



EMERGING INFECTIOUS DISEASES BY PARASITES: A REVIEW TILL 2019

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ABSTRACT

This paper describes the various findings and literature written by different authors to know about the dangerous parasites prevailing in our society, which cause harmful infections to human race. It even constitutes of many techniques used to detect parasitic infections in various animals at various places. My approach is all about studying of these dreadful parasites and certain precautions to be taken to prevent such infections which turn out into chronic diseases that are very difficult to control, so precautions must be taken beforehand to prevent such diseases.

KEYWORDS: Parasites, infectious diseases, human health.

INTRODUCTION

A **parasite** is an organism which is completely dependent on its host for completing its life cycle and metabolic requirements.^[1] Without a host, a parasite cannot live, grow, and multiply. For this reason, it rarely kills the host, but it can spread diseases, and some of these can be fatal. They are smaller than their host and they reproduce at a faster rate. On the basis of location parasites can be categorised into two types: Endoparasite and Ectoparasite.

Ectoparasites: These are those parasites which live on the surface of the body such as skin or hair. For example- *Pediculus humanus*, the human louse. The infection by these parasites is known as infestation. They act as vectors, transmitting pathogenic microorganisms.

Endoparasites: These are parasites which live inside the body of the host, in the tissues, body cavities, digestive tract, and other organs. All protozoans and helminthic parasites are endoparasites. The invasion of these parasites is referred to as infection. These are further subdivided into 5 types.

1. **OBLIGATE PARASITES:** Organisms that cannot survive without a host. (e.g.- *Toxoplasma gondii*)
2. **FACULTATIVE PARASITES:** Organisms which under a particular circumstance may either behave like a parasite or a free-living organism. (e.g.- *Balamuthia mandrillaris*)
3. **ACCIDENTAL PARASITES:** These are those organisms which attack an unusual host. (e.g.- *Echinococcus granulosus* in man)

4. **ABERRANT PARASITES:** Organisms which attack a host where they cannot live or develop further. (e.g.- *Toxocara canis* in man)
5. **FREE-LIVING PARASITES:** These refer to the non-parasitic stages which live independent of their host. (e.g.- Hookworms have free-living stage in soil)

A **host** is an organism which harbours the parasite by providing shelter and nourishment to it. It is of following types: -

1. **DEFINITIVE HOST-** It is the host which harbours the sexual phase of a life cycle. When the most highly developed form is not obvious, the definitive host is the mammalian host.
2. **INTERMEDIATE HOST-** It is the type of host which alternates with the definitive host and harbours the asexual phase of lifecycle. They are even called as first and second intermediate hosts respectively.
3. **PARATENIC HOST-** This is the host in which the larval stages of parasite survive but does not develop further. It may not be a necessary part of a life cycle.
4. **RESERVOIR HOST-** It is the host that acts as a reservoir for parasites in transmitting infections.
5. **COMPROMISED HOST-** It is the host in whom normal defence mechanisms are impaired. Such hosts are extremely susceptible to a variety of pathogens.

A **vector** is referred to as an insect that transmits an infection from one human host to another. It is of two types: -

Mechanical Vector- It is a vector which assists in transfer of pathogens between hosts but is not essential in the life cycle of the parasite.

For example- a housefly that carries parasite cyst and eggs.

Biological Vector- It is a vector in which pathogens undergo developmental changes with or without multiplication. It is of three types: -

- *Propagative vector*
- *Cyclo-propagative vector*
- *Cyclo-developmental vector*

Taxonomic Categories: Protozoa are free-living microscopic parasitic organisms which are capable of multiplying in humans which cause their survival and they cause serious infections to develop from just a single organism.² Transmission of these protozoa parasites occur by fecal-oral route or by an arthropod vector (for example, through the bite of a mosquito or sand fly).

The protozoa that are infectious to humans can be classified into four groups based on their mode of movement:

- Sarcodina – the amoeba, e.g.-*Entamoeba histolytica*
- Mastigophora – the flagellates, e.g.-*Giardia*, *Leishmania*
- Ciliophora – the ciliates, e.g.-*Balantidium*
- Sporozoa – organisms who have non-motile adult e.g.-*Plasmodium*, *Cryptosporidium*

Helminths are multicellular organisms that are large and can be visible to naked eye in their adult stages. They can be free living or parasitic in nature. Helminths cannot multiply in humans at their adult forms.

There are three main groups of helminths

- Thorny-headed worms – the adult forms of these worms reside in the gastrointestinal tract.
- Flatworms (platyhelminths) – these include the trematodes (flukes) and cestodes (tapeworms).
- Roundworms (nematodes) – the adult forms of these worms can reside in the gastrointestinal tract, blood, lymphatic system or subcutaneous tissues. Parasitic infections cause tremendous increase of diseases in both tropics and sub-tropics as well as in temperate climates. Out of all the parasitic infectious diseases, malaria causes most deaths globally approximately 6,60,000 people per year, most of which are young children.

