

## MEMO / NOTE DE SERVICE



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From / Expéditeur	David Salisbury, MD, MHSc, FRCPC Medical Officer of Health	
Subject / Objet	Update on the Medical Research on the Health Effects of Pesticides Inquiry 04-07 CPSC Meeting /Recherche concernant les effets des pesticides sur la santé - Mise à jour Demande de renseignements - Réunion 04-07 du CSCP	Date: September 6, 2007 le 6 septembre 2007

In June 2007, Councillor Cullen requested an update on the medical research on the health effects of pesticides since City Council last dealt with the issue in 2005. The issue under discussion was the phasing out of lawn and garden pesticides or “cosmetic” use on private properties in Ottawa. The use of pesticides for agricultural purposes and disease prevention was not the focus of the discussion.

### **Summary of Findings Presented to Council in 2005**

In 2005, Dr. Cushman, then Medical Officer of Health for the City of Ottawa, prepared a review of the current knowledge about the health effects of pesticides. This information was presented to Council in October 2005 by Dr. Salisbury and can be summarized as follows:

- Some people are more vulnerable to the effects of pesticides in our society – pregnant women and fetuses, infants and children and seniors. This means that they can be harmed in ways that healthy adults will not be.
- The health risks to pregnant women and fetuses include difficulty in conceiving; miscarriages; DNA damage and occupational exposure that may be associated with birth defects, fetal death and intrauterine growth retardation.
- The health risks to children and infants include kidney cancer; brain cancer; hematologic tumours, including leukemia and non-Hodgkin’s lymphoma; and acute leukemia.
- The health risks to seniors include Parkinson’s disease and prostate cancer.
- The conclusion reached was that no health benefits exist for the cosmetic use of pesticides and that the risks outweigh the benefits for this non-essential exposure.
- It was suggested that the precautionary principle should guide the decision about the non-essential use of pesticides in our community. The precautionary principle states “Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent adverse health impacts or environmental degradation.”

- It was stated that aggregate scientific evidence and the precautionary principle supported the need for a cosmetic pesticide prohibition in Ottawa.
- Summary documents of more extensive literature reviews conducted by the Ontario College of Family Physicians and the City of Toronto Medical Officer of Health both came to the same conclusions as the 2005 MOH's report.

This current review seeks to update the findings of the 2005 report with new evidence of health effects on humans.

## **Methodology**

A total of 23 articles published in English between 2005 and 2007 in peer-reviewed journals on the effects of pesticides and human health were reviewed for this update. The search for articles was done with the assistance of the Ovid Medline search engine through the University of Ottawa-Ottawa Public Health library services. Only studies and review articles that were methodologically sound were included in this review.

## **Findings**

The assessment of exposure to pesticides is not straightforward. Epidemiologists assess exposure to pesticides through surveys, combinations of survey and visual observation, biological monitoring of pesticide metabolites in urine, ambient air monitoring, blood serum analysis, evaluation of dermal exposure intake, and measurements in breast milk and umbilical cord blood. Despite these methods, determining what pesticides people were exposed to, when, and the details of the exposure is very difficult.

There continues to be many limitations on the study of human health impacts associated with pesticides. Lack of exposure data is considered the major weakness of many epidemiological studies of pesticide health effects. Multiple pesticide exposure makes identifying a single causative agent impossible. Pesticide users often apply a range of different agents, sometimes as mixtures, making it difficult to implicate specific agents. The most common conclusion reached by researchers and reviewers is that better exposure information needs to be developed for causal assessments to be made in future research.

Despite these limitations, studies in the areas of cancers, reproductive disorders, neurological diseases and children's health continue to find statistically valid associations between pesticides exposure and human health impacts.

