Air & Water Borne Diseases

ISSN: 2167-7719

Hadush and Pal, Air Water Borne Diseases 2016, 5:1
DOI: 10.4172/2167-7719.1000126

Review Article Open Access

Ascariasis: Public Health Importance and its Status in Ethiopia

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Abstract

Waterborne diseases are a major public health problem in many countries of the world including Ethiopia. Waterborne diseases are caused by viruses, bacteria, protozoa, helminthes, and fungi. Currently, about 1.1 billion people in the world drink unsafe water, which is responsible for millions of cases of waterborne diseases. Ascariasis is among the several parasites which is widely prevalent helminthic disease of public health significance. It is commonly found in warm tropical and sub-tropical climates in Sub-Saharan Africa and Southeast Asia. It flourishes in areas with poor sanitation and crop irrigation by improperly treated wastewater. Severe ascariasis infections cause approximately, 60,000 deaths annually, mainly in children. It is transmitted through accidental ingestion of Ascaris eggs from contaminated water, food or soil. Among the *Ascaris* species, *Ascaris lumbricoides* and *Ascaris suum* are the parasitic nematode infections of humans and pigs with serious outcomes, respectively. Ascariasis is found in association with low personal hygiene, poor sanitation, and in places where human faeces are used as fertilizer. Clinical spectrum of disease varies from asymptomatic to nausea, vomiting, abdominal pain, pneumonia, and intestinal obstruction. Laboratory help is imperative to assist the clinical diagnosis. Treatment of adult worms can be done with albendazole, mebendazole, and pyrantel pamote. Public health department should improve the safety of the drinking water. Health education to the community, mainly the school children about the personal hygiene and environmental sanitation will be important in preventing the infection. Ascariasis caused by *A. lumbricoides* is found among children and adults in Ethiopia. Considering the importance of ascariasis from public health and economic perspective, further research on the development of safe, potent and cheap vaccine is emphasized. Moreover, comprehensive studies on zoonotic importance of *A. suum* should be planned particularly, in pig rearing countries.

Keywords: Ascariasis; Children; Ethiopia; Parasite; Pig; Public health; Water

Introduction

Waterborne disease can be defined as any illness caused by either drinking of contaminated water or by contact with polluted water. Waterborne diseases result in higher morbidity and mortality rates both in developing and developed countries of the world [1]. A number of waterborne diseases such as amoebiasis, ascariasis, balantidiosis, campylobacteriosis, cholera, colibacillosis, cyclosporiasis, cryptosporidiosis, echinococcosis, enterobiasis, fasciolopsiasis, giardiasis, hymenolepiasis, infectious hepatitis, legionellosis, leptospirosis, microsporidiosis, poliomyelitis, schistomiasis, shigellosis, taeniasis, toxoplasmosis, typhoid fever, and yersiniosis are reported all over the world [1,2-7] According to different reports, waterborne diseases cause about 1.7 million human deaths annually, and 88% is attributed to unsafe water supply, poor sanitation, and lack of hygiene. It is described that approximately, 10% of the population in the developing countres are infected with various intestinal worms [2]. The use of faecal contaminated water is the main source of intestinal parasites. Among these diseases, ascariasis (round worm infection) is a chronic and potent fatal parasitic disease, caused principally by *Ascaris lumbricoides*. The disease is important with enormous health and social implications for school going children in many developing countries of Africa, Asia, and Latin America. Due to this condition, one fourth of the population of world is infected with *A. lumbricoides*.

Ascariasis is a roundworm, which is most commonly found in warm tropical and sub-tropical regions of the world including Ethiopia and India. Disease may be acquired through accidental ingestion of *Ascaris* by eggs contaminated water, food, or soil [4,8]. After the eggs are swallowed, they will be hatched into larvae after passed into the intestine. The larvae can cause severe coughing and wheezing after migrating into the bloodstream. Eventually, the larvae are swallowed and lay eggs sometimes up to 240,000 per day after returning to the small intestine where they mature. Before the cycle begins again, ascaris eggs are passed into the feces and incubate in the soil for a minimum of two weeks. Adult roundworms can grow as long as twelve inches and as wide as a pencil and can live in the body for one to two years. Ascariasis can be detected by observing the presence of worms in the stool as initially as can be asymptomatic [9]. Ascariasis particularly in children can cause intestinal blockage and obstruction in severe cases.