The Neglected Tropical Diseases (NTDs), which suffered from a lack of attention by the public health community, include parasitic diseases such as onchocerciasis, lymphatic filariasis, and Guinea worm diseases. The NTDs affect 1 billion people-one sixth of the world's population-largely in low income countries of rural areas. These diseases include lost ability to

attend work or college, retardation of growth in children, impairment cognitive skills and economic burden placed on entire countries. A parasite species has an aggregated distribution across host individuals which mean host harbours few parasites, whereas a few hosts carry a large majority of parasite individuals. Modern day quantitative parasitology is based on more advanced biostatistical methods. In vertebrates, it is said that male parasites carry more load as compared to female parasites due to which there is difference in their diet, choice, body size. Often males have more habitat ranges and are likely to reside in parasite-dense areas than female. The larger sex is thought to have higher parasite load whenever sexual dimorphism is exhibited. This parasite load is linked with variation of insects' genesis and colony. Colonies with high genetic variation such as Hymenoptera (wasps, ants, bees) were exposed to parasites and these experienced lesser parasitic load as compared to more genetically similar colonies.^[3] (Wikipedia,2018). The abundance of parasites is said to be as total number of parasites recovered upon total number of hosts examined.^[4] (Mofasshalin et.al., 2012). Parasite achieve greater abundance on their principle host species and less abundances on auxiliary host species.^[5] Parasites are transmitted to humans through contaminated food and water. Here these estimates represent impact of foodborne diseases globally and regionally given by WHO. The disease burden is highly focal and result in mortality.^[6] Emerging and re-emerging parasitic infections can be brought about by many factors such as global warming and climate change, population mobility, trade and food supply, changes in biodiversity, immune suppressed host, farming practices, increase in host density and excessive use of drugs leading to drug resistance. The parasitic infections have numerous possible origins and the impose threat to animal as well as human health. There is need to detect the factors that predispose infections or disease.^[7]

Recent evidences show that climatic change is altering the spread of parasitic infections. This poses direct or indirect threat to humans, directly these parasites have the ability to infect greater amount of people by emergence or re-emergence and indirectly development of communities may slow due to spread of infection to livestock and crops which can hinder the economic growth. It is not necessary that due to parasitic infections the mortality rate would be high, but it can be very devastating preventing economic growth and causing diseases among poor people. The areas of the world still being affected by climatic changes are the ones which are still developing and the ones developed are less prone to such infections as they can afford to have proper vaccines against certain infections. So, it is thereby said that we should start preparing for changes which are about to come as planning for certain methods to eradicate parasitic diseases on global scale.^[8] Emerging Infectious Diseases (EID) are referred to as diseases that have newly appeared or they may have existed in the past and are increasing rapidly in geographical range and

frequency. United State Institution of Medicine has defined EIDs as those infections that have been increasing in past few decades or may increase in mere future. Zoonotic parasites are the parasites which have the potential to infect both human and animal health. Example of zoonosis is **Echinococcosis**, it is the infection caused by adult *Echinococcus granulosus* in dog and is very harmful. Whereas in humans Echinococcosis is caused by metacestode larva of *Echinococcus granulosus* known as hydatid cyst and can be said as Hydatidosis in humans.

Significance of parasitic infections is that these diseases cause economic loss and can even cause diseases to both humans and animals, it possesses challenges to government to control these infections so to stop losing animals and humans by such diseases.

There are many types of emerging and re-emerging parasitic infections that have been studied and recorded from all parts of the world which may be of different origins such as helminths, protozoans or entomologically or vector borne. According to a study in Nigeria certain parasites attain a high rank in causing diseases which are Cryptosporidiosis, Malaria, Lyme disease and Yellow fever.

There are three types of Emerging and Re-emerging parasitic diseases

1. Helminth Emerging and Re-emerging Parasitic Diseases: This group of EIDs include *Echinococcus species*, *Schistosoma*, *Gnathostoma species*, *Spirometra species*, *Onchocerca species*, *Ophisthorchis species*, *Clonorchis species*, *Dirofilaria immitis*, *Aelurostrongylus abstrusus*, *Angiostrongylus vasorum*, *Angiostrongylus cantonensis*, *Baylisascaris cantonensis*. *Taenia species*.
2. Protozoan Emerging and Re-emerging Parasitic Diseases: These types of parasites are common and include *Trypanosoma cruzi*, *Giardia*, *Toxoplasma gondii*, *Leishmania*, *Coccidiosis*, *Cryptosporidium parvuum*, *Lyme disease*, *Malaria*, *Sarcocystis*, *Plasmodium knowlesi*. It is said that due to ecological disturbances these parasites contribute greatly to the emergence of certain zoonotic diseases such as Malaria, Leishmaniasis, Giardiasis, Filariasis and Onchocercariasis. Every environmental change contributes to changes in ecological balance. The waterborne parasites transmitted by contaminated food are *Giardia*, *Cryptosporidium* and *Cyclospora*.
3. Vector Borne Emerging and Re-Emerging Parasitic Diseases: This class of diseases include *Tick paralysis*, *Tick toxicosis*, *Sarcoptes scabiei*, *Lyme borreliosis disease*, *Yellow fever*, *Plague*, *Dengue* and *Chikungunya*. *Lyme disease* is caused by *Borrelia burgdorferi* which is transmitted by black legged tick among animals. Cases of *Lyme disease* can be treated with antibiotics. *Aedes* mosquito acts

as a vector for transmission of chikungunya. Male and Female fleas are a vector for plague.