### Cancers

Six original articles and one review article on pesticide exposure and the development of cancers were reviewed for this update. The review article reiterated that pesticide exposure is recognized as an important environmental risk factor associated with cancer development and that children are extremely vulnerable to pesticide exposure, which can be a risk factor for childhood cancer, especially in children of agricultural workers. (Jaga & Dharmani, 2005)

A study looking at breast cancer in California women found that girls exposed to the pesticide DDT in their youth have an increased risk of developing breast cancer risk later in life. Many women exposed to DDT in childhood have not yet reached age 50, and the public health significance of DDT exposure in early life

may be large. (Cohn et al, 2007) Another study that looked at reported pesticide use and breast cancer risk found a breast cancer risk associated with “ever lifetime residential use” but no evidence of an increasing risk with increasing lifetime applications. The researchers also found that lawn and garden pesticides was associated with breast cancer risk, but there was no dose response relationship established. (Teitelbaum et al, 2007)

Five other studies were unable to confirm risks of cancers related to exposure to pesticides (Cooney et al, 2007), (Walker et al, 2007), (Murphy, R.R., Haith, D.A., 2007), (Reynolds et al, 2005)<sup>1</sup>, (Reynolds et al, 2005)<sup>2</sup>. Many of these studies cited the need to refine methods that better characterize the exposure to pesticides.

### Reproductive Studies

The knowledge of genotoxic risks associated with pesticide exposure is limited. In experimental animals and pesticide factory workers aneuploidy (a chromosomal disorder) in sperm of exposed workers has been shown to occur. (Harkonen, K. 2005) These findings were not found in agricultural workers and researchers are calling for more studies on the aneugenic effects of different classes of pesticides to determine if parental exposures pose a risk for future generations.

Another study found reduced semen quality in men who had agricultural pesticide metabolites in their urine suggesting an association between current-use pesticides and reduced semen quality. (Swan, S. 2006)

Endocrine-disrupting chemicals are thought to play a role in human reproduction and development. A study that looked at the additive effect of several pesticides when mixed together found a 10-fold increase in some combinations of pesticides on the estrogenic effects in a laboratory scenario. They concluded that there was a significantly higher estrogenic effect in comparison to the results of the respective pesticides when tested individually. (Manabe et al, 2006) The researchers called for more research in environmental settings.

A study of prenatal exposure to some persistent pesticides may adversely affect the testicular descent in the foetus. Breast milk was collected from new mothers of healthy boys and boys who were born with one or more undescended testes. Metabolites of pesticides in breast milk were used as a proxy for maternal exposure to 27 organochlorine pesticides. These study results are in line with results from animal studies that found prenatal exposure may adversely affect testicular decent in boys. (Damgaard et al, 2006)

A study that looked at the effect of organophosphorous pesticides on reproductive hormones in agricultural workers concluded that exposure to these compounds disrupts the hypothalamic-pituitary endocrine function and also indicates that follicle-stimulating hormone and the luteinizing hormones are most affected. (Recio et al, 2005) These pesticides were suspected of altering reproductive function by disrupting hormones.

### Neurological Diseases

Two review articles that looked at Parkinson’s disease and pesticide exposure published in 2006 came to similar conclusions that there appears to be a relatively consistent relationship between pesticide exposure and Parkinson’s disease. (Brown et al, 2006) (Dick, 2006). “There is evidence of a modest increase in the

risk of Parkinson's disease in association with pesticide exposure, but no single agent has been implicated consistently. A meta-analysis of case-control studies and the largest cohort study yet undertaken both indicate an approximate doubling of the risk of Parkinson's disease with pesticide exposure, although there is little evidence, as yet, of an exposure-response relationship." (Dick, 2006) " At present, the weight of evidence is sufficient to conclude that a generic association between pesticide exposure and Parkinson's disease exists but this is insufficient for concluding that this is a causal relationship or that such a relationship exists for any particular pesticide compound or combined pesticide and other exogenous toxicant exposure." (Brown et al,2006).

A study looking to shed light on whether chronic, low-dose exposure to pesticides is suspected to increase the risk for Parkinson's disease found that individuals exposed to pesticides had a 70% higher incidence of Parkinson's disease than those not exposed. The relative risk for pesticides exposure was similar for farmers and non- farmers. These data support the hypothesis that exposure to pesticides may increase the risk for Parkinson's disease and suggest further studies should seek to identify the specific chemicals responsible for this association. (Ascherio, 2006)

Elevated levels of agricultural pesticides in household dust and their metabolites in urine have been associated with residential proximity to treated fields. Two studies looked at residential proximity to agricultural fields and neurological effects on residents. The first study looked at its association with neural tube defects (NTDs) and suggest that ambient exposure to certain categories of agricultural pesticides may increase the risk of NTDs. (Rull et al, 2006) A second study looked at its association to autism spectrum disorder among children in California. (Roberts et al, 2007). They found the association was strongest for residences closest to pesticide applications and was attenuated with increasing distance. This study recommended that the results require replication and should be treated with caution.

