

Pesticides and Human Health

Why Public Health Officials Should Support a Ban on Non-essential Residential Use

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ABSTRACT

The College of Family Physicians of Ontario recently released a comprehensive report on pesticide exposure and health risk, concluding that various pesticides had adverse health effects. The pesticide industry says that pesticides are “safe” when used as directed because they are studied and approved by governmental agencies. Yet many municipalities, including Canada’s three largest, and the province of Quebec have enacted bans on cosmetic use of pesticides, largely in response to health concerns. Reviewing the report, the status of regulation of pesticides and the limitations of studies and of regulation in Canada, it appears that on the basis of evidence available to date, public health officials should support a ban on cosmetic use of pesticides.

MeSH terms: Pesticides; environmental health; public health; legislation; Canada; toxicity

La traduction du résumé se trouve à la fin de l'article.

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The College of Family Physicians of Ontario has recently released a comprehensive review of health effects of pesticides.¹ The Toronto Board of Health, which did a major review on health effects,² led the effort to achieve a bylaw. Toronto, Montreal, Halifax and Vancouver each have instituted phased-in bans on non-essential, residential use of pesticides within the last four years.³⁻⁵ In Quebec, after a number of individual municipalities passed their own by-laws, the government introduced a province-wide Pesticides Management Code⁶ in 2003, severely limiting the sale and use of most commonly used lawn and garden pesticides. Such actions compel consideration of the general question of what role health professionals, and in particular those in public health, should take on the issue of bans on pesticide use.

History

Pesticides, as the name ‘cide’ implies, are killers – that is, they are meant to selectively kill organisms we consider undesirable. As such, they are analogous to chemotherapeutic agents or antibiotics. Historically, pesticides included heavy metals such as arsenic, lead and mercury and plant derivatives such as nicotine from tobacco leaves, pyrethrum from chrysanthemum flowers and rotenone from the derris root. Synthetic pesticides were developed in the 20th century, frequently for use in warfare – a historical reality that underlines their toxicity.

Their use has broadened and now pesticides have become ubiquitous in our environment. Groundwater tests have revealed that our drinking water may contain residues of up to 39 different pesticides.⁷ Peaches, apples, pears and grapes and even breastmilk and meconium⁸ contain residues of a variety of pesticides. Seventy percent of pesticides are used in agriculture. The remaining thirty percent are applied in a wide range of human activities including forest management, lawn and garden, golf course maintenance, pet care, industrial site care, as repellents, and for indoor pest management such as in washrooms, closets and building structures.

Health effects and vulnerable groups

The acute adverse human health effects of insecticides, including neurological, gastrointestinal, dermatological and respiratory manifestations, and even heart block,

coma and death, are primarily linked to acetylcholine blockade. The WHO estimates that pesticides annually poison up to 3,000,000 people worldwide with 200,000 deaths⁹ primarily due to accidental exposure or intentional ingestion. With notable exceptions, such as paraquat, a severe respiratory toxin, herbicides generally have little acute toxicity.

Chronic effects are more difficult to demonstrate. Rachel Carson's influential *Silent Spring* (1962) was the first major work to demonstrate more chronic problems (an increase in Non Hodgkin's lymphoma in agricultural areas).¹⁰ Certain groups are more vulnerable to effects of pesticides than others. Increased use puts farmers and their families, gardeners and golf course superintendents at higher health risk. Children, fetuses, the elderly and pets may have a biological vulnerability. Relative to their weight, children eat more, drink more, breathe more and have a greater surface area and a more permeable blood brain barrier than adults do. In addition, they may have greater exposure due to diets more concentrated in specific foods and more hand-mouth behaviour, including eating soil. They spend hours in areas of highest concentrations of pesticides – on the ground (floor, grass), often with little clothing. Finally, children (and pets) cannot read warning labels or instructions.

