

# Behavioral and structural risk factors underlying male-female disparities in tuberculosis burden: An analysis of Brazil's National Tuberculosis Disease Registry from 2015-2022

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**Background:** Globally, tuberculosis rates are consistently higher among males than females. The extent to which modifiable risk factors – such as incarceration, smoking, and alcohol use – contribute to this male-female gap is unknown.

**Methods:** We analyzed adult cases of tuberculosis from Brazil's national tuberculosis registry from 2015-2022. For incarceration, smoking, and alcohol use, we estimated the share of the male-female difference in tuberculosis diagnoses occurring among individuals with that risk factor, overall, stratified by year, age group, and Brazilian state. To address overlapping exposures, we classified individuals into eight mutually exclusive groups and estimated each group's share of the male-female gap.

**Results:** Of 733,615 cases, 534,286 (72.8%) were males resulting in 334,957 excess cases of tuberculosis among males. In Brazil, a substantial fraction of the male-female gap occurred among individuals with at least one of the three factors. Across all years, 19.4% (95% Confidence Interval (CI): 19.3, 19.5) of excess male notifications occurred among individuals incarcerated, 33.7% (95% CI: 33.5, 33.9) among those reporting alcohol use, and 28.9% (95% CI: 28.1, 29.6) among those reporting smoking. A greater share of percent excess cases reported smoking when compared to alcohol use and incarceration from 2015 to 2022. When stratified by age group, incarceration contributed the most to the male-female gap among adults 18-29 (31.5%; 95% CI: 31.4, 31.9) with incarceration contributing less as individuals aged. Risk factors frequently overlapped, with the majority of excess cases occurring among individuals reporting alcohol use and smoking (18.2%; 95% CI: 18.0, 18.3).

**Conclusion:** Incarceration, alcohol use, and smoking were each associated with a large share of the male–female disparity in tuberculosis diagnoses. The contribution

of incarceration was greatest at younger ages and declined with age and is in line with broader trends of incarceration. Interventions addressing these modifiable exposures may substantially reduce sex-based tuberculosis disparities.

**Disclosure of Interest Statement:** No contributions were received relevant to this work.