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MINNA

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INAUGURAL LECTURE SERIES 14

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INTRODUCTION

Parasitic Diseases are among the important causes of morbidity and mortality world wide. Nearly 25% of world population are infected with parasites, with *Plasmodium* parasites accounting for about 300 million new clinical cases yearly (Bogitsh and Chang, 1998). Malaria alone accounts for 2 million deaths annually with majority of cases in Africa (WHO, 2003). The climate, cultural beliefs and practices, eating habit, poor sanitary conditions, poverty and ignorance combine to create optimum environment for infection and proliferation of parasitic diseases in Africa. There are about 370 species of parasites that infect man (Cox, 2002). A larger number of parasites infect domestic and wild animals. Parasites inflict injuries to their hosts by mechanical damage to the host tissue (Dracunculus), obstruction of gut passage *Ascaris lumbricoides*, the tape worms and some Trematodes). The hookworms are causes of major Intestinal blood loss. Generally, the Intestinal parasites are responsible for malnutrition by either interferring with food absorption (Giardia) or absorbing digested food materials from the intestine. They also inhibit normal peristalsis by blocking gut lumen which is important in food digestion or reduce absorptive gut surfaces. Malaria ranks the most important parasitic infection world wide. The other commonly encountered parasitic infections include Trypanosomiasis, Filariasis, Amoebiasis, Schistosomiasis, Hook worm infections, Ascariasis, Enterobiasis, Trichuiriasis, Giardiasis, Taeniasis, and Trichomoniasis. Apart from inflicting sickness and death on mankind, parasites make life miserable for man through poverty, sapping of energy, and animal protein. Loss of several man hours and absenteeism from school and work has greatly been attributed to parasitic infections. Animal Trypanosomiasis alone accounts for losses amounting to about 300 billion naira annually in Africa (ILRAD, 1990).

1.1 EVOLUTION OF PARASITES

Evolutionists believe the parasites evolved from other organisms. The creationists believe God ab initio created everything (good or bad). The evolution of parasitism is however less controversial. Parasites (whether through evolution or creation) initially lived as free living organisms. Contact with possible hosts and the development of preadaptation qualities eventually led to the establishment of parasites in or on the host. Parasitism as a way of life evolved with the objective of acquiring metabolic dependence, development stimuli, nutritional materials, digestive enzymes, and control of maturation (Smyth, 1976). Co evolution leads to extensive local adaptation. Parasites in a particular area infect hosts from the same area more efficiently than they infect hosts from another geographically distinct population.

Contact between the parasites that were created free and their would-be hosts was very crucial in the adaptation of parasites to their hosts. Preadaption features and contact with hosts lead to the development of hosts' specificity. There are parasites that are adapted to plants, man, vertebrate invertebrate and animals. Movement of man from place to place has led to the acquisition of new species of parasites by man either from animals or from the different soil environments. The evolutionary process did not end with host selection but also involved organ or tissue specificity. The selection of which organ or tissue to be colonized by parasites had to do largely with intrinsic and extrinsic factors. Parasite intrinsic factors are largely preadaption features such as metabolic adaptation, development of suckers, spines, loss of digestive system, hermaphroditism, production of large numbers of offspring within a short time, and developmental stages. Developments of mode of transmission, utilization of intermediate hosts are all aspects of adaptation.

The extrinsic factors involve physiological conditions of the host internal and external environment which may or may not be suitable for the survival of the parasite. The evolutionary process of animal parasitism which might have taken several thousand years of trial and error in the selection of host and tissue or organ has finally resulted in parasites being classified according to their habitats viz: intestinal parasites, tissue, parasites, blood parasites etc. The evolutionary process has also led to parasites being classified as those having direct life cycle and those having indirect life cycle. Parasites with direct life cycle can complete their development in one host while those with indirect life cycle require at least 2 hosts to complete their life cycle. Ectoparasites are those that live on the external surfaces of their hosts e.g. insects, body lice and ticks. Endo parasites are those that live inside the host. These are the majority of parasites. They include, *Ascaris lumbricoides*, (Fig. 1) Hook worms, *Enterobius*, Malaria parasites, Trypanosomes, Leishmania, Filarial worms, Amoebae, Schistosomes, *Toxoplasma,* the Tape worms (Fig. 2), *Fasciola* etc.