### Children's Health

A review article of the adverse health effects of children's exposure to pesticides was summarized as follows: "Children may be exposed to pesticides in several ways, such as by trans-placental transfer during foetal life, by intake of contaminated breast milk and other nutrients, or by contact with contaminated subjects and areas in the environment such as pets treated with insecticides, house dust, carpets and chemically treated lawns and gardens. Exposure early in life, and particularly during periods of rapid development, such as during foetal life and infancy, may have severe effects on child health and development by elevating the risk of congenital malformations, cancer, malabsorption, immunological dysfunction, endocrine disease, and neurobehavioural deficiencies. As pesticides can interfere with parental reproductive health, exposure of parents may have consequences for the offspring leading to reduced chance of male birth and increased risk of childhood cancer." (Jurewicz et al, 2006)

The authors of this review concluded by stating: "Current knowledge about tolerable levels and consequences of toxic exposure to pesticides during human development is scarce. Owing to the high risk of exposure to pesticides, particularly in less developed countries, further studies in this area are urgently needed."

Two studies done in Ecuador found that residence in communities with high potential for exposure to pesticides was associated with poorer neurobehavioral development of the child. (Grandjean et al, 2007) (Handal et al, 2007) The Handal et al study found children who resided in high-exposure communities (close to cut flower farms) scored lower on gross motor, fine motor and socioindividual skills compared

with children in a low-exposure community. The Grandjean et al study also studied children living in the cut ornamental flower region. The study found that maternal occupational exposure to pesticides during pregnancy is an important risk factor for the neurobehavioral development of a child. The exposure may adversely affect brain development, the effects may resemble symptoms of malnutrition and they differ from those of post-natal toxicity. These are likely to cause permanent deficits in children exposed prenatally.

Two review papers have been published since 2005 on the topic of pesticides and children's cancer risks. One found that leukemia, brain cancer, non-Hodgkin's lymphoma and neuroblastoma are potentially associated with pesticide exposure among children, however, despite increasing evidence in support of this finding, it is still limited because of the weakness of research methodology. (Jurewicz & Hanke, 2006) The other concluded that the available literature does not allow firm conclusions with regard to pesticides and any type of childhood cancer. (Nasterlack, 2006) Both reviews concluded that exposure information needs to be improved before causal assessments are investigated in future research.

## **Conclusions**

There continues to be a body of evidence about the human health impact of pesticide use in our society that raises concern. Despite the fact that many of the studies report low relative risks associated with pesticide exposure, the population exposed to lawn and garden pesticides is very large. Therefore even a small increase in risk can have large population effects. This large population exposure requires public health researchers to err on the side of caution when drawing conclusions about their findings. The studies published in the last two years have focused mainly on improving exposure information and generating potential causal links. Pinning down the answers to these questions is very important in order for us to fully understand how we can best minimize human health impacts from exposure.

The conclusions about the safety of non-essential pesticides made by Dr. Cushman, Dr. Basrur (former MOH, City of Toronto), Dr. Nosal (MOH for Halton Region), and other Medical Officers of Health in Ontario have been strengthened with the passage of time. There have been hundreds of municipalities across Canada that have joined cities such as Toronto, Halifax, Vancouver and the Province of Quebec in phasing out the non-essential use of pesticides citing the protection of public health as the justification.

The importance of the precautionary principle as an essential public health policy decision tool was also strengthened by the recommendation of Justice Campbell in his SARS Commission report earlier this year. He stated that: "The precautionary principle that safety comes first, that reasonable efforts to reduce risk need not await scientific proof. Ontario needs to enshrine the principle and enforce it throughout our entire health system."

*Original signed by*

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