Pesticide Review OCFP Report¹¹

Method

The College of Family Physicians of Ontario, concerned that published reviews and studies which led to ultimate government approval were not adequately systematic or comprehensive and that many studies showing harm or safety were poorly conducted, chose to critically evaluate this body of work. Led by academic physicians from three Ontario medical schools, a team from the College examined peer-reviewed works from 1992 to 2003 in English, French, Spanish and Portuguese, initially surveying Medline and CancerLit and other language databases. Beginning with over 12,000 studies, they then filtered out the extensive literature concerning organochlorines, which are already banned, as well as those with poor or uncertain methodology. This provided a dataset of 30 high-quality reviews and over 250 well-done primary studies (100 cancer

TABLE I

Why Studies Cannot Fully Protect Society

- a) **Vulnerable populations:** Certain populations, such as children, fetuses and the elderly, may be disproportionately exposed or vulnerable. Certain individuals may be ethnically or genetically sensitive.
- b) **Acute vs. chronic, low-level exposure:** Studies generally look at short-term effects and extrapolate. With animals, it is often short-term high exposure.
- c) **Weather conditions:** Studies may assume ideal weather conditions for use.
- d) **Multiple exposures/interactions:** A number of different pesticides are often present together in the same commercial products. Their effects may be additive or multiplicative.²⁶
- e) **Critical vulnerability** may occur with exposure during critical periods in foetal development, but this is usually neither noted nor measured.
- f) **Other ingredients:** While active ingredients are tested, other components such as formulants, stickers, spreaders, emulsifiers and solvents are not. Many of these, such as toluene or benzene, are known carcinogens.
- g) **Who studies?** With governmental resources increasingly curtailed on ideological or short-term economic grounds, industry has been allowed responsibility for doing its own studies. Unfortunately, though regulators formally provide oversight, industry researchers have biases which might be reflected in the design, conduct or reporting of study findings.
- h) **Grandfathering:** Most pesticides were registered long before extra safety factors and present analytical methods were in place; many have not been re-evaluated for decades, if ever. 6,000 were registered by the 1969 PCPA administered by Agriculture Canada before the PMRA. The vast majority have not been re-tested.
- i) **End point not studied:** Studies of 'hormone disruption' or effects on the nervous system of children can be difficult to carry out, and have only rarely been done.

and 150 non-cancer) on which the reviewers performed detailed analysis.

Results

Triazine herbicides were found to be associated with increased breast cancer risk; phenoxy herbicides and carbamates with increased lung cancer risk; while the indoor use of insecticides was linked to brain cancer (including astrocytomas and gliomas) and acute lymphocytic leukemia in children. Exposure to pesticides in the home and garden during pregnancy increased the risk of childhood acute lymphocytic leukemia. Even offspring of occupationally exposed men had higher rates of kidney cancer. Six pesticides, including 2,4-D and Dicamba, were associated with increased time to pregnancy and pyrethrins with delayed, chronic neurological effects (Parkinson's disease), chromosome aberrations, rashes in licenced pet pesticide applicators, and fetal intrauterine growth retardation (IUGR). Fungicide exposure had positive association with dermatitis. The herbicides, glyphosate and glufosinate, were associated with congenital malformations. Parkinson's disease and possibly amyotrophic lateral sclerosis (ALS) and Alzheimer's disease in men (one study only for each of the last two), all were linked to long-term pesticide exposure. Despite evidence of toxicity to the developing nervous system, only two studies were undertaken on adverse neurological effects in children, but both demonstrated significant reasons for concern. Included here was the justifiably well-known work of anthropologist Elizabeth Guillelte.¹²

Especially impressive was Hardell and Erikson's 2003 study of the decline in non-Hodgkin's lymphoma in countries where the herbicide 2,4-D had been banned for over ten years. The authors concluded that 5% of NHL is attributable to pesticide exposure.¹³

No clear link of any harm to the fetus was found when pregnant women used the insect repellent DEET during the second and third trimesters of pregnancy.

The final conclusion, i.e., that exposure to all commonly used pesticides (phenoxy-herbicides, organophosphates, carbamates and pyrethrins) has shown positive association with adverse health effects, made headlines throughout North America.¹⁴⁻¹⁶

Response of the Pesticide Industry

Since the pesticide industry is worth \$30 billion (US)¹⁷ worldwide, such a startling conclusion could not go unchallenged. The pesticide industry claims that pesticides reduced cancer rates by introducing more fruits and vegetables into the North American diet.¹⁸ Unsupported by medical evidence, proponents further assert that pesticides are necessary for children who are susceptible to allergies such as ragweed, and asthma and to control infections such as West Nile disease.¹⁹

