

The hidden costs of cats in Australia: Cat-dependent diseases and human health

In brief

There are several cat-dependent diseases in Australia that can be passed to humans, including toxoplasmosis, toxocariasis and cat scratch disease. The health impacts of these diseases range from very mild to very severe, and cost the Australian economy \$6 billion a year in medical and other direct costs, and lost income.

These diseases are caused by pathogens that were introduced to Australia by cats, and that depend on cats for part of their life cycle. Human infection rates could be lowered by: reducing the number of feral cats living in towns and cities; keeping pet cats securely contained indoors or in a cat run; reducing transmission rates via food and from the environment with hygiene practices; and/or encouraging people not to keep pet cats.

Background

Cats were introduced to Australia in 1788. They now cover the entire Australian mainland except for fenced areas built to exclude cats, and are present on most larger islands. About 2.1 million feral cats live in natural environments in Australia. Over 0.7 million feral cats live in our towns and cities, and there are approximately 3.8 million pet cats in Australia. The numbers of both feral and pet cats in our

towns and cities are increasing as the human population grows and residential areas expand.

The majority of pet cats (71%) are allowed to roam outside, where they are exposed to a range of pathogens that can cause disease in people as well as in the cats themselves. Some of these pathogens depend on cats for part of their life cycle, and would not exist in Australia if cats hadn't been introduced here.

There are approximately 3.8 million pet cats in Australia. Of these, 71% are allowed to roam outside where they may contract diseases that they can pass to humans. Image: Zane Lea, Unsplash



Cat-dependent diseases that affect people in Australia (continued)

Toxoplasma gondii

Cats are the primary host for *Toxoplasma gondii*. The parasite sexually reproduces in the cat gut, releasing a large number of oocysts (an egg-type life stage) in faeces, over a period of 1–2 weeks. Under favourable conditions, these oocysts can remain viable in the environment for at least 18 months. When secondary hosts ingest the oocysts, the parasite replicates asexually, migrating through the host's body, and eventually encysting in body tissue. The parasite's life cycle is completed when the secondary host is eaten by a cat.

People become infected by eating parasite cysts in raw or undercooked meat, or by ingesting the parasite's oocysts. Oocysts can be common in garden soil, children's sandpits and kitty litter, and transferred from people's hands to their mouths accidentally.

People can also become infected through contaminated water or unwashed vegetables, and less commonly, by inhaling contaminated dust. The parasite replicates rapidly and migrates through the human body, eventually enclosing in a cyst, often in the brain, where it remains indefinitely as a latent infection (Figure 1).

T. gondii infection can affect people in a range of ways. Many cases are asymptomatic, while others are accompanied by flu-like symptoms that are easily misdiagnosed. In some cases, brain or eye tissues may be damaged and, in immunocompromised people, infections can damage the heart and nervous system, and may be fatal.

Infections are potentially very serious in women who contract the infection for the first time during pregnancy.

The infection can be transmitted to the unborn baby, potentially causing miscarriage or life-long congenital defects. Infected babies may also be born without obvious symptoms, but experience vision, hearing and development difficulties later in life.

T. gondii infections may change the chemistry of the brain: latent infection is associated with long-term behavioural shifts such as decreased conscientiousness, riskier behaviour and slower reaction times. *T. gondii* infections are associated with higher incidence of mental health issues, including depression, bipolar disorder, schizophrenia, poor cognitive function and suicidal behaviour.

The parasite is very common: worldwide, around 30% of people are infected. In Australia, estimates for infection rates range between 23 and 66% of the population.