Fig. 1. Adult Ascaris lumbricoides

Fig. 2. *Tape Worm*

1.2 Transmission of Parasitic Infections

Parasitic infections can be transmitted by man to man or from animals to man through several ways.

1. **Oral route.** Intestinal parasites such as *Ascaris lumbricoides, Trichuris trichiura, Enterobius vermicularis, Taenia solium, Taenia saginata, Dracunnculus medinensis, Diphyllobotrium latum, Echinococcus granulosus, Entamoeba histolytica, Toxoplasma, Fascliola hepatica, Trichinella, coccidian (including Cryptospridium)* are some of the parasites transmitted through the oral route.

2. **Per cutis:** The infective stages of the parasites (cercariae, filariform larvae) pierce the skin of victims who walk with bare foot or swim in infected water bodies. This includes parasites such as *Necator americanus, Ancylostoma duodenale, Schistosoma mansoni, Schistosoma haematobium* and other schistosomes.

3. **Insect vectors**: Insects can serve both as intermediate hosts and vectors of human parasites. The infective stages of the parasites develop in the insects, migrate to the mouth parts and are inoculated into the susceptible human host through insect bites during blood meals. Such parasites include malaria parasites (through Anopheles mosquitoes), African Trypanosomes through the *Glossina* flies), *Onchocerca volvulus* (*Simulium damnosum* complex, *Loa Loa* (Tabanid flies),

Wuchereria *bancrofti* (through culex, Aedes mosquitoes), *Leishmania* parasites (sand flies) *Trypanosoma cruzi* (Triatomine bugs)

4. **Through sexual intercourse**: *Trichomonas vaginalis* (in humans) and *Trypanosoma equiperdum* (in horses).

1.3 Sources of Parasitic infections

(i) Food: Uncooked or improperly cooked meat, rats, crayfish, fish, crab. The parasites include *Taenia solium, Taenia saginata, Diphyllobotrium latum, Clonorchis sinensis, Trichinella spiralis, Toxoplasma gondii.*

(ii) Contaminated Vegetables or fruits. These include parasites such as *Entamoeba histolytica, Fasciola hepatica, Fasciola gigantica, Fasciolopsis buski.*

(iii) Soil: These are soil transmitted parasites. They include Hook worms, *Trichuris trichiura, Strongyloides stercoralis, Toxocara cati, Toxocara canis, Ancylostoma braziliense, Ascaris lumbricoides.*

(iv) Water: *Dracunculus medinensis, Cryptosporidium sp, Giardia lamblia, Entamoeba histolytica, Schistosoma mansoni, S. haematobium, S. Japonicum.*

(v) Insect Vectors: *Plasmodium sp, Trypanosomes, Onchocerca volvulus, Loaloa, Wuchereria bancrofti, Leishmania sp, Babesia, Theileria, Erlichia, Hymenolepis diminuta.*

(vi) Human directly: *Trichomonas vaginalis, Enterobius vermicularis, Strongyloides stercoralis.*

(vii) Domestic Animals: *Hymenolepis nana, Echinococcus granulosus, Toxocara canis, Toxocara cati, Ancylostoma braziliense,*

1.4 Incidence of Major Helminthic Infections

1.	Schistosomiasis	-	200 million people infected globally. (170 million people infected in Africa)
2.	Hook worm	-	700 800 million people (200 million people in Africa)
3.	Trichuris	-	700 800 million people (200 million people in Africa)
4.	Ascaris	-	1.2 billion people
5.	River Blindness	-	17.7 million people (99% cases in Africa)

Parasitic infections abound world wide. Tropical and sub tropical countries suffer the greatest burden of parasitic infections. The environment, the climate and the social behaviour and economic poverty make developing countries more susceptible to parasitic infections compared to developed countries. In developing countries the following predisposing conditions to parasitic infections abound: Inadequate water supply and sanitation, crowded living conditions, lack of access to health care, low level of Education, poor personal hygiene, poor environment / lack of toilet facilities.

