JAMA Network Open

Invited Commentary | Global Health

# Spatial Epidemiology of Diabetes and Tuberculosis in India

Daniel J Corsi, PhD

+ Related article

Author affiliations and article information are listed at the end of this article.

In this issue of *JAMA Network Open*, Hernandez et al[1] describe the spatial distribution of diabetes among adults aged 15 to 50 years using data from the fourth National Family Health Survey (2015-2016) in India. These findings support existing evidence indicating a spatial concentration of diabetes prevalence in the southern and eastern states of India. The authors also report associations between diabetes and increasing wealth, alcohol consumption, and tobacco consumption. The National Family Health Survey is an important data source on diabetes in India, and the fourth round introduced random glucose testing for respondents in addition to self-reported diabetes status.[2] Previous analyses of these data revealed the marked geographic and socioeconomic patterning of diabetes prevalence in India.[3] Hernandez et al[1] extend the analysis of the spatial clustering of diabetes to consider a potential overlap between diabetes prevalence and tuberculosis prevalence in areas where both are highly endemic. There are some methodological concerns related to the analysis by Hernandez et al[1] that may affect the interpretation of their findings.

The study by Hernandez et al[1] contains some inconsistencies in the reporting of the National Family Health Survey and the study methods. It appears that these discrepancies may not affect the conclusions drawn by the authors but should be considered. Data come from the fourth round of the Indian National Family Health Survey conducted between January 2015 and December 2016 by the Ministry of Health and Family Welfare of the government of India in a representative sample of 601 509 households in India.[4] Different from previous rounds of the National Family Health Survey, the fourth round was designed to provide estimates representative at the level of districts, which are administrative units within states. The fourth survey also included additional biomarker sampling to collect blood glucose level and blood pressure measurements among women aged 15 to 49 years and a subsample of their male spouses aged 15 to 54 years.

The National Family Health Survey uses a cluster-based design, and a subsample of 15% of households were selected for additional modules, including the men's survey. A representative subsample was achieved by conducting the additional modules in alternating households within 30% of selected clusters. Different weight variables allow inferences for the full population of women or the representative subsample of men and women. It appears that Hernandez et al[1] used the standard women's weight for women and used the subsample or men's weight for the men. Although the difference is minor, an alternate approach would be to use the subsample weight for men and women, resulting in an overall self-reported diabetes prevalence of 1.95% (95% CI, 1.82%-2.08%) compared with the 1.76% reported in the article.

Hernandez et al[1] favor the use of self-reported diabetes status because of the potential for overclassification of diabetes using random glucose level testing. Although self-reported data are useful, the true burden of diabetes is likely underestimated owing to reduced sensitivity of identifying diabetes cases in populations with reduced access to health care or lower levels of education.[5] In a previous study,[2] the authors used glucose values adjusted for time since last meal and combined with information on the use of diabetes medications. This definition resulted in an overall prevalence of diabetes of 2.49% (95% CI, 2.33%-2.66%) among women aged 15 to 49 years and 3.25% (95% CI, 3.07%-3.44%) among men aged 15 to 54 years, with the caveat that this is not a clinical definition and has some underlying uncertainty. For all analyses, a data set of 757 958 individuals was used.

The potential association between tuberculosis and diabetes deserves consideration. There is an increasing concern of the potential for a coepidemic of tuberculosis and diabetes in India.[6] India

has a high prevalence of tuberculosis, particularly in the north and northeastern states. Diabetes is a potentially significant risk factor.[7] Despite emerging evidence for this association, there is a lack of national-level and geographic analyses exploring the spatial coexistence of these 2 conditions. The work by Hernandez et al,[1] therefore, makes a significant contribution. Of interest, the authors found a lack of support for the hypothesis of a spatial correlation using district-level tuberculosis prevalence data from the Revised National Tuberculosis Control Programme for India 2014 report. The authors used a spatial smoothing approach to map primary sampling units in the National Family Health Survey (rural villages or census blocks in urban areas) to the district-level tuberculosis data. It is not clear how this method was used and whether the authors used the global positioning system data.[8] The potential advantages or disadvantages that this method may have over linking the 2 data sources directly at the district level are not known.

