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Out of thin air? Investigating the association between pollution and psoriasis in the United States

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To the Editor:

Over 90% of the world's population experiences unsafe levels of daily air pollution [1]. Emerging evidence suggests that such pollution can be toxic to the skin [2]. One pollutant in particular, fine particulate matter (PM_{2.5}), is 20 times smaller in size than human pores and has been linked to various dermatologic conditions including acne, alopecia, psoriasis, and even skin cancer [2]. In psoriasis, gene based and in vitro studies have shown environmental concentrations of ultrafine particles disrupted keratinocyte differentiation, increased pro-inflammatory cytokines, and up-regulated psoriasis related genes [3,4]. However, a critical gap exists in studying the role of pollution on psoriasis prevalence and severity at a population-level. We investigated the relationship between pollution and psoriasis in the United States (U.S.) by utilizing Centers for Disease Control and Prevention (CDC) air quality data and Google Trends data.

To assess psoriasis prevalence or severity at a population-level across the U.S., we utilized Google Trends data for the search term "psoriasis." Google Trends data may serve as a proxy for the prevalence or severity of psoriasis because patients with newly diagnosed psoriasis or those experiencing a flare are more likely to search for the term "psoriasis." Google Trends has been used in numerous epidemiological studies throughout medicine, including dermatology, and its output has been successfully

validated against other healthcare datasets [5,6]. Google Trends utilizes Google search data and provides an adjusted, indexed output as a search volume index (SVI), which provides relative rankings of interest for a given search term.

To characterize air quality, we obtained PM_{2.5} levels for each state across the U.S. from the CDC from 2016 to 2018. We then compared these levels to the "psoriasis" SVI from the same time period using regression analysis. Multivariate analysis was also performed, adjusting for precipitation, temperature, percentage of the population living in an urban environment, and density for each state.

Additionally, two negative control analyses were performed. For our disease control, we used SVI for "down syndrome" and compared it to PM_{2.5} levels. Down syndrome was selected because it is a genetic condition that is not known to be associated with pollution. For our exposure control, we used atmospheric nitrogen (N₂) concentrations and compared it to "psoriasis" SVI. Nitrogen was chosen because it is a small molecule also present in the surrounding ambient air but, likely due to its inert nature, it is not known to have an association with psoriasis.

Elevated levels of PM_{2.5} were associated with higher SVI for "psoriasis" (R²=0.11, P=0.02) but showed no association with SVI for "down syndrome" (R²<0.001,

P=0.88). Additionally, atmospheric N₂ concentrations demonstrated no association with SVI for "psoriasis" (R²<0.001, P>0.99). After adjustment, searches for "psoriasis" were found to have a stronger association with PM_{2.5} levels (R²=0.37, P=0.001).

This digital epidemiological approach demonstrated a modest but significant association between air pollution and searches for psoriasis. Additionally, exposure and disease negative controls helped confirm the validity of the model and demonstrated specificity between PM_{2.5} and psoriasis. However, limitations of this analysis include the inability to distinguish whether increased searches for psoriasis reflect increased incidence or exacerbation of psoriasis.

This novel finding contributes to our understanding of the pathogenesis of psoriasis and provides a population-level analysis to support findings of previous studies [3, 4]. It is important to investigate

this relationship further to characterize how psoriasis severity may be affected by pollution levels. Furthermore, population-based studies evaluating psoriasis severity in more polluted cities versus less polluted regions may also help inform our understanding of this relationship.

Potential conflicts of interest

April W. Armstrong has served as a research investigator and/or scientific advisor to AbbVie, Almirall, Arcutis, ASLAN, Beiersdorf, BI, BMS, EPI, Incyte, Leo, UCB, Janssen, Lilly, Nimbus, Novartis, Ortho Dermatologics, Sun, Dermavant, Dermira, Sanofi, Regeneron, Pfizer, Parexel, and Modmed. Manan Mehta, Sabrina Khan, Samiya Khan, Nicole Maynard, Rasika Reddy, Danielle Yee, and Caterina Zagana-Prizio have no conflicts of interest to declare relevant to this manuscript.

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