Association of air pollution and chronic inflammatory skin diseases: Challenges of Google Trends data and importance of local data

To the Editor: We read with great interest the research letter published by Whang et al[1] entitled "Association of particulate matter air pollution and itch: A digital epidemiology approach"[1] The authors used a Google Trends Search Volume Index (SVI), a normalized value from 0 to 100, to show that increased air pollution, as measured by the concentration (μ/m^3) of particulate matter 2.5 μm and smaller ($PM_{2.5}$ concentration), was correlated with increased SVI for the term *itch* at the state -level in 2014. Although this finding aligns with evidence linking exposure to airborne pollutants with increased atopic dermatitis symptoms, the sociodemographic characteristics of participants and their local environments may introduce bias in the use of $PM_{2.5}$ concentrations as a proxy for personal exposure.[2,3]

We also have been recently evaluating the association between air pollution and several chronic inflammatory skin conditions. However, we evaluated a longer time frame, including data from 2010 to 2019, and evaluated annual SVI data at the designated market area (DMA) level, which is 4 times more discrete than the state level. We used annual monitored mean $PM_{2.5}$ concentrations from the US Environmental Protection Agency Air Quality Statistics Report at the core-based statistical area level, which we mapped to the corresponding DMA. In an effort to mitigate unmeasured

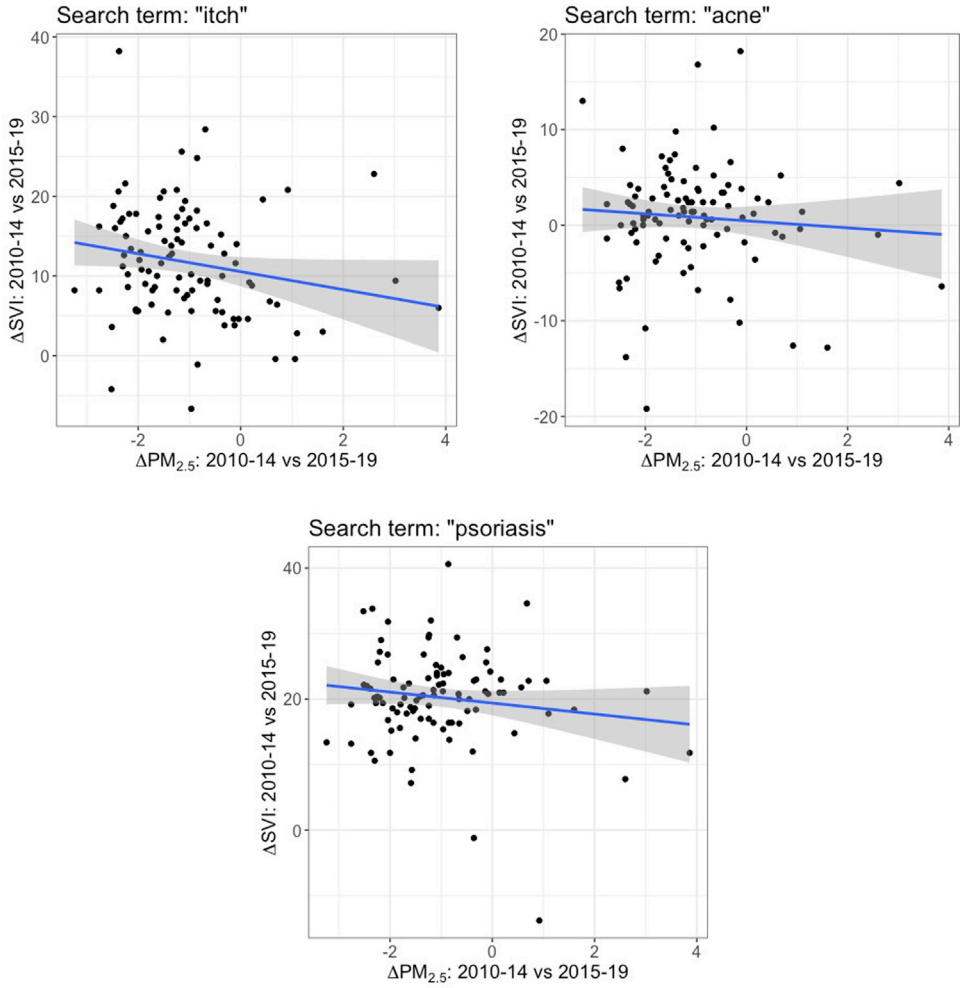

Fig 1. Changes in $PM_{2.5}$ concentrations versus changes in SVI for the search terms *itch*, *acne*, and *psoriasis*, 2010-2014 versus 2015-2019, at the designated market area level. The blue line represents the linear regression, and the gray shade represents the associated 95% confidence interval. $PM_{2.5}$ represents the concentration (μ/m^3) of particulate matter 2.5 μm and smaller, reported as weighted annual means. *SVI*, Search Volume Index.

confounding due to regional factors, we allowed each DMA to serve as its own control by comparing the difference in SVI and $PM_{2.5}$ concentrations between the 2015-2019 period and the 2010-2014 period. Analyses were conducted with R, version 3.6.1 (R Foundation for Statistical Computing, Vienna, Austria).

Multivariate linear regression was performed to examine the association between changes in $PM_{2.5}$ concentrations and changes in *itch* SVI, adjusted for urbanicity (based on National Center for Health Statistics classification scheme). Changes in annual average $PM_{2.5}$ concentrations did not predict changes in *itch* SVI (β = -0.954; 95% confidence interval, -2.099 to 0.192; P = .102; R^2 = 0.105; adjusted R^2 = 0.067). Analyses of *acne* SVI and *psoriasis* SVI also showed no correlations (Fig 1). Similar analyses using annual median Environmental Protection Agency Air Quality Index, a composite air quality score, also identified no correlations. Additionally, we performed a state-level analysis with the methods of Whang et al[1] for the years 2004 (the earliest SVI data available) to 2014. Although we successfully replicated their results for 2014, we found no correlation between annual statewide $PM_{2.5}$ concentrations and *itch* SVI for the years 2004 through 2010.

Although Whang et al[1] have made an intriguing observation of the association between $PM_{2.5}$ concentrations and SVI, our findings highlight several limitations that caution against generalization. First, interpreting $PM_{2.5}$ concentrations at the state level may pose challenges due the heterogeneity of environments within each state. Second, a broad study period is warranted, given the availability of multiple years of SVI and $PM_{2.5}$ data. Finally, singular measures such as $PM_{2.5}$ concentrations are subject to a wide variety of potential confounding measures, and it may be difficult to account for these factors. As a result, although population-scale and digital epidemiologic approaches can be valuable, it is important to consider study designs that reduce the potential influence of confounding and that evaluate the effects of pollution on skin disease at the level of the individual.[4,5]

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Funding sources: Dr Barbieri is supported by the National Institute of Arthritis and Musculoskeletal and Skin Diseases of the National Institutes of Health under award number T32-AR-007465 and receives partial salary support through a Pfizer Fellowship in Dermatology Patient-Oriented Research grant to the Trustees of the University of Pennsylvania. The funding sources had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

Conflicts of interest: None disclosed.

IRB approval status: Not applicable since study uses publicly available data and is not human subjects research.

Reprints not available from the authors.

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https://doi.org/10.1016/j.jaad.2020.05.047