Ascaris lumbricoides and *Ascaris suum* are nematodes belonging to Family *Ascarididae*, and cause infections in humans and pigs, respectively. *Ascaris lumbricoides* is one of the most common human roundworm in the world, infecting 1.4 million population globally. There are reports of Infections which are most commonly documented in sub-Saharan Africa, Latin America, China, and East Asia. The spectrum of disease associated with *A. lumbricoides* infection in human is known as ascariasis, and is the major cause of disease burden, especially in developing countries, with an estimated loss of 1.2 to 10.5 disability-adjusted life years. Moreover, significant morbidity rate with serious health consequences is observed in 122 million cases per year. However, ascariasis being a neglected tropical parasitic disease, could not receive much attention.

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Received May 07, 2016; **Accepted** June 02, 2016; **Published** June 20, 2016

Citation: Hadush A, Pal M (2016) Ascariasis: Public Health Importance and its Status in Ethiopia. Air Water Borne Diseases 5: 126. doi: 10.4172/2167-7719.1000126

Ascariasis in pigs is caused by *Ascaris suum* which is a widespread parasitic nematode that causes infection with high prevalence rates in host populations. Transmission occurs through oral-faecal route [10]. The prevalence of *A. suum* infection can vary due to differences in geographical regions, and farm management practices. Swine ascariasis can interfere with health and productivity of pigs resulting in reduced feed to gain ratios, and liver condemnation incurring economic losses [9,11]. Moreover, pig serves as reservoir of *A. suum*, and pig handlers can acquire *A. suum* infection from pigs [4,12]. The zoonotic implications of *A. suum* is not well established in many countries. Hence, the prime objective of this paper is to present an overview on ascariasis as a common helminthic disease of developing nations with more emphasis on Ethiopia.

Etiology

Ascariasis is caused by *A. lumbrioides* and *A. suum*, which are nematode parasites of public health significance. The later species is of zoonotic importance as pig serves as reservoir of the infection [4,10,13]. Human and pig Ascaris are morphologically indistinguishable that have showed a difference by only six (1.3%) nucleotides in the first internal transcribed spacer (ITS-1) and by 3-4% in the mitochondrial genome (mtDNA) sequence, which indicates the species are closely related at a phylogenetic level. Experimental cross-transmission studies have demonstrated that *A. lumbricoides* can infect pigs and vice versa however, both parasitic nematodes display strong affinity for their conventional hosts. In North America and Denmark which are non-endemic areas for *A. lumbricoides*, infected humans were found to harbour worms of pig origin. This showed that pigs are a potential reservoir of the infection for the human host population. However, in Ascaris endemic regions of Guatemala and China, molecular epidemiological studies revealed that the level of cross-infection between host species is low or absent and that gene flow is limited between/among different genotypes [9,11,14].

Life Cycle of Parasite

The faecal-oral route is the most important means of ascaris infection in both human and pig. When infective eggs are ingested and hatched, *Ascaris* larvae develop in host parenteral tissues [9]. A similar migratory route is observed in human and pig hosts. After ingestion of the infective ova, L3 larvae covered by the L2 cuticle, hatch in the small intestine and migrate to the caecum and proximal colon where they penetrate the mucosa. The larvae reach the liver after migrating via the portal blood, where the L2 cuticle is shed. Following migration in the liver, the larvae advance to the lungs on day 6-8 post ingestion. The larvae move to the pharynx after penetrating the alveolar space and they are swallowed, resulting in returning to the small intestine on days 8-10. *A. suum* moults again to L4 stage larvae in the small intestine on day 10 [9,10,13,15]. In the small intestine, larvae grow and reach sexual maturity and moults again (L5 stage larvae) on day 24. After the uptake of eggs in pigs and humans, the hepato-tracheal migration takes place over a 10 to 14 day period, respectively. Majority of worms are expelled after 23 weeks of infection in pigs but adult worms may reside in the intestines for approximately one year. Male and female adult worms measure 15-25 cm and 20-35 cm, respectively. Even though, the number of eggs a female produces decreases with worm load, the daily *Ascaris* female egg production generally are in the range of 200,000 eggs. Unembryonated ova can remain viable in the soil for many years after entering to the environment via the faeces. The larvae may undergo two moults in the egg during embryonation [9,11,13,15].

Epidemiology

Parasitic diseases, caused by cestodes, nematodes, trematodes, and protozoa, are the cause of morbidity and mortality in many regions of the world [4]. These diseases are more prevalent in countries with poor socioeconomic status, where living conditions are unhygienic, and supply of safe drinking water is scarce or limited [1,8]. Ascariasis is mainly a disease of people exposed to untreated waste water. It is one of the most commonly occurring helminthic human diseases of worldwide distribution. Globally, more than 1.4 million people are infected with *A. lumbricoides*. Ascaris of both human and pig origin showed an over dispersed distribution, which results in the worms aggregating in few heavily infected hosts. Moreover, provision of anti-helminthic treatment and subsequent observation of intensity of re-infection have occurred, which showed that individuals tend to re-acquire similar worm burdens to those harbored before treatment [11,15].