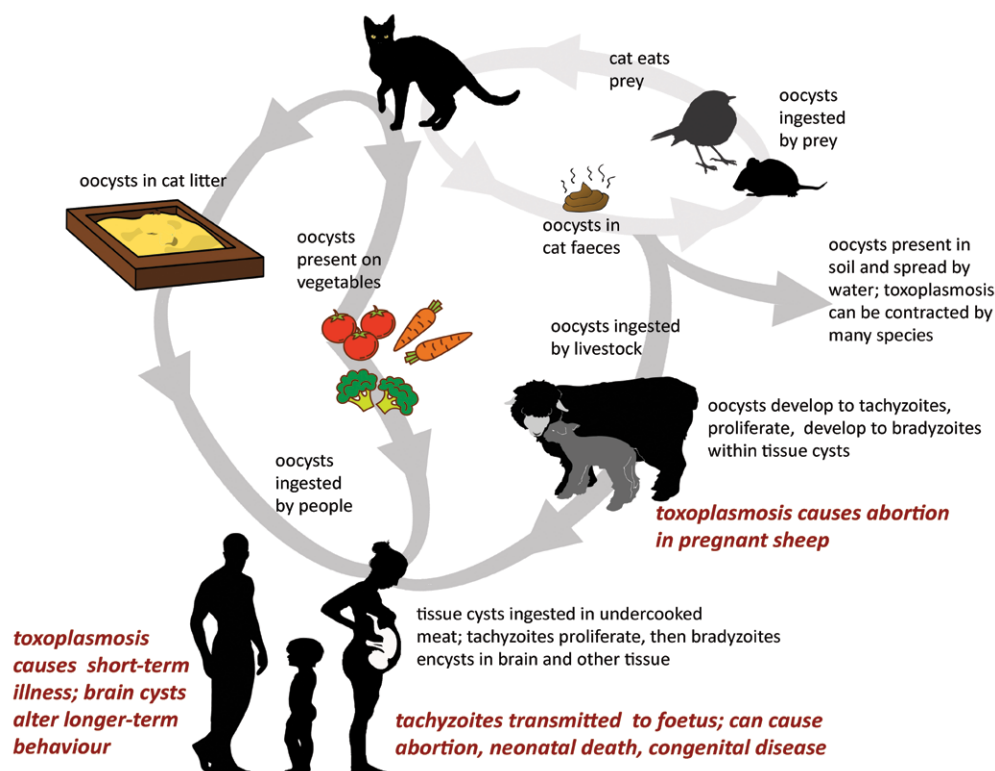
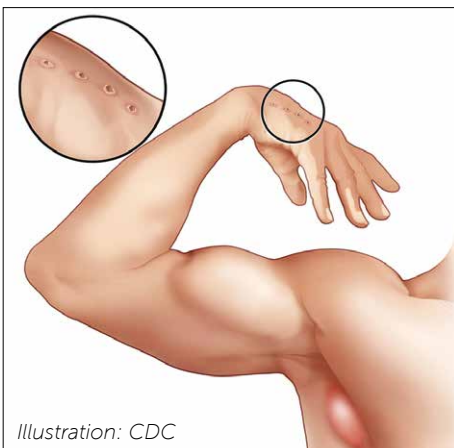


Figure 1: Life cycle of *Toxoplasma gondii*.

Bartonella henselae

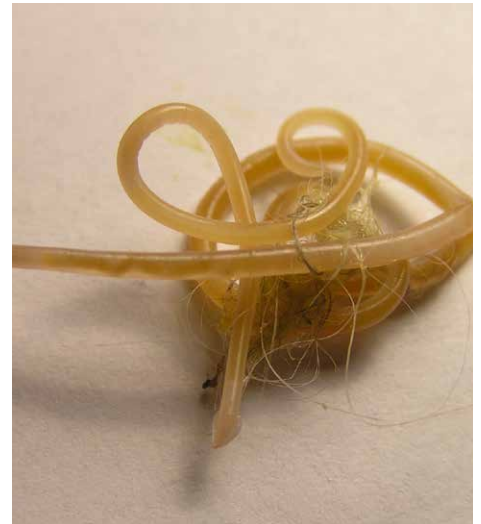
Bartonella henselae is a bacterium that lives in infected cats' blood cells. People who are bitten or scratched by infected cats can develop cat scratch disease, also known as cat scratch fever. The symptoms range from small sores, to mild fevers, aches and swollen glands (below), and last for approximately one month. Immunocompromised people may experience more serious symptoms, including swelling in the brain, severe muscle pain and skin lesions.