Soil transmitted helminthes *(Ascaris lumbricoides, Necator americanus, Ancylostomia duodenale, Strongyloides stercoralis)* and *Schistosoma mansoni* depend on egg contaminated environment for transmission. For intestinal helminths (i.e. STHs) the life span is between 1 and 4 years. Under favourable conditions (warm, moist, shaded environment) the eggs can remain viable for some years. Reinfection rates remain high until the adult worms are removed by chemotherapy. Soil transmitted helminth infections are generally higher in school age children (6 15 years) although that of *A. lumbricoides* and *T. trichiura* may peak before the age of 5 years. Prevalence of *Ascaris lubricoides* and Hook worms may remain high even in adult populations. Agricultural workers (who walk bare foot) are predisposed to Hook worm infections. Worm burden is also higher in children than adults probably due to Reinfection from the environment. Prevalence is generally the same between male and female children within the preschool and early school age children (18 years) (Galadima and Olatunde 1987). Soil transmitted helminthic infections are very prevalent in Nigeria.

Soil transmitted helminthes have indirect life cycle. The parasites do not require intermediate hosts to complete their life cycles. *Ascaris lumbricoides*, *Trichuris trichiura*, require a suitable environment for their eggs that have been voided with faeces to hatch into the larval stages which later develop to become infective. The infective eggs are taken through the month where the larvae are released to undergo migration and further development in the body until they finally reach their adult stages in the small intestine (see Fig.3 and 4).

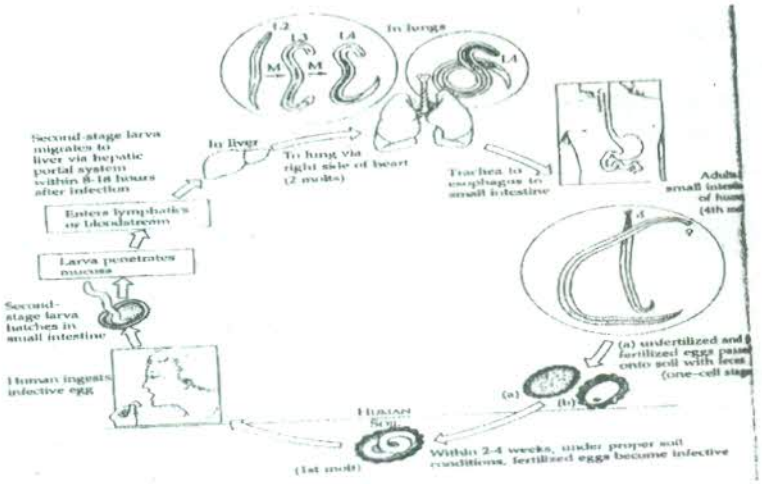

Fig. 3. Life Cycle of Ascaris lumbricoides (Adopted from Bogitsh and Chang 1998)

The eggs of Hook worms and *Strongyloides* hatch into the larval stages which become infective at L3 (Fig. 5). These larvae penetrate the skin and are carried by blood circulation until they develop into full adult forms in the small intestine (Okpala 1956, Nwosu 1981; Oyerinde, 1982; Azikiwe, 1984; Galadima *et al.*, 1989a; Galadima *et al.*, 1989b,)

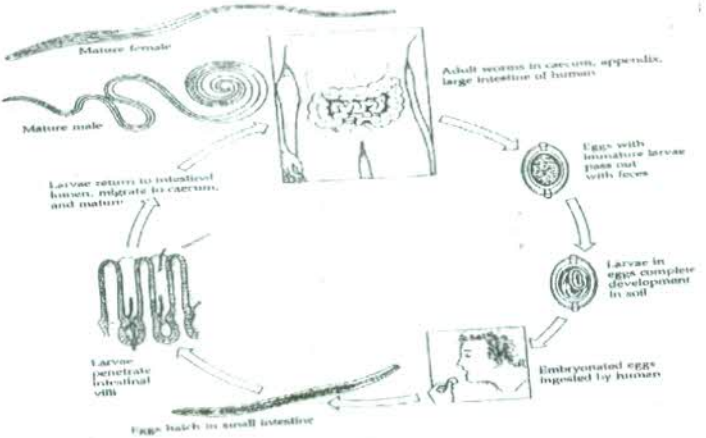

Fig. 4. Life Cycle of Trichuris trichiura. (Adopted from Bogitsh and Chang 1998)