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RESEARCH WATCH

Dirty environment for adult life: The bad, the good, the unknown

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Abstract We know the bad things of dirty environment which is associated with infectious diseases. In this Research Watch, we discuss the good and the unknown of dirty environment, based on a recent *Nature* paper. We emphasize the role of environment (microbiota) in the development of the human immune system in health and diseases.

We all know the bad things of dirty environment: infectious diseases and public health burden. We start to know that environment trigger is a key factor in the pathogenesis of chronic diseases, such as inflammatory bowel diseases (IBD).[1] We also know that early exposure to dirty environment lowers the risk of allergy.[2] Now scientists have added new evidence about the role of environment and genetics in the development of the human immune system.

A scientific team led by Drs. Stephen C. Jameson and David Masopust of the University of Minnesota, USA, reported that co-housing laboratory mice raised in the specific pathogen free environment with mice from pet stores can produce "dirty mice" that model human immune system accurately.[3] They found that laboratory mice had less diverse memory T cells, compared to humans. The immune systems of laboratory mice more closely resembled those of human infants, particularly the number and tissue distribution of memory T cells. In contrast, the non-laboratory mice had immune systems more like those of adult humans. After co-housing laboratory mice with healthy mice raised in a pet store for eight weeks, patterns of T cells and other immune system components are more closely matched the pet store mice, as well as adult humans. These findings suggest that "dirty mice" may closely model the human immune system. Laboratory mice

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raised in pathogen-free environments lack microbial diversity, which may contribute to these differences. These studies suggest the variation in microbial environment could account for the different immune system makeups in the laboratory mice and non-laboratory mice.

In mouse studies, microbiome can play an important role in shaping experimental findings and conclusions. Some biomedical interventions that work well in mouse models could fail when they advance to safety and efficacy testing in humans. One reason for this may be the differences of immune system development and microbiome. Dirty mice might be valuable for testing the "hygiene theory", immune function and treatments for disease in the settings of transplantation, allergy, autoimmunity, and vaccination, and perhaps in disparate diseases that involve the immune or inflammatory systems. Other diseases, such as cancer, could be influenced by these changes to the animals' immune systems.

The current study could not answer the following questions: How dirty will be considered as healthily and reasonably "dirty"? Is there an accurate way to define and quantitate the clean vs not clean living? What is the role of the microbiome in the process of immune maturation? Further, how the microbiome shapes healthful versus harmful outcomes in the human host?

In an age of Nintendos, Smart phones, Facebook, and YouTube, will kids have opportunities to get dirty in nature? It is still unknown how the modern life style shapes the microbiome in kids and influences their adult life. The current study may also raises the concern that children need get outside, engage with nature, and take advantage of "dirty" environment. Diligent and persistent effort is needed to define the potential public health and clinical significance of environment (with microbiome) for healthy adult life.

Conflicts of interest

The author declares no conflict of interests.

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References

1. Sartor RB. Microbial influences in inflammatory bowel diseases. *Gastroenterology*. 2008;134:577—594.
2. Liu AH. Revisiting the hygiene hypothesis for allergy and asthma. *J Allergy Clin Immunol*. 2015;136(4):860—865.
3. Beura LK, Hamilton SE, Bi K, et al. Normalizing the environment recapitulates adult human immune traits in laboratory mice. *Nature*. 2016;532(7600). http://dx.doi.org/10.1038/nature17655.