Environmental Exposures and Autoimmune Risk: Implications for Rheumatology

By Sasha Bernatsky, MD, PhD; and Autumn Neville, BA

For well over a decade, I have had a strong interest in air pollution's association with immune dysregulation and the development of rheumatic diseases. When the *Journal of the Canadian Rheumatology Association (CRAJ)* invited me to write about my research in this area, I was thrilled! Of course, in rheumatology we know that environmental exposures, alongside genetic susceptibility, likely play key roles in disease initiation and progression. However, many exposures that are strong triggers for certain autoimmune rheumatic diseases (such as respirable silica) are relatively uncommon. Air pollution, on the other hand, is something everyone is exposed to.

Using large data sets from Canada (and the United States), my group examined fine particulate matter (air particles that are less than 2.5 μ in diameter, PM2.5) and other common air pollutants in relation to both autoantibodies and clinical rheumatic disease. A key theme of this research is identifying pre-clinical markers of autoimmunity (such as autoantibodies) that may be influenced by environmental exposures long before patients present for rheumatology care.

Several studies have suggested links between air pollution and autoantibodies. In one large Ontario-based analysis, we demonstrated that long-term exposure to PM2.5 was associated with the presence of antinuclear antibodies (ANA) in the general population. We also found that exposure to industrial air pollution, including sulfur dioxide and PM2.5, was strongly correlated with the presence of anti-citrullinated protein antibodies (ACPA) in a Quebec cohort. Because ANA and ACPA positivity can precede the onset of systemic autoimmune disease by years, these findings support the hypothesis that air pollution may act early in the autoimmune disease pathway, potentially contributing to immune system activation.

More recent work has extended these findings to disease incidence. Leveraging administrative health databases, we examined long-term exposure to ambient PM2.5 and systemic autoimmune rheumatic diseases (SARDs) and rheumatoid arthritis (RA) onset. PM2.5 exposure was associated with an increased risk of incident disease, even after accounting for key sociodemographic factors. Collectively, these studies strengthen the biological plausibility that inhaled particulates from air pollution promote systemic inflammation and immune dysregulation relevant to rheumatologic disease.

A constant challenge in this kind of research has been methodological rigor, including refined exposure assessment, sensitivity analyses, and attention to potential confounders. While these studies are observational, their convergence across outcomes (autoantibodies and disease incidence) underscores the relevance of air quality as a modifiable environmental exposure when it comes to rheumatic disease burden.

Parallel to this research agenda, rheumatologists across North America (and beyond) have worked to promote knowledge translation and clinician engagement through REACTRheum (which stands for Rheumatology Engaged in Action for Climate Health). REACTRheum is an international consortium of rheumatologists, researchers, trainees, and allied health professionals interested in planetary health, exploring the intersections of climate change, air pollution, and rheumatic disease. This initiative provides educational resources, webinars, and supports dialogue on how environmental health considerations can be incorporated into rheumatology practice and research.

Recent REACTRheum topics have ranged from pollution-related health impacts to sustainable approaches to clinical care, with the broader goal of empowering the rheumatology community to engage in evidence-based action and advocacy.

In summary, recent research reinforces the relevance of air pollution as a potential contributor to autoimmunity and systemic rheumatic disease, while initiatives such as REACTRheum help translate these insights into education, advocacy, and action within the rheumatology community. I hope you will join us! More information and resources are available at *https://reactrheum.org*.

Sasha Bernatsky, MD, PhD
James McGill Professor of Medicine,
Department of Medicine, McGill University
Senior Scientist,
Centre for Outcomes Research and Evaluation
The Research Institute of the McGill University Health Centre

Autumn Neville, BA
Research Coordinator,
Centre for Outcomes Research and Evaluation
The Research Institute of the McGill University Health Centre