importance of anthropological investigation in international health efforts and clarifies the central role that ethnography and basic research has for future intervention programs.

References Cited

- Banwell, J.G. & Schad, G.A. (1978) Hookworm. *Clinics Gastroenterol.* 7: 12-155.
- FAO/WHO. (1988) Requirements of vitamin A, iron, folate, and B12. FAO Food and Nutr. Series No. 23, Rome.
- Fauci, A. S., Braunwald, E., Isselbacher, K.J., Wilson, J.D., Martin J.B., Kasper, D.L., Hauser, S. L. & Longo, D.K> (1998) Harrison's principles of internal medicine. McGraw-Hill, New York.
- Giles, H.M. (1985) selective primary health care: strategies for control of disease in the developing world. *Hookworm infection and anemia. Rev. Infect. Dis.* 7: 111-118.
- Layrisse, M. & Garcia-Casal, M. N. (1997) Strategies for the prevention of iron deficiency through foods in the household. *Nutr. Rev.* 55(6): 233-239.
- Layrisse, M. & Roche, M. (1964) The relationship between anemia and hookworm infection: results of surveys of rural Venezuelan population. *Am J. Hyg* 79:279-301.
- Mascie-Taylor, C.G. N. Alam, M., Montanari, R. M., Karim, R. Ahmed, T., Karim, E. and Akhtar, S. (1999) A study of the cost effectiveness of selective health interventions for control of intestinal parasites in rural Bangladesh. *J. Parasitol.* 85 (1): 6-11.
- Oberhelman, R.A., Guerrero, E.S., Fernandez, M. I., Silio, M., Mercao, D., Comiskeu, N., Ihenacho, G. & Mera, R. (1998) Correlations between intestinal parasitosis, physical growth, and psychomotor development among infants and children from rural Nicaragua. *Am J. Trop. Med. Hyg.* 58 (4): 470-475.
- Palupi, L., Schultink, W., Achadi, E. & Gross, R. (1997) Effective community intervention to improve hemoglobin status in preschoolers receiving once-weekly iron supplementation. *Am. J. Clin. Nutr.* 63:: 884-890.
- Ridwan, E Schultnik, W. Dillon, D. & Gross, R. (1996) Effects of weekly iron supplementation on pregnant Indonesian women are similar to those of daily supplementation. *Am. J. Clin. Nutr.* 63: 884-890.
- Santiso, R. (1997) Effects of chronic parasitosis on women's health. *Int. J. Gynecol. & Obstet.* 58: 129-136.
- Schultes, RE and Von Reis, S. (1995) *Ethnobotany: Evolution of a Discipline.* Portland, Oregon: Dioscorides Press.
- Stephenson, L. s., Latham, M.C., Kurz, K.M., Kinoti, S. N. & Bringham, H. (1989) Treatment with a single dose of albendazole improves growth in Kenyan schoolchildren with hookworm, *Trichuris trichuria*, and *Ascaris lumbricoides* infections. *Am. J. Trop. Med. Hyg.* 41: 78-87.

- Stettler N., Schutz, Y. & Jequier, E. (1998) Effect of low-level pathogenic helminth infection on energy metabolism in Gambian children. *Am. J. Troop. Med. Hyg.* 58 (4): 476-479.
- Tshikuka, J., Gray-Donald, K., Scott, M. & Olela, K.N. (1997) Relationship of childhood protein-energy malnutrition and parasite infections in an urban African setting. *Trop. Med. & Int. Health.* 2 (4): 374-382.
- UNICEF. (1998) *The State of the World's Children: 1998i.* Oxford university Press, New York NY.
- Warren, K. S., Bundy, D.A.P. & Anderson, R.M. (1993) Helminthic Infection. In: Jamison, D.T., Mosely, W. H., Measham, A.R. & Bobadilla, J.L. eds. *Disease control priorities in developing countries.* Oxford University Press, New York.
- Weigel, M.M., Calle, A., Armijos, R.X., Vega, I.P., Bayas, B.V. & Montenegro, C.E. (1996) The effect of chronic intestinal parasitic infection on maternal and perinatal outcome. *Int. J. Gynecol. & Obstet.* 52: 9-17.