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Is animal research sufficiently evidence based to be a cornerstone of biomedical research?

Evolutionary considerations can inform animal research

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In their discussion of the value of animal research for medicine, Pandora Pound and Michael Bracken mention in passing the "different evolutionary trajectories" of humans and other animal species.(1) A fuller appreciation of the evolved differences between humans and other species can guide our use of animal research in ways that are most likely to benefit human health.

Mice are the most frequently used mammalian "model organism." Mice and humans have a high level of genetic homology and have many biochemical and physiological similarities. But the lineages leading to modern rodents and primates diverged some 85 million years ago. Since that time, species in these lineages evolved in and became adapted to different environments. As a result, mice and humans now have very different life histories. Probably because they have evolved to be much smaller than humans, mice have a higher specific metabolic rate and suffer higher rates of oxidative damage, they devote a larger proportion of their energy to reproduction, and they have a much shorter life expectancy than do humans. In nature, mice die of starvation, hypothermia, and predation, causes of death to which we are relatively immune. In the laboratory, cancers are a major cause of death in mice, while cardiovascular diseases are negligible. Because of their small size and terrestrial habitat, mice are heavily exposed to respiratory pathogens, and they depend much more on olfaction and touch than on sight and hearing. Finally, mice and humans have different diets, are exposed to different environmental toxins, and have different microbiomes.

Mice and other experimental animals are invaluable for understanding those processes that arose early in evolution and that we share with these other species. Much of our knowledge of the immune system, for example, comes from research on mice. Research on mice and other mammals is also essential for elucidating the pathways by which the highly conserved mammalian genome can give rise to organisms with vastly different phenotypes. This research has helped to clarify the origins of developmental abnormalities. But mice are less likely to be good models for understanding chronic, non-communicable diseases, which is the focus of much biomedical research, because the pathogenesis of these diseases is so enmeshed in our species' unique, evolved life histories.(2) Consideration of the differences as well as the similarities between humans and non-human animals will help direct our efforts to research that is most likely to benefit humans—or the animals themselves—and not divert resources into research that is less likely to be productive.

References

1. Pound P, Bracken MB. Is animal research sufficiently evidence based to be a cornerstone of biomedical research? BMJ 2014;348:g3387.
2. Perlman RL. Evolution and Medicine. Oxford: Oxford University Press, 2013.

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