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WHY CONTROLLING TICKS IS IMPORTANT

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YOUNG REVIEWERS:

EMILY
AGE: 15

EMMA
AGE: 11

MANANYA
AGE: 8

Learning about ticks is important because of the diseases and problems they can cause in people and animals. Ticks are related to spiders and are not insects—they are parasites that live outside their host's body and infest a variety of animals. Ticks must feed on blood to survive, and when they feed, they can spread germs that cause diseases in people and animals. Ticks are found all around the world and various strategies have been tried to control these parasites. Chemical control (pesticides) is the most common method; however, some ticks have shown resistance to these chemicals. Alternative methods have been explored, including vaccinating animals to stop ticks from feeding on them. All tick-control methods have their own

pros and cons, which will be discussed in this article. Some methods can even be combined for greater tick-killing effectiveness.

WHAT IS A TICK?

Ticks are fascinating crawling creatures similar to spiders. They have six legs in the tiny larval stage and eight legs and relatively large bodies in the later stages of their life cycle. Depending on the species, ticks can live between 1 and 2 months, 2 and 3 years, or up to 30 years. Ticks are **ectoparasites**, which means they live outside the body of their **host**. They infest a wide range of animals, including birds, mammals, amphibians and reptiles. Because they are parasites, when feeding on the blood of their hosts, ticks can transmit **pathogens**—disease-causing organisms like viruses and bacteria.

Ticks are found throughout the world and are divided into those with hard bodies and those with soft bodies (Figure 1). Hard ticks have **dorsal shields** and visible mouthparts. Soft ticks do not have dorsal shields and their mouthparts are hidden. After having a blood meal, a single female hard tick can lay thousands of eggs, but then she dies. On the other hand, soft ticks can lay only dozens of eggs, but these ticks can live for many years, even decades. Hard ticks are the most important type because they have a greater ability to transmit pathogens to people and animals, such as dogs, horses, and cattle.

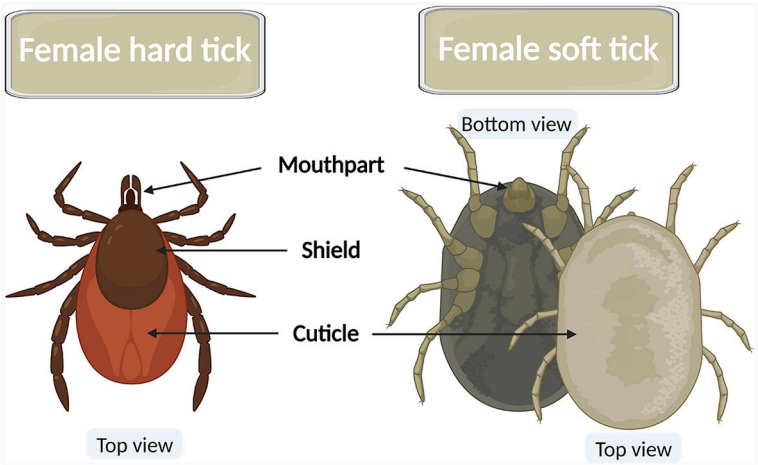

Figure 1

The life cycle of ticks typically includes four stages: egg, larva, nymph, and adult (Figure 2). Ticks must feed on blood to move to the next phase of their life cycle. Ticks are often found in places with a lot of grass and trees, like forests and meadows. They hang onto brush and plants, waiting for a suitable host to come by, then they use their legs

ECTOPARASITE

Organisms that live outside their host's body.

HOST

An organism that provides shelter and nutrition to a parasite.

PATHOGENS

Germs that cause disease, such as viruses, bacteria, and other small organisms.

DORSAL SHIELD

A protective anatomical structure located on the upper surface or back of an organism, often found in mites and ticks.

Figure 1

Body differences between ticks. Hard ticks: they have dorsal shields, visible mouthparts, hard cuticles, division between the cephalothorax and the abdomen, and the size can be between 1 and 16 mm (0.04–0.63 inches; similar to the size of an apple seed). Soft ticks: they do not have dorsal shields, mouthparts are hidden, soft cuticle, no division between the cephalothorax and the abdomen, and the size can be between 0.5 and 10 mm (0.02–0.4 inches; similar to the size of a poppy seed). Figure was created with BioRender.

to climb aboard—ticks cannot jump. Suitable hosts for ticks to feed on include people, wild animals, farm animals, and pets. Once ticks find their targets, they use their mouthparts to attach to the skin, pierce it, and start feeding on blood [1].

