

# Review of: "Urban bat pups take after their mothers and are bolder and faster learners than rural pups"

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In this article Harten and colleagues, use a common garden experiment to study whether divergence in behavioral traits between urban and rural newborn fruit bat pups are innate or acquired. The authors found that cross-fostering significantly influenced pups' risk-taking and exploration, suggesting a maternal role in the acquisition of these behavioral traits. Rural pups raised by urban mothers exhibited higher risk-taking and lower exploratory tendencies than rural pups raised by their biological mothers. Urban pups raised by rural mothers exhibited reduced risk-taking levels and more exploratory behavior.

The authors suggest that higher levels of cortisol in urban bats might be a possible mechanism, acting via breast-feeding or through maternal behavior—although more data is necessary to relate cortisol levels with behavior. The degree to which the pups learn the risk-taking behavior from the mother is also unanswered. Nevertheless, this is an elegant study that makes important observations on how urban-related behavioral traits are acquired.

In reading the manuscript, I was also struck by the similarities that exist between the biological effects of urbanization on bats and humans. Relevant to the current research is that changes in cognitive function have been described as a component of a constellation of subtle clinical differences that exist between rural and urban populations living in sub-Saharan Africa (Bickler et al., 2018). In humans, decreased cognitive function in rural areas results in poorer performance in school; fewer years of completed schooling, and ultimately, lower economic productivity during adulthood. The differences in cognitive function that exist in rural and urban areas of sub-Saharan Africa likely relate to the higher rates of chronic and recurrent infections in rural areas and their intrinsic link to under-nutrition. I would image that the immune consequences for a bat pup reared in a natural cave in a rural area might be markedly different than being reared in an abandoned old building in the middle of the city, because of differences in rates of infection due to crowding. I am curious to know if there were any size differences between the bats from the rural and urban areas, suggesting a possible difference in nutritional status.

Finally, I would like to encourage the researchers to imagine how their findings might relate to the epidemiology of human diseases. Urbanization in low-income countries represents an important inflection

point in the epidemiology of disease in humans, with infectious diseases predominating in rural areas and urban populations taking on a profile of non-communicable diseases (NCDs), principally cardiovascular diseases, cancer, and respiratory diseases. NCDs are now the leading cause of death in lower-middle, upper middle, and high-income countries. Even in low-income countries where infectious diseases have been the dominant public health problem, NCDs are rising rapidly and are projected to exceed communicable, maternal, perinatal, and nutritional diseases as the most common causes of death by 2030. It might be worthwhile to investigate whether the urban bats have any evidence of non-communicable diseases (e.g., aortic plaques suggestive of atherosclerosis). If so, the rural-urban bat model could be an important model for understanding the origins of NCDs in humans.

Congratulation on a fantastic publication!

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## Reference

Bickler SW, Wang A, Amin S, Halbach J, Lizardo R, Cauvi DM, De Maio A. Urbanization in Sub-Saharan Africa: Declining Rates of Chronic and Recurrent Infection and Their Possible Role in the Origins of Non-communicable Diseases. *World J Surg.* 2018 Jun;42(6):1617-1628.