The Report has been criticized as having family doctors who were less knowledgeable, and possibly biased, as principal investigators. The evaluative team's expertise was far greater: also included were a community medicine professor/epidemiologist, an MD, MPH, PhD environmental epidemiologist,

and reviewers including a PhD specializing in systematic reviews who consulted, a research/clinical oncologist at the Mayo Clinic who reviewed the cancer chapters, a genetics researcher at Sick Kids who reviewed the genotoxicology chapter, a PhD in reproductive epidemiology who worked on the reproduction chapter, a PhD student in environmental epidemiology, and two community medicine residents. (Personal communication, Margaret Sanborn, project leader, September 21, 2004.) The industry has felt compelled to respond with legal threats and to launch its own presumably unbiased reviews in response. Deserving closer scrutiny and consideration is the claim by Lorne Hepworth, President of CropLife Canada: "It (the Report) ignores the fact that Health Canada regulates all pest control products manufactured and sold in Canada, and that the products are subject to some of the toughest regulatory standards in the world."²⁰

Who regulates the use of pesticides and how?

In general, all three levels of government are involved in the regulation of pesticides. The federal government is responsible for product safety, approval and label requirements; the provinces for the sale and handling of products and licensing applicators; and municipalities for development of bylaws regulating use on public and private land. How has each chosen to act?

In 1991, Hudson, Quebec became the first Canadian jurisdiction to ban the use of pesticides for cosmetic purposes on both public and private property. The bylaw withstood a Supreme Court challenge in 2001. Using its mandate to regulate sales, the province of Quebec adopted a Pesticides Management Code in 2003, prohibiting the sale of such products as 2,4-D, MCPA and combination pesticide and fertilizer products. It further prohibited the use of pesticides inside and in proximity to day-care centres, schools and summer camps, citing the heightened vulnerability of children. By 2008, domestic use products will only be distributed in Quebec stores via special access shelving inaccessible to the public except by permit. But it is the federal government that tests and licenses products and whose approval industry cites to support safety of their products. Is that regulation sufficient protection?

The federal government's Pest Management Regulatory Agency (PMRA) was established in 1995 to act as a branch of Health Canada.²¹ Mandated to protect human health and the environment, the PMRA also assumed the regulation of pesticides through the administration of the Pest Control Products Act (PCPA).²²

Problems with monitoring

Monitoring by the PMRA has been hampered by limited resources. Prospective studies are very expensive. Randomization would be difficult if not impossible for most exposures, and in any case would be unethical, at least in humans. Studies are often conducted using a single chemical exposure on healthy adult male humans or other animal models. Industry often conducts its own studies, employing a standardized, but scientifically unproven product safety factor meant to provide for differences between animals and people, and between different types of people. Table I details some problems with this approach. Other epidemiological methods have their own problems. Ecological studies are indirect, relying on limiting factors such as type of crop or job description, and may have no true control group. Case control studies may be flawed due to recall bias, low participation or sample size, and loss to follow up.

As has become clear in the last few decades, government approval is no guarantee of safety. Lead, mercury, PCBs and asbestos are only a few of the substances that have received government approval in the past, and have resulted in tremendous ecosystem damage, severe health problems, massive cleanup operations and sizeable legal bills. Previously approved pharmaceutical drugs are recalled on a monthly basis.

Over the years, pesticides have regularly been removed from the market because of unacceptably toxic effects. The US Environmental Protection Agency (EPA) considers many organochlorines (the earliest synthetic pesticides) including DDT to be probable carcinogens.²³ In the last few years, some organophosphates such as Dursban (chlorpyrifos), Diazinon, methyl parathion and azinphos methyl used to control insects and grub worms,²⁴ have all been subject to a 'voluntary' phaseout by the EPA. And in Canada, as recently as May 2004, producers voluntarily removed the racemic form of mecoprop, a herbicide found in many weed

killers for home use, after learning it was about to be banned or restricted.

The PMRA felt compelled to respond to the College Report. "The PMRA agrees with the recommendation of the OCFP report that Canadians can and should seek opportunities to minimise their exposure to and reduce their reliance on pesticides. As such, the PMRA supports Integrated Pest Management (IPM) practices. IPM is an approach that combines biological, cultural, physical and chemical tools to manage pests so that benefits of pest control are maximized and health and environmental risks are minimized."²⁵

Is legislation practical or necessary?