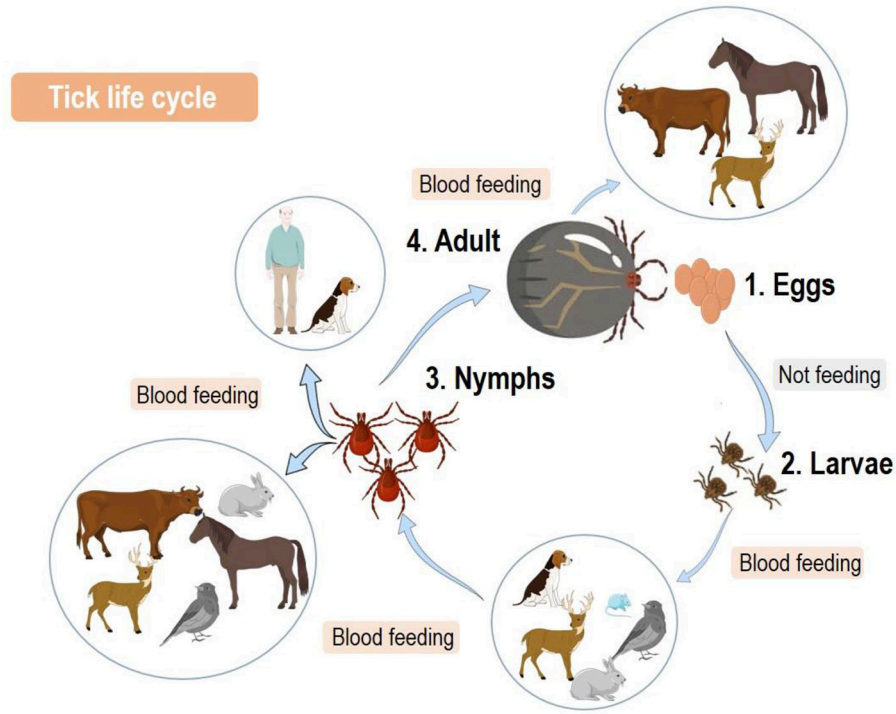

Figure 2

Figure 2

The life cycle of ticks. Ticks life cycle includes four stages: egg, larva, nymph, and adult. After an egg hatches into a larva, ticks requires a blood meal to transition between the other life stages. Individual species of ticks are adapted to feed on specific hosts, including mammals, birds, reptiles and amphibians. Figure was created with BioRender.

WHY AND WHERE ARE TICKS A PROBLEM?

Ticks can be found in a variety of places: grassy fields, forests, woodlands, deserts, backyards and even cities. The widespread distribution of ticks increases the likelihood that animals and people could become exposed to them and the pathogens they carry. Ticks can transmit a variety of pathogens—including bacteria, viruses, fungi, and some parasites—to their hosts when feeding. These tick-transmitted pathogens can cause serious health issues [2]. The types of diseases that tick-borne pathogens can cause vary depending on the location (Table 1). In areas known to have many ticks, it is important for people and animals to take actions to reduce the risk of tick bites. Many people are not aware that tick bites can spread pathogens, and this lack of awareness can delay people from seeking medical care and treatment. Furthermore, climate change could alter the places where ticks can live.

Table 1

Diseases caused by tick-borne pathogens.

Region	Disease	Main ticks	Important host
South America	Bovine parasitic sadness	Cattle tick	Cattle
North America	Lyme disease	Blacklegged tick	Human
North America	Rocky Mountain spotted fever	American dog tick	Human
Europe	Lyme disease	Castor bean tick	Human
Europe	Tick-borne encephalitis	Taiga tick	Human
Africa	East Coast fever	Cattle tick Brown ear tick	Cattle
Asia	Theileriosis	Asian longhorned tick	Cattle
Asia	Crimean-Congo hemorrhagic fever	Camel tick, small smooth bont-legged tick and Mediterranean *Hyalomma*	Human
Oceania	Bovine parasitic sadness	Cattle tick	Cattle
Oceania	Paralysis (by a toxin)	Australian paralysis tick	Human

Table 1

HOW ARE TICKS CONTROLLED?

