Expanding the Scope of Air Pollution: Wildfire Smoke and Diabetes Prevalence

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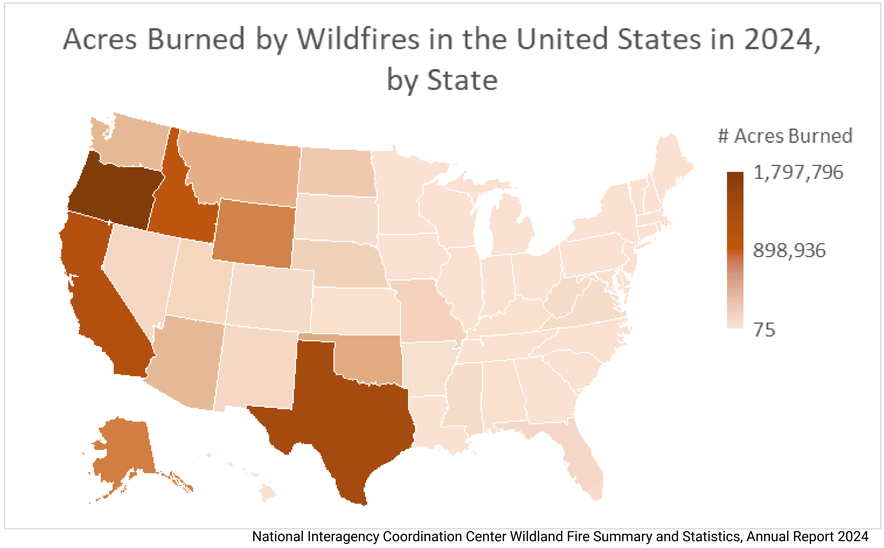
Background

Mounting evidence suggests that ambient air pollution (AAP) plays a significant role in diabetes prevalence, particularly in urban environments where industrial emissions and high traffic volume contribute to elevated pollution levels. As climate change intensifies, wildfire and forest fires have emerged as a growing and unpredictable source of air pollution, yet their impact on chronic disease remains understudied. Given that nearly half of the U.S. adult population is affected by diabetes or prediabetes, understanding environmental contributors is critical for disaster preparedness and public health resilience. Despite increasing wildfire activity, research on the specific health effects of wildfire smoke exposure, such as diabetes incidence, remains limited.

This poster explores similarities between ambient air pollution and wildfire smoke exposure and their impact on metabolic dysfunction, including inflammation, oxidative stress, and insulin resistance.

Methods

A review of peer-reviewed literature was conducted to examine the impact of ambient air pollution on adverse health outcomes. Initial search of the relationship between wildfire-related pollutants and new-onset diabetes returned 351 articles. Further, articles that did not explore wild/forest fires specifically as a potential contributor to disease, duplicate results, and results written in another language were excluded. Articles examining the impact of pollutants on the worsening of disease were excluded, unless they also examined the physiological impacts of wildfire smoke exposure. 19 results remained following these exclusion criteria.



National Interagency Coordination Center Wildland Fire Summary and Statistics, Annual Report 2024

Results

Air pollution and extreme weather events were consistently associated with an increased incidence and severity of type 2 diabetes (T2D).

- Strong relationship between exposure to particulate matter ($PM_{2.5}$), nitrogen dioxide (NO_2), and other pollutants with impaired insulin sensitivity and increased diabetes-related morbidity.
- Lead and hydrocarbons were shown to contribute to insulin resistance by crossing the blood-brain barrier
- Long-term $PM_{2.5}$ exposure was linked to systemic inflammation and endothelial dysfunction.

- Wildfire-derived particulate matter contained higher inflammatory components than urban air pollution, which may contribute to more severe metabolic effects.
- Four studies were retrieved that found that $PM_{2.5}$ levels during wildfire seasons were associated with an increase in both cardiovascular and diabetic outcomes, with effects accumulating over time.

Discussion

The impact of wildfire-related air pollution on diabetes remains understudied. As global temperatures continue to rise, wildfire activity is expected to intensify, highlighting the urgent need for targeted research to understand the extent to which wildfire-driven air pollution may contribute to the growing burden of diabetes.

Conclusion

- Future research should further investigate the specific mechanisms by which wildfire smoke exacerbates metabolic dysfunction and explore potential mitigation strategies.
- Public health policy and hazard mitigation strategy must prioritize climate resilient interventions aimed at reducing exposure to air pollution and improving diabetes management in vulnerable populations.

References