Ascaris infection is caused by consuming drink or food contaminated with roundworm eggs. Ascariasis is highly prevalent intestinal worm infection in many countries of the world with poor socioeconomic conditions. It is estimated that 25% of world population is infected with *A. lumricoides*. In India, over half of adolescents are infected with roundworms. Transmission of infection is facilitated when asymptomatically infected persons shed the eggs for years. It is found in association with poor personal hygiene, poor sanitation, and in places where human faeces are used as fertilizer. Significant prevalence of *A. lumbricoides* infection among children in Senegal was associated with severe malaria attack [9]. Both species of Ascaris are found throughout the world. The zoonotic species *A. suum*, is widely present on pig farms. Therefore, it can be considered as zoonotic occupational disease of pig handler [10]. The parasite is most common in warm, humid climates, and swine are the normal reservoir [13]. The prevalence in swine varies with the level of care and ranges from 20-70%. Infection is most common among children and persons working with swine. A related organism, *Lagochilascaris minor*, normally found in clouded leopards, has been reported as the cause of subcutaneous abscesses in humans.

Parascaris equorum and *Neoascaris vitulorum* can cause visceral larva migrans in humans. It is transmitted by ingestion of ova in drinking water, contaminated soil or on fresh vegetables [11]. *Ascaris* may exist as a zoonotic infection associated with pig and use of pig manure [13]. Zhou [14] and co-workers (2012) have reported that pig *Ascaris* is an important source of human disease in China. Sporadic zoonotic infections with *A. suum*, a pig nematode, have been described in industrialized nations but not yet fully quantified [16]. It is emphasized that further comprehensive studies to elucidate the zoonotic role of animal Ascaris should be conducted.

Clinical Signs in Humans

The incubation period of the parasite is commonly 2 weeks until the respiratory phase begins; 2 months until the intestinal phase develops. However, the clinical signs both in humans and in pigs are not obviously manifested. People infected with Ascaris often show no clinical signs symptoms. If symptoms do occur, they can be light and include abdominal discomfort. Heavy infections can cause intestinal blockage and impair growth in children. Other symptoms such as cough are due to migration of the worms through the body. The major clinical signs in humans include worms in stool, coughing (sometimes coughing up of worms), wheezing, fever, nausea, vomiting, loss of appetite, shortness of breath, swelling of abdomen and severe abdominal pain, intestinal blockage or bowel obstruction (in severe cases), pneumonia (in rare cases), malnutrition, anemia and impaired physical growth, particularly in children. Severe cases involve Loffer's syndrome in the lungs. The obstruction to gall bladder can result in cholangitis, cholecystitis, biliary colic, liver abscess, and pancreatis

[9,17]. It is advised that in case of appendicitis, immediate diagnosis must be made to prevent further complications.

Disease in Pigs

Ascaris suum is by far the largest nematode of the pig: the females are up to 40.0 cm long. The egg is ovoid and yellowish, with a thick shell. The outer layer of which is irregularly mamillated the main effect of the adult worms is to cause production loss in terms of diminished weight gain. Otherwise, clinical signs are absent except in the occasional case of intestinal or biliary obstruction. In piglets under four months old, larval activity during the pulmonary phase of migration may cause a clinically evident pneumonia which is usually transient and rapidly resolving. The migrating larval stages in large numbers may cause a transient pneumonia, but it is now recognized that many cases of so-called 'Ascaris pneumonia' may be attributable to other infections, or to piglet anemia. In the liver, the migrating larva can cause 'milk spot', which appears as cloudy whitish spots of up to l.0 cm in diameter. The adult worms in the intestine cause little apparent damage to the mucosa, but occasionally, if large numbers are present, there may be obstruction. Sometimes, a worm may migrate into the bile duct, causing obstructive jaundice, and carcass condemnation [9,13,17].

