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PESTICIDES AND THE IMMUNE SYSTEM: THE PUBLIC HEALTH RISKS

EXECUTIVE SUMMARY

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There are substantial grounds for concern about the public health risks from pesticide-induced suppression of the immune system, especially in less developed countries and countries in economic transition. The tonnage of pesticides used in these countries will continue increasing as agricultural production intensifies. Still widely used are chemicals with known acute and chronic toxicity – including many older products that have been banned, severaly restricted, or withdrawn from agricultural uses in the United States and Europe. In Japan, Europe, and the United States, there are also risks to farm workers and others significantly exposed to pesticides, though such groups make up much smaller fractions of total populations and, *by and large,* exposure levels are lower.

The controls over pesticide use in developing-country agriculture are particularly lax. Typically, government regulations on marketing and use are weakly enforced. Distribution networks provide for less product stewardship and support than in more advanced markets. Many pesticides used in developing countries are no longer under patent protection and are distributed and sold with few instructions or safeguards. Pesticides are therefore often used in applications and in ways for which they are not intended, creating safety and health risks. Misuse also occurs in more advanced countries, but not to the same extent.

Although systematic estimates of overall exposure are not available, evidence indicates that hundreds of millions of farm workers, farm households, and consumers are probably exposed to dangerous levels of pesticides. Direct observations of farmers handling, spraying, and disposing of pesticides show that they can be significantly exposed at work. Observations of the way rural households in developing countries store pesticides, prepare food, bathe, obtain drinking water, and come near pesticide spray operations estabish that rural household members can also be exposed through various routes. These observations are confirmed by biological mesurements of metallic and organochlorine pesticide residues in people's bodies and of acetylcholinesterase enzyme depletion, which indicates exposure to organophosphate pesticides. The presence of persistent bioaccumulative pesticide residues in foods, body tissues, and human breast milk indicate that even consumers far removed from agricultural operations can also be significantly exposed.

A large body of experimental evidence based on research on living cells or laboratory animals suggests that many of the pesticides to which such populations are exposed damage the immune system. Substances that are immunotoxic to test animals often are found to have similar effects on humans because the immune systems of all mammals are quite similar. Batteries of tests endorsed by the U.S. Environmental Protection Agency and international health organizations and now routinely used by immunotoxicologists show that a variety of organochlorine, organophosphate, carbamate, and metalic pesticides are immunotoxic. They alter the immune system's normal structure, disregulate and disturb immune responses, and reduce the resistance of exposed animals to antigens and infectious agents. This assessment of the experimental evidence is widely shared by immunotoxicologists working in this field. Unfortunately, many of the pesticides now on the market were never adequately tested for immunotoxicity before regulatory approval was given; nor have they been reexamined yet by regulatory bodies in light of new scientific evidence.

Studies in the wild of fish, birds, and mammals exposed to pesticides and related organochlorine compounds through their diet also provide evidence that these compounds are immunosuppressive. In particular, a carefully controlled prospective study of harbor seals in captivity in Europe demonstrated that eating fish contaminated with bioaccumulative pesticides and other polyhalogenated aromatic hydrocarbon compounds for several months significantly suppressed immune system functions. Although the study was designed to learn the reason for heavy mortality from viral infections that seals can usually tolerate, the contaminated fish – purchased right from fish markets – was originally destined for human consumption.

There is direct and indirect evidence that these research findings carry over to human populations exposed to pesticides. The indirect evidence stems largely from studies of cancer risks in populations occupationally exposed to pesticides. Such populations of farmers and other workers are at significantly elevated risks of certain cancers that are typically found in people who are immuno-suppressed because they have AIDS, because they are taking immunosuppressive drugs to safeguard organ transplants, or because they suffer from genetic immunological deficiencies. The same cancers of the immune system – certain leukemias, lymphomas, and myelomas – occur at elevated rates in people known to be immunosuppressed and also in groups exposed to pesticides, such as farmers. This finding suggests that pesticides are also immunosuppressive in humans.

There is direct evidence from clinical and epidemiological studies of humans who are occupationally or accidentally exposed to pesticides that normal immune system structure and functions are thereby altered. In general, these findings are consistent with the experimental evidence, showing reductions or disruptions in cell-mediated and non-specific immunity. Many of these studies of otherwise healthy people have not assessed or have not found concomitant evidence of reduced host resistance to infectious diseases or other significant clinical consequences. However, other epidemiological studies have shown an association between pesticide exposure and increased risks of chronic health disorders, including infectious diseases, but did not assess or document alterations in the immune system. These gaps in the epidemiological evidence make firm conclusions difficult.

For several reasons, few epidemiological studies on human populations have been designed to investigate pesticide ex-