Spotted hyenas rarely die from disease—scientists set out to discover why

April 17 2017, by Andrew S. Flies

Ol-konôî, the Maa or Maasai word for hyena, means "to eat greedily" or "the gluttonous one". It shows a not so subtle disdain many communities have for spotted hyenas *(Crocuta crocuta)*. It's true that hyenas scramble and "laugh" during intense feeding events. But then so do many human social groups.

For instance, my father was one of 11 kids. Anyone late for dinner ran

the risk of not getting enough food to eat. The same principle applies to spotted hyenas, although they use a different language. Hyena social groups, or clans, are highly organised and the complexity of social interactions rivals that of most primate societies. Their communication repertoire – such as their laugh – includes many types of vocalisations that help to maintain social order without the need for actual fights.

But there's another attribute that renders these species remarkable: they rarely die from infectious disease. Periodic outbreaks of rabies and canine distemper viruses have killed vast numbers of lions, wild dogs, and other carnivores. But not hyenas. This is well documented in a 25-year long project led by Professor Kay Holekamp which involved intense monitoring of spotted hyenas in Kenya's Maasai Mara National Reserve.

Questions about how and why spotted hyenas are able to survive exposure to pathogens that kill other species drove my research on their immune system.

Immune system

Immunology is a complex subject, steeped with technical jargon and research tools that are rapidly increasing in complexity. Very few people had previously investigated the spotted hyena immune system, so we started with the basics.

We began by looking at antibodies found in hyena blood serum. We found that they have more in common with cat – *(Felis catus)* – antibodies than dog – *(Canis familiaris)* – antibodies. This is to be expected because hyenas are more closely related to cats than dogs..

We then looked at the genetic codes for genes that are used by the immune system to recognise pathogens – for example a disease-causing

agent. These genes, called toll-like receptors, were also similar to those found in cats.

These two findings suggested that compared to other species, spotted hyena antibodies and toll-like receptors are relatively normal. So are these the magic bullet behind their immune defences?

Probably not.

After completing these two molecular-based studies, we next looked at how ecology and the environment can affect hyena immune defences.

Ecology and the environment

Most immunology research is done using inbred mice that spend their entire life in a relatively clean and stable environment. Studying immunology this way has led to great medical breakthroughs, but it has its limitations. It doesn't, for example, accurately reflect the way most humans and other animals actually live. People and wild animals live in dynamic environments where things like disease, food availability, social groups and climate are constantly changing.

Our research on spotted hyenas set out to study them in both captive environments as well as more natural settings so that we could understand the importance of the environment in regulating their immune systems.

We found that basic immune defences were different in captive hyenas and wild hyenas. Wild hyenas have higher levels of several types of antibodies than captive hyenas.

Another aspect of the spotted hyena's ecology we studied was the strict social order of their clans. High-ranking hyenas are nearly always

females. Males emigrate from other clans and enter the new clan at the very bottom of the social hierarchy.

We found a link between the ranks of hyenas and their immune profiles. For example, high-ranking hyenas had higher levels of basic immune defences. This was true between females – where a higher rank correlated to higher immunity – and between males and females where the same was true of females with a higher rank.

This could be due to several possible reasons. One is that high-ranking hyenas get more food and thus have more energy available for their immune systems to use to fight infections.

At the other end of the immune spectrum we found that females nursing cubs have lower levels of basic immune defences than pregnant hyenas. This is not surprising given that producing milk for offspring requires more energy than actually producing the offspring in the womb.

Environment and social structure play a role

In general the hyena immune system at the most basic level looks similar to other more well-studied species. But our research shows that the environment as well as social structures play a key role in regulating immune defenses.

Although we don't have all the answers yet, my research lays the foundation for a deeper understanding of the immune system of the spotted hyena so that we can continue working towards answering the question: why don't spotted hyenas get sick?

Answering this question more fully could lead to better vaccines, and more efficient use of them. For example, understanding the social structure can be important when deciding which animals to vaccinate

when vaccines, personnel, and time to administer vaccines is limited. This will become increasingly important as more and more species are pushed towards extinction.

Finally, the mainstream immunology research community is beginning to take note of how studying animals in their natural environments – wild immunology – can lead to a better understanding of disease and immunity in general. We know that hyenas are exposed to a lot of disease-causing organisms but that they rarely die. So studying wild spotted hyenas that seem to be gluttons for surviving disease is a good place to start.

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