

PARASITES – HIDDEN HORRORS IN OUR MIDST

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Parasites have a huge impact on the health and economy of the world. They are organisms which live in or on another organism (the host), for their own benefit and to the detriment of the host. Infection with a parasite commonly means that the host organism incurs nutritional or fitness costs that commonly present as chronic disease and may even lead to death.

Parasites come in many distinct forms, but are either, microscopic single celled organisms called protists (for example *Giardia*, a common cause of Delhi-Belly), or more complex, multicellular animals such as arthropods (fleas, lice, mites and ticks) and worms (flatworms and roundworms). Most of the arthropod parasites live outside their host and are called ectoparasites whereas the protists and the worms are mostly endoparasites and live inside their hosts - here we take a brief look at the endoparasites.

Parasites of humans account for much of the tropical disease burden and continue to wreak havoc on human health in the tropics. Amongst the protists, *Plasmodium* species are the most infamous as the causative agents of malaria. According to the World Health Organisation (WHO), half of the World's population live at risk of malaria infection and almost 655,000 people died from malaria in 2010, most of them children under the age of five. By the time you have finished reading this article at least 10 children will have died from this preventable disease. A major problem in the fight against malaria is drug resistance and an effective malaria vaccine remains a very high priority for researchers in this area.

Many of the other human diseases caused by parasites are designated neglected tropical diseases (NTDs). NTDs are pervasive amongst the poorest and most

under-privileged people on the planet, locking them in a cycle of disability and poverty. These impoverished populations commonly reside in remote, rural locations or urban slums and lack both financial power and a political voice. These facts serve to ensure these diseases retain low health priority status. The low health priority status of NTDs contrasts markedly with their impact – they infect in excess of 1 billion people and each year many are killed or disabled by these diseases; children are most at risk. We should reflect on the fact that infection with many NTDs is caused by unclean water and poor sanitation and most are easily preventable and/or treatable if adequate education and medical facilities were available; it seems unimaginable that so many men, women and children endure this burden needlessly.

In terms of sheer numbers, the roundworms are most impressive, accounting for an estimated 4 of every 5 animals on the planet! Fortunately, most are free-living and pose no threat to our welfare. Of the parasitic roundworms, *Ascaris lumbricoides* is most common, residing in the intestines of an estimated 1 billion people causing the disease Ascariasis in which small worm numbers cause no obvious symptoms and large worm numbers can induce a variety of symptoms such as inflammation, peritonitis, pneumonia, nutritional deficiency and intestinal blockage. Its success stems from the resilience of its microscopic eggs which pass in the faeces and remain infectious for many years. *Onchocerca volvulus* is a distinct roundworm that causes River Blindness, a disease infecting 37 million people and spread by the blood feeding Blackfly; some larval stages swim around the body and end up in the eye where they are the most common cause of infectious blindness after trachoma. Another group of parasitic roundworms which are spread by the mos-

quito causes a grossly disfiguring disease called lymphatic filariasis, the second most common cause of disability worldwide after head trauma.

Parasite infection can occur locally. For example, *Toxocara canis* is an intestinal parasite of dogs. Although rare, if infective eggs are consumed by humans, the invading larvae can wander to the eye and cause blindness. The eggs in fresh dog faeces do not present a risk as it takes three weeks for the larvae within the egg to become infective. However, the eggs can remain hazardous within the soil. Responsible dog owners should 'worm' their dogs regularly to prevent infection, as should the owners of all companion animals as non-treatment can be an animal welfare issue.

The most important flatworm parasite of humans is the blood fluke which causes schistosomiasis, a chronic, debilitating infection that can last for decades. Some 207 million people in tropical/subtropical regions suffer from the disease having become infected when they entered fresh water and a unseen larvae penetrated their skin. Visitors to endemic regions can be infected when they simply scoop fresh water in their hands from a contaminated region. As with many of these parasite diseases, the control of schistosomiasis relies on one drug (praziquantel); clearly dependence on one drug is a huge risk since development of a drug resistant parasite would have dire consequences for its control.

Unlike parasite infections of humans which are disproportionately high in the developing world, parasite impacts on agriculture are global. For example, yearly losses due to liver fluke (one of numerous different worms that can infect livestock) alone are in excess of \$US3.2 billion. Figures from indicate that up to 20% of sheep and 30% of cattle harbour infection and it is the most common worm parasite seen at abattoirs in . Particularly worrying are accumulating reports of drug resistance and predictions of a liver fluke epidemic in parts the UK and Ireland by 2020.

Roundworm parasite destruction of plants causes a 12% loss in crop production, with conservative estimates indicating financial losses in excess of \$US125 billion. Many of the chemicals used to control these plant parasites are toxic and

consequently have been banned or are being phased out. However, control options are lacking such that new strategies are needed urgently to control these plant pathogens and so diminish the risk they pose to food supply.

A key concern for parasite borne diseases centres on global climate change, with the possibility that some of these parasite diseases will spread to new regions. For example, the protistan disease Leishmaniasis is spread by a sandfly vector. Whilst increasing international travel is facilitating higher incidences of the disease, some outbreaks in the have been linked to climate change. *Haemonchus contortus*, the most pathogenic roundworm parasite of sheep is common in warmer climates but is now increasing in prevalence in Ireland and in the UK. Since climate change is hard to predict, as are the responses of parasites and vectors to it, the need for horizon scanning for new and emerging infectious diseases and threats to our food supply and health is obvious.

Although the impacts of parasites on man are overwhelmingly negative, in some scenarios parasites can be beneficial. The controlled infection of individuals with parasitic worms can alter immune system dynamics and so ameliorate the impact of various immunological or autoimmune disorders. For example, some species of nematode worms have been used to treat diseases such as Crohn's disease, irritable bowel syndrome and ulcerative colitis. Current theory behind the beneficial effects revolves around the ability of worms to dampen immune system activity and so moderate host efforts to expel the parasite invader. It is interesting to note here that the diminution of human parasite infections in the developed world coincides with the increasing prevalence of immunological /autoimmune disorders.

Parasites are remarkable animals. They can endure complex and torturous life cycles, manipulate the behaviour of their host, evade the host immune system, genetically modify host cells to their own advantage and resist control by chemotherapy and vaccines. As our immune systems endeavour to battle these invaders and scientists strive for their control and eradication, we can only marvel at their success, remarkable resilience and unique biology.

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