Rural microbes could boost city dwellers' health

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The greater prevalence of asthma, allergies and other chronic inflammatory disorders among people of lower socioeconomic status might be due in part to their reduced exposure to the microbes that thrive in rural environments, according to a new scientific paper.

The article, published in the journal *Clinical & Experimental Immunology*, argues that people living in urban centers who have less access to green spaces may be more apt to have chronic inflammation, a condition caused by immune system dysfunction.

When our immune systems are working properly, they trigger inflammation to fight off dangerous infections, but the inflammation disappears when the infection is gone. However, a breakdown in immune system function can cause a low level of inflammation to persist indefinitely. Such chronic inflammation can cause a host of health disorders.

"Chronic inflammation can lead to all kinds of problems from irritable bowel syndrome to asthma to allergies and even depression," said Christopher Lowry, an associate professor in the University of Colorado Boulder's Department of Integrative Physiology and a co-author of the paper. "The rise of chronic inflammation and these associated disorders, especially among people living in the cities of developed countries, is troubling."

The two other article co-authors are Graham Rook of UCL (University

College London) and Charles Raison of the University of Arizona.

Some scientists have hypothesized that the increase of chronic inflammation in wealthier Western countries is connected to lifestyles that have essentially become too clean. The so-called "hygiene hypothesis" is based on the notion that some microbes and infections interact with the immune system to suppress inflammation and that eliminating exposure to those things could compromise your health.

But the idea that picking up more germs could boost our immune system function does not at first seem to hold up when applied to low-income urbanites, who suffer disproportionately from both infections caused by germs and disorders linked to chronic inflammation. The authors of the new paper say this apparent disconnect is due to a misunderstanding of the hygiene hypothesis.

The authors agree that microbes and some types of infections are important because they can keep the immune system from triggering inflammation when it's not necessary, as happens with asthma attacks and allergic reactions.

But they say the infections that were historically important to immune system development have largely been eliminated in developed countries. The modern diseases we pick up from school, work and other crowded areas today do not actually lead to lower instances of inflammatory disorders.

"The idea that we're too clean—that gives the wrong impression," said Lowry. "You want people to wash their hands because hygiene is important to avoid infections that are harmful."

During our evolutionary history, the human immune system was exposed to microbes and infections in three important ways: commensal microbes

were passed to infants from their mothers and other family members; people came into contact with nonpathogenic microbes in the environment; and people lived with chronic infections, such as helminths, which are parasitic worms found in the gut and blood.

In order for those "old infections" to be tolerated in the body for long periods of time, they evolved a mechanism to keep the human immune system from triggering inflammation. Similarly, environmental bacteria, which were abundant and harmless, were tolerated by the immune system.

According to Rook, a professor at UCL, "Helminthic parasites need to be tolerated by the immune system because, although not always harmless, once they are established in the host efforts by the immune system to eliminate them are futile, and merely cause tissue damage."

In contrast, relatively modern "crowd infections," such as measles or chicken pox, cause an inflammatory response. The result is that either the sick person dies or the infection is wiped out by the inflammation and the person becomes immune from having the same infection again in the future.

Collectively, the authors refer to the microbes and old infections that had a beneficial impact on the function of our immune systems as "old friends." Exposure to old friends plays an important role in guarding against inflammatory disorders, the authors said. Because the "old infections" are largely absent from the developed world, exposure to environmental microbes—such as those found in rural environments, like farms and green spaces—has likely become even more important.

The authors say this would explain why low-income urban residents—who cannot easily afford to leave the city for rural vacations—are more likely to suffer from inflammatory disorders. The

problem is made worse because people who live in densely populated areas also are more likely to contract crowd infections, which cause more inflammation.

In other words, city dwellers of low socioeconomic status might benefit both from being "cleaner" and "dirtier," depending on the context. Like all people, better hygiene—like washing their hands more frequently, for example—could help them avoid crowd infections while more opportunities to "play in the dirt," like visiting green spaces, could allow their immune systems to come into contact with more beneficial microbes.

"You don't want the crowd infections," said Lowry. "But you do want to find ways to increase your exposure to 'old friends.' "

Provided by University of Colorado at Boulder