There are numerous causes of emerging and re-emerging parasitic infections because of which these infections are on a hike. The main causes are: -

1. Climate Change- Due to recent climate change across the world the habitat of parasites are altered due to which many diseases are caused such as there is spread of parasites in areas where it is too cold to harbour certain parasites and to complete their life cycle.^[9] The parasites which have adopted to this new environment and started living there are said to be as, **emerging parasites**. This alteration of climate causes redistribution of infections to certain areas where it was not prevailing before. The climatic changes may lead to colder or warmer climate, due to this alteration in the climate it leads to changes in both biotic and abiotic factors which in turn change the physiological behaviour of parasites vectors themselves or parasites with its hosts in the environment. The multiplication, development and spread of many parasitic infections are due to increase in rate of global warming, rise in the temperature is an advantage to parasites but is a mere disadvantage to the host, this is because free-living parasites and developmental stages of parasites multiply faster at higher optimum temperature as compared to lower temperatures.
2. Changes in biodiversity- Another factor that includes in the emergence and re-emergence of parasites are changes in both flora and fauna because of which many parasites emerge. Different parasites behave differently to different drug strains because of which certain species of *Plasmodium* do not react to a particular drug strain made for one species of *Plasmodium* leading to increase and spread of Malaria rapidly. Parasites have developed certain evasion strategies to overcome drug strains and for survival in harsh environmental conditions.
3. Mass movement of population- Movement of people in a group from one location and then regrouping into another location forming refugee camps during wars or natural disasters such as tsunami, earthquakes, floods or droughts lead to overpopulation which causes breeding ground for a certain group of parasites causing new diseases to occur as in such areas there would be poor sanitation and malnutrition which may lead to high rates of diseases. With migration of host from one place to another these parasites also travel inside their body and then can be transmitted to another host into new area. This mass mobility can be nationally or internationally and here the host act as disease causing organism.
4. Animal Mobility- Animals are organisms which need to move from one place to another in search of food, water or shelter, during droughts or floods. The mobility of animals results in transmission of parasites or can themselves be affected by diseases

from another animal or from an infected place.^[10] In ancient time during war, cattle were transported into safe areas where they harbour certain parasites from faeces of infected animals with gastrointestinal nematodes and then these parasites resided in their intestine and because of presence of certain enzymes they were able to persist in the new environment, which caused emergence of parasites to new environment.

5. Trade and Food Supply- Due to various transport means commerce is much simplified now a days, which results in increased transport of animals and food products to areas where its demand was very high. The movement of goods and drivers act as medium for transporting various parasites to new regions.
6. Cultural and Social Factors- Certain under cooked pork or rare cooked pork causes infective larva of parasites to transfer and cause infectious diseases. Methods of processing various foods depends on cultural beliefs and habits of people. Cooking at high temperature can kill certain larval forms of parasites because consumers take food which is uncooked so it consists of certain parasites and get infected.
7. Trade of Infected Animals- The sale and trade of infected animals across the world include various climatic factors favourable for parasite infections to spread. This increases the need of animals being imported to be checked before importing to different farms or different countries.
8. Habitat Reduction- Any changes occurring as a natural phenomenon would change the ecological balance and context with which parasites and their vectors breed and diseases are transmitted. The abundance, biodiversity, human biting behaviour is affected by the changes occurring by the ecological stability disruption.
9. Immunosuppressed Hosts- A immunosuppressed host is the kind of host whose immune system is suppressed increasing the risk of emerging infectious diseases.^[11]
10. Density of Host-The factor that can modulate the increase of parasitic infections is High host concentration per unit area of the habitat. The space occupied by industrialisation and other developmental projects is the one which was once available for hosts, so with increase in density of host there could be seen emergence of parasites.
11. Improper use of Drugs- The overuse of drugs has led to widespread resistance in parasitic organisms, making it more difficult to control diseases.

CONCLUSION

The comprehensive study of emerging and re-emerging parasitic infections is necessary to understand the present-day prevalence of parasites so as to make vaccines against them by specifically targeting the part of the life cycle of different parasites so as to stop them from completing their life span and causing infectious

parasitic diseases. The study aims to form certain control measures to target certain infections which need to be eradicated from the society so as to live a healthy lifestyle. Various scientists have described various methods to detect the presence of parasitic infections in their own ways. The various techniques used by researchers to find out various emerging infections are special techniques such as- Biometric analysis, Kato-Katz technique, Coprology, Necropsy, BAL technique, Histopathological studies, Non-Linear Least Square method, and various microscopic methods.

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