Cat-scratch disease causes mild infection at the bite or scratch site and can enlarge lymph nodes.

Toxocara cati

In infected cats, adult female roundworms (right) produce eggs that are released in cats' faeces. The eggs develop over a two-month period into larvae with a resistant shell. The larvae remain viable and infective for years. Humans become infected by incidentally ingesting the larvae. Most infections are asymptomatic, but the migration of the cat roundworm larvae through the body can cause tissue damage and inflammation, which can be serious when it occurs in eye, central nervous system or heart tissue.



Toxocara cati (Photo: Beentree/Wikimedia Commons, CC BY SA 4.0).



Keep your cat indoors. Image: Kari Shea, Unsplash

The impact of cat-dependent diseases on people in Australia

What we did

The health impacts of these three cat-dependent diseases have been described across a very large number of studies internationally, and there are estimates for the economic costs of some aspects of these diseases from some countries. Our study is the first to quantify the impacts and costs to humans of cat-dependent disease in Australia.

We collated information on the incidence of these cat-dependent diseases in humans, their medical

effects, and their associated costs, including direct medical costs, costs of ongoing medical or other care, and the cost of lost income to the infected person (and carers, when applicable).

We used Australian data on disease and infection rates where available, supplemented by data from other countries if Australian data were lacking. We used medical cost information from compilations of Australian hospital data; we used the lifelong costs of intellectual disability care summarised in a

recent Australian study; and we estimated lost income using information from the Australian Bureau of Statistics on the average wage and the proportion of working age people that are in employment.

How many people are affected?

Toxoplasma gondii

We looked at three types of outcomes from *T. gondii* infections – acute illness, congenital impacts on unborn babies, and behaviour and mental health impacts.

The impact of cat-dependent diseases on people in Australia (continued)

Acute illness: based on the prevalence of the pathogen in the Australian population, and the rates at which infections cause illnesses of varying severity (from very large studies in the US), we estimated that there are 127,500 new infections in Australia annually, of which 12,100 cause illness. In about 650 cases, the illness requires hospitalisation, and almost 50 of these cases are fatal.

Congenital infection: in Australia, between 0.05% and 0.11% of liveborn babies are infected by the parasite during pregnancy (averaging about 240 babies a year). One in four of these babies have symptoms at birth that require medical care, mostly diseases of the eyes, ears, brain or central nervous system. A small number are so seriously affected that they die soon after birth. About three-quarters of the symptomatic babies

also have intellectual disabilities that require lifelong care, affecting their ability to work as well as the working ability of family members who care for them. Of the 75% of infected babies who are born without obvious symptoms, many (up to 80%) develop problems later in life, usually to their vision, that also requires medical care.

Effects of latent infection on behaviour, mental health: Recent analyses across many studies have estimated that 17% of car accidents, 10% of suicides and suicide attempts, and 21% of schizophrenia cases would not occur without *T. gondii* infections. In Australia annually, *T. gondii* is therefore estimated to account for 200 deaths and 6500 hospitalisations due to car accidents, 300 suicides and 4500 suicide attempts, and 800

new schizophrenia diagnoses.

Bartonella henselae

There are no data on the incidence of cat scratch disease in Australia. We used disease incidence data from the US and Europe, where cat ownership rates and the prevalence of *B. henselae* in cats are similar to here. From this, we estimated that annually 2700 people get cat scratch fever requiring at least one visit to a GP. Of these, about 10% of cases (270) require hospitalisation. Surveys of exposure to *B. henselae* from screening blood samples suggest that the incidence of infection across the human population is much higher than what we used in our estimation. Cat scratch fever is under-diagnosed and under-reported, so it is likely that the real incidence and disease costs are higher than our estimates.

