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

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

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To the Editor:

We read with great interest the research letter published by Whang et al. entitled “Association of particulate matter air pollution and itch: A digital epidemiology approach”.¹ The authors used Google Trends Search Volume Index (SVI), a normalized value from 0 to 100, to demonstrate that increased air pollution as measured by 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 recently have been evaluating the association between air pollution and several chronic inflammatory skin conditions. However, we evaluated a longer timeframe 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 EPA Air Quality Statistics Report at the core-based statistical area (CBSA) level, which we mapped to the corresponding DMA. In an effort to mitigate unmeasured 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 3.6.1.

Multivariate linear regression was performed to examine the association between changes in PM_{2.5} concentrations and changes in *itch* SVI, adjusted for urbanicity (National Center for Health Statistics). Changes in annual average PM_{2.5} concentrations did not predict changes in *itch* SVI ($\beta = -0.954$ [95% CI = -2.099, 0.192], $p = 0.102$, $R^2 = 0.105$, adjusted $R^2 = 0.067$). Analyses of *acne* SVI and *psoriasis* SVI also revealed no correlations (Figure). Similar analyses

using annual median EPA 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. for the years 2004 (the earliest SVI data available) to 2014. While we successfully replicated their results for 2014, we found no correlation between annual statewide PM_{2.5} concentrations and *itch* SVI for the years 2004-2010.

While Whang et al. 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 to 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, while population-scale and digital epidemiological 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}

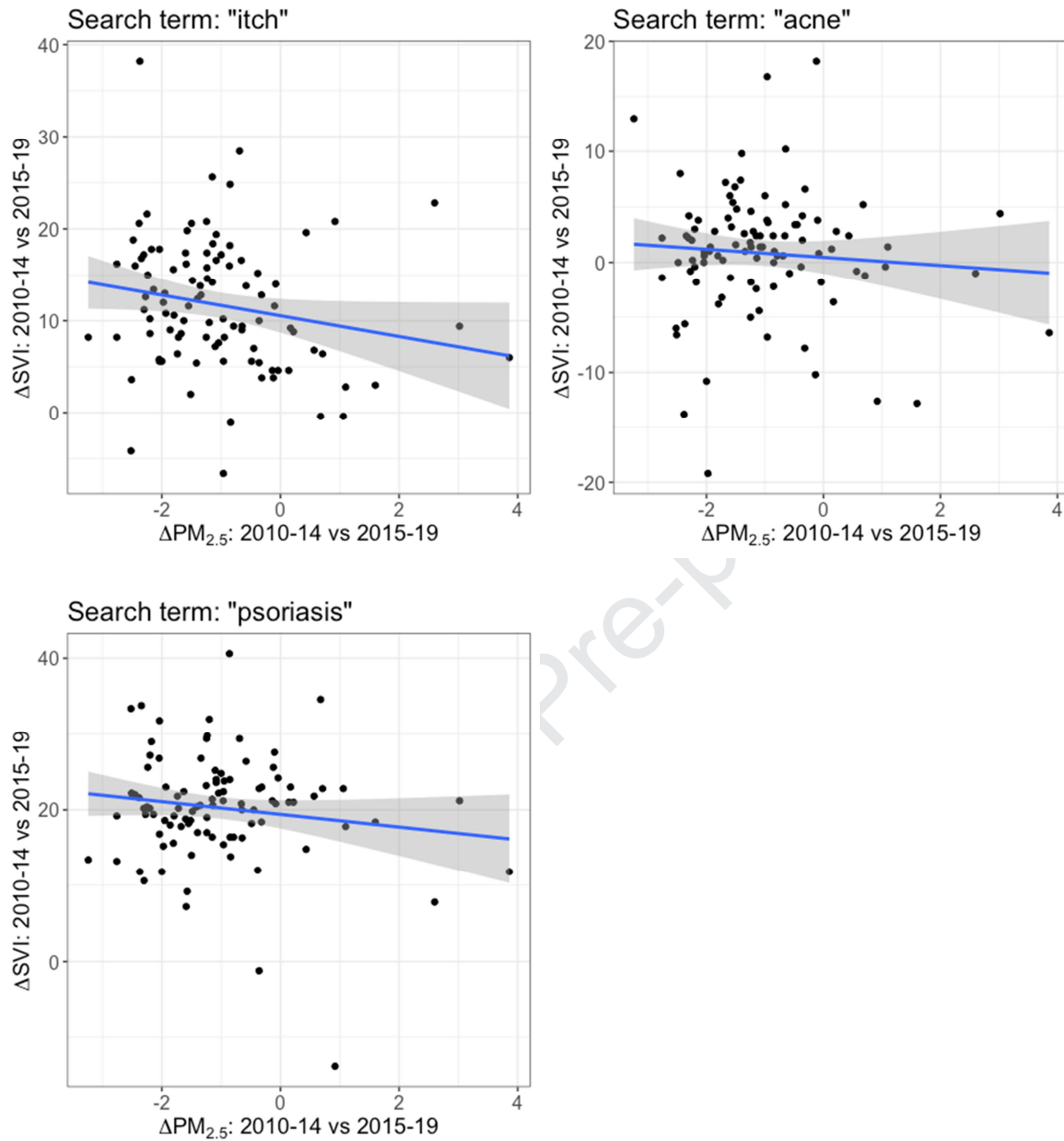


Figure. Changes in PM_{2.5} concentrations vs changes in SVI for the search terms “itch”, “acne”, and “psoriasis”, 2010-2014 vs 2015-2019, at the DMA-level. The blue line represents the linear regression and the gray shade represents the associated 95% confidence interval. PM_{2.5} concentration is the concentration (μ/m^3) of particulate matter 2.5 μm and smaller, reported as weighted annual means.

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