Diagnosis

Diagnosis is based on clinical signs, and chest x-ray may reveal evidence of eosinophilic pneumonia (Loffler's syndrome). Blood test can show increase number of eosinophiles. The stool examination is done to detect the eggs and adult worm. Yellow-brown ovoid eggs with thick mamillated shells can be demonstrated by direct microscopic examination of stool specimen. X-ray after barium meal can detect adult worm in the intestine. Even though ova are not present in the faeces during the 2-month prepatent period, microscopic examination of fresh faeces for ova of *A. suum* is helpful for diagnosis. Being dense, the eggs float more readily in saturated solutions of zinc sulphate or magnesium sulphate than in the saturated sodium chloride solution, which is used in most faecal examination techniques [4,8,9,17]. Very recently, Dutto and Petrosillo [10] reported that PCR-RFLP analysis has revealed a hybrid genotype, intermediate between *A. suum*/*A. lumbricoides*.

Treatment

Chemotherapic treatment using a number of drugs such as albendazole, levamisole, mebendazole, piperazine, and pyrantel pamoate can be used for the treatment of ascariasis [4,9,10]. These medications can paralyze or kill intestinal parasitic worms. Albendazole is administered as a single dose of 400 mg orally where as mebendazole is given orally at the rate of 100 mg twice daily for three consecutive days. Both the drugs i.e. albendazole or mebendazole sare contraindicated in pregnant women. Pyrantel pamoate, being a safer drug, is recommended for pregnant patients. In cases of suspected Ascaris pneumonia (in pigs), injectable levamisole and ivermectin may be more convenient [13]. In severe cases such as blockage of the intestine caused by a large number of worms, endoscopy to remove the worms by surgery may be required to manage intestinal blockages or bowel obstruction. Currently, no vaccine is available for the prophylaxis of ascariasis [9,15,17].

Prevention and Control

Ascariasis is the most common intestinal worm infection, which occurs due to consumption of contaminated water, and raw vegetables contaminated with *Ascaris* eggs. It is found in association with low personal hygiene, and poor sanitation. The parasite is most common in warm, and humid climates. Hence, measures such as drinking of boiled water, avoiding contact with soil contaminated with human faeces, proper washing of hands with soap and warm water before handling the food, proper washing, peeling, or cooking of all raw vegetables and fruits before eating, particularly those that have been grown in the soil that has been fertilized with manure, will be helpful in preventing the infection. Moreover, implementing effective sewage disposal systems, avoiding open defecation, sanitary disposal of swine faeces, seasonal deworming of pigs, periodic treatment of pig shed with sodium hypochlorite, and health education of children about the source of infection, mode of transmission, nature of disease, and personal hygiene are some of the prevention strategies [4,9,10,13,17]. It is advised that periodic deworming of school going children and others living in endemic areas may prove useful in the prevention of disease.

Disease Status in Ethiopia

Ascariasis caused by *A. lumbricoides* is found among all segments of the Ethiopian society. It is the most commonly occurring parasitic illness infecting children as well as adults in Ethiopia, especially in the malaria-free highlands [18]. The most comprehensive study on ascariasis in Ethiopia was conducted between 1979-1982 involving over 32,000 persons with a high prevalence rate of 44% among the study participants, two-thirds of whom were children. The infection rates as high as 59% percent were calculated for some highland study sites above 2500 meters with low laying elevations (below 1000 meters) burdened to a much lesser degree (7.8%). Arid climates are unfavorable for the survival of the parasite's eggs. Re-infection after de-worming is also very common in Ethiopia.

A study in the late 1970's sought to show the link, if any, between ascariasis and malnutrition among Ethiopian children living in urban areas. It assumed a prevalence rate of about 10% in infants, 28% in children 1-2 years old, and 62% in children over 3 years [19]. Surprisingly, this double-blind study found no effect of Ascariasis on the nutritional status of children. The biotic contamination of the living environment particularly from improper disposal of human waste and integration of the lives of humans and animals in rural Ethiopia accounts for the epidemic nature of parasitic infection in the country. In addition, a study conducted in rural areas close to Lake Langano, Southeast Ethiopia reported a prevalence of 6.2% (17 out of 259) among school students [20]. Another study conducted on Southwest Ethiopia recorded a prevalence of 4.3% among the urban dwellers in the study area [21]. Moreover, a study conducted in Jimma town detected 37.3% *A. lumbricoides* ova from a soil sample, and an overall proportion of helminth ovas recovered was 41.5% [22].

