# Research Statement

## Kartik Verma

My research interests are at the intersection of health economics, labor economics, and public health, and their interaction with religion and caste. I have training and experience in quantitative research, and causal inference using observational data. I have analyzed observational data including large secondary datasets, data from randomized controlled trials, and data from qualitative studies. I have been trained to employ identification strategies for difference-in-differences analysis, fixed-effects strategies, panel data methods, instrumental variables approach, among others.

My focus is on the use of applied econometrics to explore the determinants and consequences of improved sanitation toilets in rural India. A wide body of interdisciplinary research has documented the various determinants and consequences of improved sanitation toilet access and use. My research explores the causal impact of water infrastructure on improved sanitation toilet access, which has so far been overlooked in the case of rural India. It further looks at the heterogeneity in treatment across religions and caste groups. My research also looks at the association between the average improved sanitation toilet use at the village level and child diarrhea.

**Current Research**

My dissertation looks at the determinants of improved sanitation toilet use, examines an important pathway which impacts improved sanitation toilet access, and further looks at the consequences of improved sanitation toilet use by studying the association between the population density adjusted improved sanitation toilet use and reported child diarrhea. I use nationally representative individual and household-level data on rural India from the National Family Health Survey – IV (India's DHS) conducted in 2015-16, and two waves of nationally representative household-level data from the India Human Development Survey (IHDS) conducted in 2005 and 2011-12.

My first paper looks at the determinants of improved sanitation toilet use at the household level. It is a descriptive study that looks at the association between the various socio-economic characteristics of a household like wealth, education, religion, caste,

whether a household is headed by a female, the time that is required to fetch water for the household and improved sanitation toilet use. I quantify caste and wealth deprivation and explain what role caste and religion play in improved sanitation toilet use. I also comment on the important role that female agency plays in improved sanitation toilet use.

My job market paper (the second essay in my dissertation) looks at the impact that water infrastructure has on improved sanitation toilet access. Contrary to the previous literature, my research shows that water infrastructure is an important factor in toilet access. Using a fixed effects identification strategy, I estimate that households, where water is "delivered" inside the house/compound, are more likely to adopt improved sanitation toilets. This effect is heterogeneous in treatment across religions. In the context of the adoption of improved sanitation toilets in rural India, this important result brings focus on the importance of water infrastructure for toilet adoption – which has so far been lacking, as research has focused on cultural factors. Without overlooking cultural factors, the results from my research suggest that investments in infrastructure that focus on "delivering" water inside the house/compound will lead to more toilet adoption, saving the Indian economy on premature mortality and productivity, time, and health-related costs due to inadequate sanitation. A preliminary cost-benefit analysis suggests that for every rupee invested, the economy would save two rupees.

Given the importance of *causal* analysis for evidence-based investment in infrastructure, I use a fixed effects identification strategy. I control for endogeneity by making a substantial case against reverse causality, include various time-varying covariates that correlate with the variable of interest, and cluster the standard errors at the appropriate level.

My third paper looks at the association between the population density-adjusted average improved sanitation toilet non-use at the village level and the incidence of diarrhea among children less than five years old. Controlling for covariates, I find a statistically significant association between average toilet non-use and the incidence of diarrhea among children less than five years old. Previous approaches have not captured the negative externality present when some households of the village do not use improved sanitation toilets and have overlooked the fact that population density is an important factor in the spreading of

infection due to fecal matter. In improving the analysis further, I plan to use an instrumental variable approach to estimate the causal impact of the lack of improved sanitation toilets on child diarrhea.

Given the importance of ending the practice of open defecation to the global sanitation community, my research adds to the literature on the social determinants of toilet access, in particular, the impact of water infrastructure on improved sanitation toilet access. It also provides an important contribution in modeling the negative infection externality associated with non-use of improved sanitation toilets at the village level.

I plan on publishing part of this research in a leading peer-reviewed journal. Also, I plan to liaise with agencies funding evidence-based investment in water and sanitation to better inform governments and other agencies in achieving the United Nations' sustainable development goal on clean water and sanitation.

**Ongoing Research Agenda**

Starting from the idea that multiple factors determine population health, which includes gender equality, the absence of physical and mental violence, the absence of caste prejudice, and factors like both general and specific investment in public health, I plan to research the infrastructural deficiencies that determine public and population health outcomes. In particular, in association with health professionals, I plan to quantify the impact of a lack of sanitation on Women's health outcomes in the developing world, which include contracting urogenital tract infections, mental stressors related to social regulation of movement, and adaptive behaviors such as withholding intake of food and drinks. I also plan to measure the impact across different regions, religions, and other such contextual factors. Further, I plan to look at the impact of a lack of sanitation on labor market outcomes for Women, which includes labor market participation rates, absence from work, wage rates, and upward mobility in jobs. The work that I propose here is interdisciplinary and would require participation between the various social and health sciences.

In furthering my dissertation research, I plan to conduct a comprehensive cost-benefit analysis of the impact of investment in water infrastructure on the Indian economy. The results could be used to better inform policymakers of the difference in the effectiveness of various sanitation interventions. I also plan to incorporate another wave of data from

IHDS into my analysis when it becomes available to examine whether the relationship that I quantify in my job market paper changes substantially over time.

One of the takeaways from my job market paper is that caste discrimination is a dynamic institution that undergoes constant regeneration. It is conceptually different from caste-based notions of ritual purity in the context of sanitation, which are concerned with the handling of human feces which are considered ritually impure and the placement of the toilet within the ritually pure confines of a home. Caste discrimination is difficult to measure, and even if there is a suitable static measure to quantify caste discrimination, it should not be used as a proxy to measure ritual purity. To effectively study the impact of ritual purity on toilet access and use, the notion of ritual purity needs to be measured well. I plan to develop a measure to quantify ritual purity by contextualizing the problem and gathering information from the various parts of India, not just the places where caste prejudice is high. This new measure will enable comparisons of caste-based ritual purity across time and would enable the sanitation community to study its impact on improved sanitation toilet use. It will also enable the sanitation community to decompose the inability of rural India in ending open defecation among its various contributing factors – cultural, infrastructural, financial, etc.

The overarching objective of my research is to contextualize cultural factors that may affect health outcomes, find ways to measure them effectively, and quantify the impact of infrastructural deficiencies and interventions in public health infrastructure on health and labor market outcomes.