RESISTANCE

Ability of an organism to tolerate a control strategy, resulting in new generations of the organism that are not susceptible to the control strategy.

Because ticks can cause human and animal diseases, finding ways to control them is necessary. Completely eliminating ticks is almost impossible due to their complex life cycle and the variety of hosts they use for feeding. Many scientists think the best strategy to control ticks is to reduce the number of ticks found in specific areas, such as on farms or on pet animals. Currently, there are reports that several tick species show **resistance** to common pesticides—meaning these poisons used to work to kill ticks but are no longer effective. Thankfully, it is possible to control ticks using several strategies, each with their own advantages and disadvantages (Figure 3), and strategies can be mixed and matched to stop the tick life cycle [3].

Chemical Control

Pesticides are chemicals that can often effectively kill ticks. They offer quick and immediate results. Pesticides are available in various forms such as sprays, dips, spot treatments, and collars. However, misuse of chemical pesticides can pollute the environment, harm other living creatures, and lead to resistance in tick populations. Continuous use of chemicals also can disrupt nature by harming helpful plants and animals.

Environmental Management

Environmental management is a type of tick control that involves clearing tall grasses, creating empty "safe spaces", and keeping

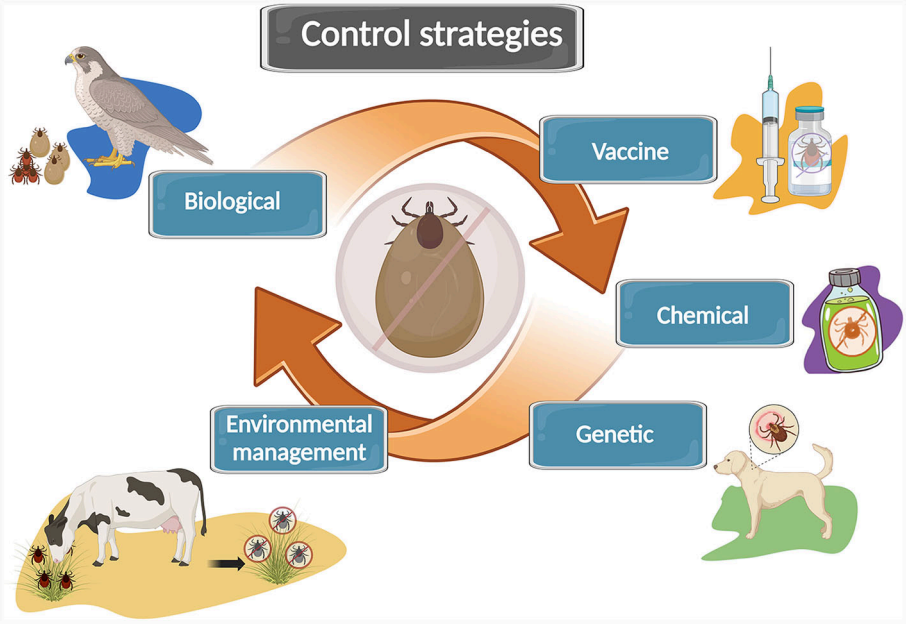

Figure 3

Different tick control strategies. Vaccine: development of vaccines against specific tick species. Chemical: application of chemical substances. Genetics: use of resistant animals. Environmental management: safe spaces by pruning tall grasses which stops the life cycle of ticks. Biological: use of natural predators such as parasites or pathogens that target ticks. Figure was created with BioRender.

lawns well-maintained. These actions can remove places for ticks to live and can stop the tick life cycle. For example, removing tall, thick grass reduces moisture at ground level, making it harder for tick larvae to find hosts. The delay in finding a host can cause ticks to die because they do not get the blood meal they need. However, environmental management may not completely eliminate tick populations, especially in wooded or natural areas. This control method also requires regular maintenance (lawn mowing, brush trimming) to remain effective.

