

Report 53: Effects of the Environment on the Immune System

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Brief History: Recent studies have emphasized the importance of environmental factors in immune system development and function; however, this has been an understudied area at NIEHS and at NIH overall.

Discussion Highlights:

- The role of environmental exposures in allergic diseases pathogenesis has historically gotten lots of attention, but there has been limited focus on other areas of importance including autoimmune diseases, infectious diseases and host defense mechanisms. Research involving animal models and human studies are both critical.
- There is a disconnect between what epidemiologists and basic researchers are studying with respect to environmental exposures; research efforts need to be better coordinated.
- Both human and animal research efforts need to focus on measuring endpoints that relate directly to immune system function.
- A barrier for research in humans is accessibility of relevant tissues/cells; some tissues (e.g. nasal washes) are more easily accessible than others, but may not be suitable in some situations.
- The inherent memory of the immune system is an untapped resource that may provide a biomarker of past environmental exposures.
- There is a gap in knowledge about how environmental factors impact innate immune system function, especially at mucosal sites, to affect disease onset and/or progression including diseases that develop in non-immune locations (e.g. brain).
- The emerging role of the microbiome – immune system as a bridge between host and environment.
- The role of genetic susceptibility and how this needs to be factored into research on environmental influences on immune function.
- The impact of the environment on immune system development needs more attention with an emphasis on epigenetic regulation and vulnerable windows; there was extensive discussion on this topic.
- Need to develop cross-species translational biomarkers
- Tox21 could be used conceptually to study immunotoxicity of environmental agents. Blood or cultured cells could be used as tools to answer key questions and/or validate human biomarkers of exposure.

- Better marketing is needed for immunotoxicology and host susceptibility.

Recommendations:

- 1) Expand research on how the environment impacts immune function and health in human populations; expanded use of existing human databases to focus the research questions.
- 2) Strengthen NIEHS' niche as leaders in understanding how early life environmental exposures (i.e. in utero and early post-natal) affect the development and function of the immune system.
- 3) Extend research on vulnerable windows throughout the lifespan – from conception to adolescence to aging – as these either are susceptible windows in time or represent especially susceptible populations of individuals.
- 4) More research on how the environment influences host defenses (how the environment serves as a modifier of host defense mechanisms) and how infections modify how the host responds to environmental exposures (e.g. bidirectional interactions).
- 5) More mechanism-based studies on how environmental chemicals perturb immune system function.
- 6) Develop PPG mechanisms (e.g. cooperative agreements, U01) that pull together scientists in three arms of NIEHS (NTP, DIR, DERT) to work collaboratively/cooperatively on studies related to environmental influences on the immune system.
- 7) Improve publicity of NIEHS' and NTP's research capabilities and contributions to this area of research.
- 8) Hold a series of workshops to develop ideas for research opportunities and foster more research in this area.

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