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STUDENT REFLECTION

From Theory to Practice: An Epidemiology Student's Reflection on Navigating Observational Research Biases and Pitfalls for Trustworthy Science

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Observational epidemiology examines the distribution and determinants of disease in human populations without an investigator *administering* an intervention.[1] Unlike experimental studies, such as randomized controlled trials, where participants are randomly assigned to groups to assess treatment effectiveness by an investigator, observational studies are necessary when administering an exposure would be impractical or unethical.[2] However, epidemiologists increasingly recognize the need for rigorous methodologies and careful interpretation to enhance the quality and clinical relevancy of observational research.[3–5] While no study is free from error or bias, we must acknowledge limitations and build upon previous research. As a PhD candidate in epidemiology using observational data for my dissertation, I often reflect on the challenges of study design and biases that could influence my findings, striving to uphold the integrity of my research.

From my first day as a graduate student, I learned the importance of identifying and mitigating biases in epidemiologic study design. Initially, these concepts felt theoretical; something to memorize. However, as I progressed, they became tangible challenges that shaped my ability to critically evaluate data sources and analytical methods. A wise instructor once told my class that each data point represents a real-life experience. This idea may seem obvious, but working with large, complex data sets made it easy to lose sight of the human narratives behind the numbers. I knew I wasn't alone in this realization when, at the most recent Society for Epidemiologic Research annual meeting, the opening speaker replaced traditional unique identifiers with labels such as "Real Person #1, #2, etc." This simple yet profound visual served as a reminder of our ethical responsibility as researchers: to ensure our findings honor the lived experiences of the populations we study.

Throughout graduate school, I have focused on understanding and addressing the harmful effects of flawed study designs, inappropriate statistical methods, and various forms of bias. These issues not only compromise individual studies but also contribute to conflicting scientific evidence, which can erode public trust in research and hinder progress in public health. Additionally, the emphasis on quantitative methods may cause researchers to overlook the human stories behind the data. Incorporating qualitative and mixed-methods approaches offers a valuable opportunity to uncover biases in quantitative research and build stronger connections with the communities being studied.

Consider my research population, whose exposure to environmental contamination was explored in a phenomenological study published in a previous Ohio Journal of Public Health issue.[6] Using transcribed interviews from the Fernald Living History Project, recurring themes of disruptions to daily life and information-seeking emerged. These findings reinforce the rationale for my quantitative approach to examining long-term associations between perceived risk of contamination and health outcomes. As I embarked on this work, I remained committed to addressing research pitfalls and biases, ensuring the community's lived experiences were faithfully represented.

By embracing methodological rigor, transparency, and ethical responsibility, epidemiologists uphold the integrity of scientific inquiry and strengthen the impact of observational research. When thoughtfully designed and interpreted, observational studies can uncover significant associations, guide interventions, and, ultimately, improve public health.

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AUTHOR CONTRIBUTION

Sara Burcham: conceptualization, methodology, formal analysis, writing–original draft, project administration, review, editing.

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