Biological Control

Introducing natural predators, parasites, or pathogens that target ticks can be an eco-friendly way to control them. For example, certain mites (similar to ticks), nematodes (worms), and fungi (like molds) can help kill ticks without harming the environment. Also, scientists believe some types of plants can control the movement of ticks, preventing them from attaching to a host. Certain plants have natural scents or oils that can keep ticks away. For example, oils from plants like citronella, eucalyptus, and lavender are natural tick repellents. Using parts of these plants, such as in a spray or lotion, can provide an alternative tick repellent for people who are concerned about exposure to pesticides. Finally, reducing the number of potential hosts (such as deer and mice) can help decrease tick populations because the ticks will not have as many potential blood meals.

However, effective biological control can be challenging. Scientists must balance finding the right natural enemies that specifically target ticks but that do not cause harm to other living things. Managing host populations, especially large animals like deer, can be challenging and

may not be possible in all areas. Biological methods can also take a lot of time to have a noticeable impact on tick populations.

IMMUNE SYSTEM

Biological defense mechanism with cells, tissues, molecules that works collaboratively to defend the body against pathogens.

Genetic Control

Some animals have a natural ability to prevent ticks from attaching and feeding on them. This resistance is due to how the animal's **immune system** responds against ticks—similar to how a person's body fights off viruses like the common cold or the flu. Animal resistance also happens in more visible ways, for example when tick larvae cannot feed because the animal removes them by grooming. Genetic methods to control ticks are possible, such as using cattle that are specifically bred to resist tick bites. While not all cattle breeds possess inherent resistance to ticks, those that experience frequent infestations develop a degree of immunity against certain tick species. Exposure to a higher number of infestations is crucial for the natural development of resistance in these breeds.

Tick Vaccine

Vaccines against ticks can specifically target the tick and/or the pathogens carried by ticks. Vaccines appear to be a promising, environmentally smart and effective alternative for tick control. In recent years, scientists have discovered several tick proteins that could be used to create vaccines to prevent ticks from transmitting pathogens. For example, after a person or animal, such as a deer, has this type of vaccine, their immune system can alter tick behavior when a tick tries to feed on them. The vaccine could prevent ticks from feeding, digesting blood, and reproducing, so the overall number of ticks is decreased.

In the early 1980's, vaccine approaches relied on using tick body parts to warn the host's immune system about the danger of an invading tick. Then, newer tick research resulted in the development of the first anti-tick vaccine to reach the market (TickGARD). This vaccine used a gut protein (named Bm86) from a type of cattle tick to help the host's immune system recognize the threat [4]. Interestingly, this vaccine can also protect against some other tick species. However, the vaccine did not work consistently in all countries and regions of the world, possibly due to local environmental conditions such as heat and humidity. This inconsistency reinforces the need to develop new, more effective vaccines against ticks [5]. Vaccines against ticks are still being studied by scientists, and developing effective vaccines against ticks is a time-consuming and costly process.

CONCLUDING REMARKS

Integrated pest management (IPM) combines several tick control methods, including biological and chemical approaches, to control tick populations. The goal is to reduce chemical treatments and the environmental impacts generated by the excessive use of chemicals,

while preventing ticks from becoming more resistant. This approach also balances pest control and ecosystem health, taking into account climate change that could alter where ticks can live, which will generate greater awareness in preserving the environment and human health.

Research is needed to identify new chemical compounds and also to develop new vaccines that make it possible to control different tick species at the same time, and that can also be used in different regions of the world.

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YOUNG REVIEWERS

EMILY, AGE: 15

I enjoy family trips to the beach, fishing, and canoeing. At school my favorite subjects are mathematics and science. I spend my spare time working out at the gym and playing volleyball.

EMMA, AGE: 11

I am in 6th grade and love to read and I also love doing experiments in my spare time. I enjoy going to the beach and exploring nature. Fun fact about me is that I collect rocks and I have over 200 unique rocks in my collection. Whenever I have extra time, I sketch movie characters.

MANANYA, AGE: 8

Hello, I am Mananya and I am in third grade. I love doing piano and art. I enjoy swimming, acting and reading comics. I have not thought about my career yet, but I do like science and engineering.

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Jéssica Waldman is a postdoctoral researcher at the Universidade Federal do Rio Grande do Sul in Brazil. Her research is focused on studying tick physiology and identifying new tools to control these parasites.

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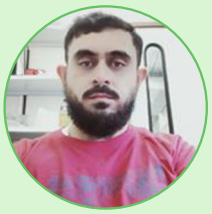

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