

## **A Cross-Sectional Study on Geographic Alignment of Student-Run Free Clinics with County-Level Environmental Hazards**

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**Background:** Populations served by student-run free clinics (SRFCs) are disproportionately impacted by poverty, lack of insurance, and other social drivers of health.<sup>1</sup> Studies have shown an increased density of coal-fired powerplants in communities of color.<sup>2</sup> These powerplants produce particulate matter with a diameter of less than 2.5 micrometers (PM2.5), which is the fifth highest ranking risk factor for global mortality.<sup>3</sup> Due to the historical practice of redlining, people living in poverty and minoritized populations are at an increased risk of exposure to higher PM2.5 levels and other air pollutants.<sup>4</sup> Student-run free clinic (SRFC) patient populations are studied frequently on a clinic-by-clinic basis. However, there has not been a nationwide analysis regarding SRFC locations and exposure to social drivers of health. This study will determine if SRFCs are in areas disproportionately affected by environmental health hazards to inform clinic resource allocation and screening protocols.

**Methods:** This cross-sectional study leverages publicly available data to determine the extent to which environmental health hazards may impact the patient populations served by SRFCs, as identified in the Society of Student-Run Free Clinics' master list. Clinics were categorized based on designation as Primary Care Health Professional Shortage Areas (pcHPSAs) and/or Medically Underserved Areas (MUAs) using the Health Resources and Services Administration database. Population characteristics and insurance coverage rates were obtained from the United States Census Bureau. Environmental Health Hazard exposure is estimated by the U.S. Department of Housing and Urban Development and includes standardized estimates of carcinogenic, respiratory, and neurologic hazards. Values are inverted and ranked with values 0-100, with 100 being the highest quality environment. Statistical analysis includes descriptive statistics and Poisson regression. This study was IRB exempt as non-human research under 45 CFR 46.104(d)(4)<sup>5</sup>.

**Results:** 25.3% of clinics were in the bottom quartile for environmental hazard index, 27.8% were in the second quartile, 23.7% were in the third quartile, 23.3% were in the top quartile, as shown in Table 1. County-level analysis of 200 SRFCs demonstrated that clinics were disproportionately located in communities characterized by greater environmental burden. Lower environmental hazard index values, corresponding to poorer environmental conditions and higher environmental hazard exposure, were directionally associated with greater proportions of SRFCs located in pcHPSAs and MUAs via Poisson regression modeling (adjusted IRR 0.998, 95% CI 0.992–1.004,  $p=0.518$ ).

**Conclusions:** Descriptive analysis demonstrated that 53.1% of SRFCs operate in counties within the bottom two quartiles of the environmental hazard index, suggesting that many clinics serve communities impacted by overlapping healthcare disparities and environmental pollution. Although the association is not statistically significant, the directional trends align with previous literature outlining the overlap between environmental injustice and healthcare inequities. Future research should explore the relationship between environmental pollution and clinical outcomes among patients receiving care at SRFCs, and whether health screening initiatives tied to environmental hazards may benefit these populations.

## Figure

Table 1: Distribution of SRFCs by Environmental Hazard Index Quartile

| Environmental Hazard Quartile    | Index Range | SRFC Count | SRFC % |
|----------------------------------|-------------|------------|--------|
| Q1 (lowest quality environment)  | ≤19         | 49         | 25.3   |
| Q2                               | 20-38       | 54         | 27.8   |
| Q3                               | 39-60       | 46         | 23.7   |
| Q4 (highest quality environment) | >60         | 45         | 23.2   |

## References

1. Cason J, Dinkel D, Metcalf M, et al. Disparities in patient demographics at a student-run free clinic: comparing clinic utilization to city, state, and national trends. *Cureus* [Internet]. 2025 Apr 28 [cited 2026 May 7]; 17(4):e82873. Available from: <https://pmc.ncbi.nlm.nih.gov/articles/PMC12069466/>
2. Braveman PA, Arkin E, Proctor D, Kauh T, Holm N. Systemic and structural racism: definitions, examples, health damages, and approaches to dismantling. *Health Aff (Millwood)* [Internet]. 2022 Feb [cited 2026 May 7];41(2):171-8. Available from: <https://www.healthaffairs.org/doi/10.1377/hlthaff.2021.01394> doi: 10.1377/hlthaff.2021.01394.
3. Cohen AJ, Brauer M, Burnett R, Anderson HR, Frostad J, Estep K, et al. Estimates and 25-year trends of the global burden of disease attributable to ambient air pollution: an analysis of data from the Global Burden of Disease Study 2015. *Lancet* [Internet]. 2017 May 13 [cited 2026 May 7];389(10082):1907-18. Available from: <https://pmc.ncbi.nlm.nih.gov/articles/PMC5439030/>
4. County Health Rankings & Roadmaps. Air pollution - particulate matter [Internet]. Madison (WI): University of Wisconsin Population Health Institute; 2025 [cited 2026 May 7]. Available from: <https://www.countyhealthrankings.org/health-data/community-conditions/physical-environment/air-water-and-land/air-pollution-particulate-matter?year=2025>
5. Columbia University. The revised common rule [Internet]. New York (NY): Columbia University Research Compliance and Training; [cited 2026 Jan 22]. Available from: <https://research.columbia.edu/revised-common-rule>