Use of the tuberculosis information in the National Family Health Survey collected at the household level from an eligible woman responding on behalf of all household members[9] permits analysis at both the individual and district levels. A crude analysis of the association between diabetes and tuberculosis at the individual level suggests an odds ratio of 1.75 (95% CI, 1.21-2.54) for diabetes among those with tuberculosis. However, this association attenuates to 1.15 (95% CI, 0.79-1.68) with the inclusion of age and sex in the model, and there does not appear to be any interaction by urban or rural areas. At the district level (n = 640), the correlation between the prevalence of tuberculosis and diabetes was −0.069 ($P$ = .08), suggesting a limited spatial overlap. These findings are intriguing given the existing literature. Previous studies, however, may not have adequately controlled for potentially confounding variables or may have been conducted in highly selected populations. Continued exploration of this hypothesis may be warranted. However, at this time, a coepidemic of tuberculosis and diabetes does not appear to be occurring, with each condition having a distinct spatial distribution.

In summary, Hernandez et al[1] present a novel analysis of the individual and spatial correlates of diabetes in India using the National Family Health Survey. Also, the authors consider the potential for spatial overlap between tuberculosis and diabetes using district level information on tuberculosis prevalence. The finding of the lack of spatial overlap of these 2 disease burdens may have implications for disease control priority setting in India. The study represents a valuable contribution, with the caveat being that users of data in the public domain such as the National Family Health Survey provide open and transparent reporting of their analyses given the importance of these data to those in research, government decision-makers, and policy planners.

## ARTICLE INFORMATION

**Published:** May 1, 2020. doi:10.1001/jamanetworkopen.2020.3892



**Corresponding Author**: Daniel J. Corsi, PhD, School of Epidemiology and Public Health, University of Ottawa, 501 Smyth Rd, Box 241, Ottawa, ON, Canada K1H 8L6 (dcorsi@ohri.ca).

**Author Affiliation:** School of Epidemiology and Public Health, University of Ottawa, Ottawa, Ontario, Canada.

**Conflict of Interest Disclosures:** None reported.

## REFERENCES

1. Hernandez AM, Jia P, Kim H-Y, Cuadros DF. Geographic variation and associated covariates of diabetes prevalence in India. *JAMA Netw Open*. 2020;3(5):e203865. doi:10.1001/jamanetworkopen.2020.3865

2. Corsi DJ, Subramanian SV. socioeconomic gradients and distribution of diabetes, hypertension, and obesity in India. *JAMA Netw Open*. 2019;2(4):e190411. doi:10.1001/jamanetworkopen.2019.0411

3. Corsi DJ, Subramanian SV. Association between socioeconomic status and self-reported diabetes in India: a cross-sectional multilevel analysis. *BMJ Open*. 2012;2(4):e000895. doi:10.1136/bmjopen-2012-000895

**4**. International Institute for Population Sciences (IIPS) and ICF. *National Family Health Survey (NFHS-4), 2015-16: India*. IIPS; 2017.

**5**. Chun H, Kim IH, Min KD. Accuracy of self-reported hypertension, diabetes, and hypercholesterolemia: analysis of a representative sample of Korean older adults. *Osong Public Health Res Perspect*. 2016;7(2):108-115. doi:10.1016/j.phrp.2015.12.002

**6**. Burki T. Why India should worry about a coepidemic of diabetes and tuberculosis. *BMJ*. 2015;350:h111. doi:10.1136/bmj.h111

**7**. Kornfeld H, West K, Kane K, et al. High prevalence and heterogeneity of diabetes in patients with TB in south India: a report from the Effects of Diabetes on Tuberculosis Severity (EDOTS) Study. *Chest*. 2016;149(6):1501-1508. doi:10.1016/j.chest.2016.02.675

**8**. Swaminathan A, Kim R, Xu Y, et al. Burden of child malnutrition in India: a view from parliamentary constituencies. *Econ Polit Wkly*. 2019;54(2)44-52.

**9**. Mazumdar S, Satyanarayana S, Pai M. Self-reported tuberculosis in India: evidence from NFHS-4. *BMJ Glob Health*. 2019;4(3):e001371. doi:10.1136/bmjgh-2018-001371