Toxocara cati

We were unable to estimate the costs of *T. cati* infections: tests for roundworm infections do not distinguish between the cat roundworm and the dog roundworm, *Toxocara canis*. Also, there is no information about the proportion of infected people who develop symptoms and require medical care. However, the incidence of cat roundworm in both cats and people is known to be clustered; based on the limited available information, it is probable that children and Indigenous communities may have higher infection rates.



*If cats can access backyard sand pits it greatly increases the chance of young children being exposed to *T. gondii* and cat roundworm. Image: LBOI, Flickr, CC BY NC ND 2.0*

The economic cost

We estimated that the cat-dependent pathogens, *T. gondii* and *B. henselae*, pose a substantial human health and economic burden to Australia of approximately \$6.1 billion per year (Table 1). Based on the plausible range of costs for each component the true value could lie between \$2.1 and 10.7 billion.

Most of these costs are due to *T. gondii* infections, particularly through its effects on behaviour and mental health. Although the associations between *T. gondii* and mental health issues are strong, and have been demonstrated across many studies, causality is challenging to prove definitively, so the costs of *T. gondii* to human health may be overestimated.

However, we have underestimated the costs of cat-dependent pathogens in other parts of our analysis, because the resultant diseases are under-diagnosed and under-reported, and we were unable to collate costs of all manifestations of all diseases. Our study also did not include the costs of preventative measures and regulatory practices to limit disease.

Table 1. Summary of the costs of human disease arising from cat-dependent pathogens in Australia.

Disease outcomes		Estimated cost per year (in millions)		
		Direct costs (medical, residential, therapeutic, other)	Lost income	Total
Acute illness from <i>T. gondii</i>		\$8.7	\$68	\$76.7
Congenital infection of <i>T. gondii</i>		\$5.9	\$216	\$222
Behaviour and mental health impacts from latent <i>T. gondii</i> infection	Traffic accidents	\$3030	\$184	\$3210
	Suicides and suicide attempts	\$299	\$2160	\$2460
	Schizophrenia	\$39.7	\$39.7	\$79.2
Cat scratch disease		\$2.8	\$2.7	\$5.5
Cat roundworm		No costs available		
Total				\$6.1 billion

Implications

Cat-dependent pathogens have substantial impacts on human health, and inflict substantial economic costs. There are no vaccines for these cat-dependent pathogens, but the health and economic burden of their diseases could be reduced by reducing human exposure to cats, and breaking the transmission cycles of the pathogens.

*When feral cats occur in areas with livestock, *T. gondii*, the parasite that causes toxoplasmosis, can be passed to humans in undercooked meat.*
Image: Stu Spivack, Flickr, CC BY SA 2.0



Cited material

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Management options

A key risk factor for becoming infected with all three pathogens is exposure to cats. Approaches to reduce rates of cat-dependent disease therefore include:

Reduce the feral cat population around towns as these cats are a disease reservoir

- Reduce access to easy food: keep cats away from rubbish tips, bins and farms. Don't feed strays.
- Undertake strategic cat trapping.
- Desex cats by 5 months, so if they do encounter a feral cat, they do not have unwanted litters.

Reduce exposure to infected pet cats

- Encourage people to consider other types of pets.

- Do not let pet cats roam. Keep them securely contained at all times so they do not become infected by preying upon, or scavenging, infected wildlife.

Reduce contamination

- Keep cats away from farm animals.
- Prevent cats accessing veggie patches, sand pits and other areas that children and adults use.
- Wash vegetables and cook meat well.
- Wear gloves while gardening or handling kitty litter or thoroughly wash hands after contacting risky substrates.

Eradicate cats on islands

- Where this is possible it will result in the elimination of these diseases on the islands.

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Keep cats away from tips and bins.
Image: Grace-Kat, Flickr CC BY-SA 2.0