Should we not just continue with a harm reduction strategy involving IPM and education alone, and is a ban really practical? A global study showed that education campaigns alone have not resulted in a significant decrease in pesticide use.²⁷ Since 1990, the City of Waterloo, Ontario's Plant Health Care Programme²⁸ achieved a 99% reduction in pesticide use, showing that a general ban on city property was practical.

Physicians are taught "primum non nocere" ("first of all, do no harm"). Environmentalists seek the same basic protection for the ecosystems on which we depend for survival – i.e., the Precautionary Principle.²⁹ It is increasingly accepted in both the public and private sectors that the obligation should not be on citizens and their representatives to demonstrate harm, but rather on those introducing new products to society to prove not only that the products themselves are safe, but that clean production processes are used with insignificant discharge of foreign, noxious substances. This is known as the 'Reverse Onus'.³⁰ These conditions are not met by currently used pesticides.

While an argument could be made for the selective use of pesticides to deal with outbreaks, agricultural use or spot application for infestations, this is distinct from the undifferentiated, widespread use we are witnessing today. The benefits of permitting cosmetic pesticide use cannot be justified by the risk to public health.

CONCLUSION

It seems we are already past a tipping point. Political will is finally being mobilized regarding cosmetic pesticide use, with

Canada's three largest cities already having passed restrictive bylaws, and with the province of Quebec and municipalities in all parts of the country also acting forcefully to limit use. Even prior to this report, the House of Commons Standing Committee on Environment and Sustainable Development report³¹ stated: "Given what is known or suspected about the harmful effects of these products and given the purely esthetic purposes they serve, the Committee favours a ban on the use of pesticides for cosmetic purposes", adding that "...hopefully, the use of pesticides for cosmetic purposes will become as frowned-upon as smoking cigarettes in public, thus making a full moratorium a more socially acceptable solution."

The Canadian Cancer Society, Canadian Association of Physicians for the Environment and the Registered Nurses Association of Ontario have each spoken out against cosmetic pesticide use. The Ontario Public Health Association has generally supported bans on use and most recently came out in support of Toronto's bylaw.³² The report of the College of Family Physicians of Ontario provides ample evidence for these stands.

In 2002, the Canadian Public Health Association called upon Canadian municipalities "to restrict the non-essential use of chemical pesticides on public and private land" and "to strengthen legislation governing pesticide use, ...educate the public about health effects", and called for "adequate resources for provincial public health units so that they may act as a resource to municipalities on pesticide reduction initiatives".

Many provincial governments have since reviewed their policies and the federal government began an *Action Plan on Urban Use Pesticides* with three elements: "reducing the reliance of Canadians on lawn care pesticides, registration of new reduced risk products, and product re-evaluation." Currently about half of reviewed pesticides have been removed from market and several more have had new restrictions on their use.¹

Public health officials, whose opinion is more sought after than ever in the wake of SARS, West Nile and Walkerton, cannot remain silent. Their voice should be measured, credible, allowing uncertainty as to the precise magnitude of effects, but they certainly must support a ban on any and every non-essential pesticide use.

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RÉSUMÉ

Le Collège des médecins de famille de l'Ontario a récemment publié un rapport détaillé sur l'exposition aux pesticides et sur les risques sur la santé qui concluait que divers pesticides avaient des effets nocifs pour la santé. L'industrie des pesticides maintient que les pesticides sont « sécuritaires » lorsqu'utilisés selon les instructions, car ils sont étudiés et approuvés par les agences gouvernementales. Pourtant, plusieurs municipalités, dont les trois plus grandes au Canada, et la province de Québec ont décrété des interdictions sur l'usage cosmétique des pesticides, principalement en réponse aux inquiétudes sur la santé. En révisant le rapport, le statut de la réglementation sur les pesticides et les limites des études et de la réglementation au Canada, il semble qu'en se basant sur les preuves disponibles jusqu'à aujourd'hui, les responsables de la santé publique devraient se déclarer en faveur d'une interdiction de l'usage des pesticides à des fins purement cosmétiques.