Time for One Health: Do hog farms cause disease in North Carolina neighborhoods?

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Key points:

- Analytical approach of a 2018 study[1] was insufficient for testing the hypothesis that proximity to hog farms has a negative impact on human health.
- Better-designed epidemiological studies and indicators are essential to truly measure the risk of exposure to pig farming areas while correctly adjusting for other factors that can interfere with interpretation, and the responsible interpretation of data.

Background

We conducted a reanalysis of a 2018 study[1] that reported communities living near hog farms in North Carolina have increased negative health outcomes and mortalities. While the authors stated that the associations do not imply causation, speculative interpretation of their results by media and subsequent use as evidence in lawsuits caused detrimental effects on the swine industry. We repeated their study to evaluate the strength of conclusions and appropriateness of methods used with the ultimate goal of alerting on the impact that study limitations may have when used as evidence.

Methods and results

The original study tried to measure the association of a person living in a hog dense zip code and their negative health outcomes including human mortality, hospital admissions, and emergency department visits related to six disease conditions (anemia, kidney disease, infectious diseases, tuberculosis, low birth weight). They conducted logistic regression and compared the health outcomes in pig dense zip codes to the non-pig dense zip codes, excluding the urban centers. In the reanalysis, we included HIV and diabetes in addition to these six conditions and identified that if analyzed in how it was done in the original study, not only the six conditions but also, HIV and diabetes, which are not causally relatable to hog farming, were also prominent in these neighborhoods likely reflecting underlying systemic health disparities. Several other shortcomings were also identified suggesting the analytical approach was insufficient for evaluating the study objectives.

Notably, the original study did not correctly account for the confounding factors: that is the fact that zip codes with hog farms have greater proportions of marginalized populations, lower household incomes, fewer residents with higher education level, and fewer primary care providers. When acquiring data for these confounding factors, 2018 study generalized these sociodemographic characteristics to the zip code or county a person live in, yet conducted the regression analysis at the individual level (i.e. assuming any person who lives in a certain zip code has the same household income as everyone else in the zip code; hence, "Ecological Fallacy"). With this critical oversight, the measured association is inaccurate. It is essential to account for these confounding factors pertaining to race, income, education, and healthcare demographics, which are established as social determinants of health, linked to profound underlying systemic health disparities.

Discussion

In such epidemiological studies, we are trying to answer the epidemiologically intriguing question of whether these communities would have similar negative health issues if there were no pig farms. With limited data, studying association between exposure to pig farms and how that impacts public or environmental health is a complex and challenging subject; many fronts to consider, and no silver bullets. The reanalysis highlighted the importance of careful study design and responsible interpretation of data for understanding the impact of agricultural practices on human health. A follow up project is underway that builds on the reanalysis to come up with a better indicator of the exposure to large hog farms and conducting the analysis at population level while accounting for the relevant confounding factors. Understanding of the complexity of exposure in relation to air, soil, and water characteristics; farm characteristics; and demographic, social, economic, healthcare, and infrastructure characteristics of neighboring communities is crucial for at the very least to improve understanding of the interconnectedness and development of strategies down the road to maximize human health, environmental health, and agricultural sustainability promoting One Health solutions.

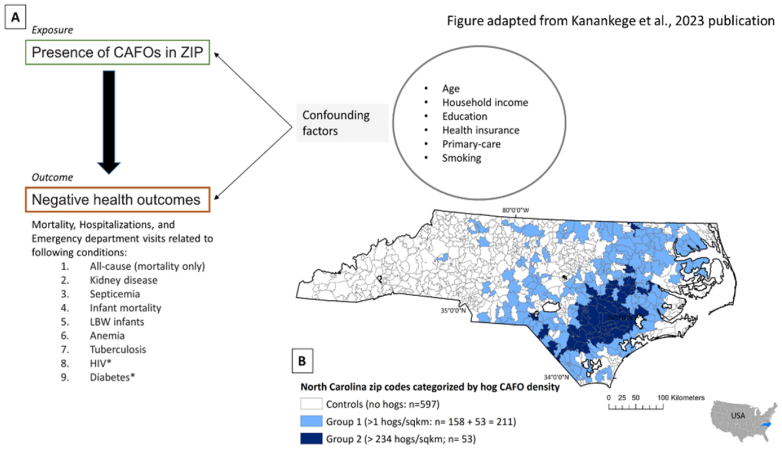

Figure adapted from Kanankege et al., 2023 publication

Reference

1. Kravchenko, Julia, Sung Han Rhew, Igor Akushevich, Pankaj Agarwal, and H. Kim Lyerly. "Mortality and health outcomes in North Carolina communities located in close proximity to hog concentrated animal feeding operations." North Carolina medical journal 79, no. 5 (2018): 278-288.
2. Kanankege, Kaushi ST, Isaac Traynor, and Andres M. Perez. "A reanalysis: Do hog farms cause disease in North Carolina neighborhoods?." Frontiers in Veterinary Science 9 (2022).