Conclusion

Ascariasis is a widely prevalent helminthic disease, which is frequently reported from warm tropical and sub-tropical regions affecting children more commonly and seriously. Ingestion of Ascaris eggs due to contaminated food, water or soil can result in an infection. Disease is observed more commonly in poor socio-economic groups, which live unhygienic and unsanitary hygiene conditions. Since it is a highly prevalent helminthic infection in the developing countries, it is both important from health and economic perspective. Even though the infection has wide range of impacts on the health of hosts and economy, ascariasis still remains a neglected tropical disease. Moreover, the parasite's persistence and prevalence presents difficulties in controlling the worm itself and concurrent infectious diseases. Therefore, use of boiled drinking water, avoiding contact with soil that may be contaminated with human faeces and awareness creation,

especially of the children in schools on personal hygiene and sanitation of the environment will certainly help in reducing the prevalence of ascariasis. Moreover, further research on the prevalence, distribution and mechanism of infection is required in order to facilitate future initiatives in control and prevention.

References

1. Pal M and Anberber M (2014) Monograph on Microbiology of Drinking Water.1st Edition LAP Lambert Academic Publishers Saarbruchen Germany.
2. Ashbolt NJ (2004) Microbial contamination of drinking water and disease outcomes in developing countries. Toxicology 189: 229-238.
3. Dubey JP (2004) Toxoplasmosis-waterborne zoonosis. Veterinary Parasitology 126: 57-72.
4. Pal M (2007) Zoonoses. 2nd Edition Satyam Publishers Jaipur India.
5. Pal M and Boru BG (2010) Cyclospora cayetanensis: An emerging foodborne pathogen. Journal of Natural History 6: 9-11.
6. Pal M and Dutta JB (2013) Echinococcosis: An emerging and re-emerging cyclozoonosis of global significance. International Journal of Livestock Research 3:5-13.
7. Pal M, Tafese W, Tilahun G, Anberber M (2016) Cryptosporidiosis: An emerging food and waterborne protozoan disease of global significance. Beverage and Food World 43: 43-45.
8. Parija SC (1996) Textbook of Medical Parasitology. AIPD Madras India.
9. Pal M (2014) Parasitic Zoonoses. Ph.D. Lecture Notes, Addis Ababa University, College of Veterinary Medicine, Debre Zeit, Ethiopia 1-34.
10. Dutto M and Petrosillo N (2013) Hybrid Ascaris suum/ lumbricoides (Ascarididae) infestation in a pig handler. A rare cause of zoonotic ascariasis. Central European Journal of Public Health 21: 224-226.
11. Dold C and Holland CV (2011) Ascaris and ascariasis. Microbes and Infection 13: 632-637.
12. CDC (2013) Ascaris associated with pig farming-Maine 2010-2013. Morbidity and Mortality Weekly Report **62**: 413.
13. Soulsby EJL (2005) Helminths, Arthropods and Protozoa of Domesticated Animals.7th Edition Bailliere Tindall-An Imprint of Elsvier Elsvier Publications.
14. Zhou C, Li M, Yuan K, Deng S, Peng W (2012) Pig Ascaris: an important source of human ascariasis in China. Infection and Genetic Evolution 12: 1172-1177.
15. Urquhart GM, Armour J, Duncan JL, Dunn AM, Jennings FW (1995) Veterinary Parasitology. The disease Ascariasis 2nd ed Faculty of Veterinary Medicine University of Glasgow Scotland. Black Well Sc 67-69.
16. Anderson TJ (1995) Ascaris infections in humans from North America: Molecular evidence for cross infection. Parasitology 110: 215-219.
17. Martin E, William T, Harry V (2000) Zoonoses; Recognition, Control, and Prevention. Iowa State A Blackwell Publication Company Iowa State Ames USA.
18. Habtamu B and Helmut K (2006) Intestinal Parasitism. The Epidemiology and Ecology of Health and Disease in Ethiopia. Edited by Y. Berhane, D. Hailermariam and H. Kloss. Published by Shama Books Addis Ababa Ethiopia.
19. Freij L (1979) Ascariasis and malnutrition. A study in urban Ethiopian children. American Journal of Clinical Nutrition 32:1545-1553.
20. Mengistu L and Berhanu E (2004) Prevalence of intestinal parasites among schoolchildren in a rural area close to the southeast of Lake Langano, Ethiopia. Ethiopian Journal of Health Development 18:116-121.
21. Amare M, Solomon G, Tesfaye K (2005) Prevalence of intestinal parasitic infections among urban dwellers in southwest Ethiopia. Department of Pharmacology Faculty of Medical Sciences Jimma University Jimma and Addis Ababa university Addis Ababa Ethiopia.
22. Worku L and Solomon G (2005) Sanitary survey of residential areas using *Ascaris lumbricoides* ova as indicators of environmental hygiene in Jimma town. School of Environmental Health, Faculty of Public Health, Jimma University, Jimma and Addis Ababa University, Addis Ababa, Ethiopia.

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