Children's Environmental Health Issues

There is increasing evidence that environmental pollution, even at low exposure levels, can have an adverse health impact, and that children may be more at risk. The experience of lead is a good example. The publication in 1993 of report of the US National Research Council Committee on Pesticides in the Diet of Infants and Children illustrated the many factors that can increase the vulnerability of children, not only to pesticides, but all pollutants. Pollutants in air water and soil may affect the health of children. In particular, the association between air pollutants and respiratory disease is convincing. Several studies have associated pesticide exposures with cancer, and collectively they suggest an increased risk (Daniels, et al., 1997, McBride, 1998).

Asthma rates have increased in North America in the last 30 years. Prevalence of asthma in Canadians over the age of 15 is about 6 percent and physician-diagnosed rates for 5 to 19 year-old has been estimated at 13 percent. In Canada, it is estimated that about 60 children die each year due to asthma (TPH, 1999b; Wilkins & Mao, 1993).

Childhood cancer is rare in Canada, but it incidence has been rising and it is the most common cause of death for 1 to 14 year-olds (McBride, 1998; TPH, 1999b). Leukaemia and brain cancer are the two most common forms of childhood cancers with an age standardised incidence rate for 1989-1993) of 48.1 and 29.6 cases per 1,000,000 (TPH, 1999b). Total incidence of childhood cancer was 156.8 per 1,000,000. Parental exposure to radiation, radon, low frequency electromagnetic fields (EMF) and pesticides are among the environmental agents that have been associated with increased cancer risk (Daniels, et al., 1997; McBride, 1998).

Special Vulnerability of Children

Developing humans, in the womb and through puberty can be uniquely vulnerable to environmental toxicants. Many children's organs are not fully matured, and they go through several stages of rapid growth. This renders them more sensitive to the effects of certain pollutants. Children eat proportionately more food, drink more fluids, breathe more air, and play outside more than adults. Therefore, they are potentially at risk of higher exposure to environmental contaminants than adults are.

For example, children are more vulnerable to air pollution for several reasons. During childhood the lungs are still developing, reaching full maturity in the late teens. Children have a high respiration rate per kilogramme of body weight, thus the amount of inhaled air relative to a child's size and weight is substantial. Studies have also shown that the concentration of some pollutants is higher close to the ground. Since children are more likely to be playing and active outdoors, they are more exposed to outdoor pollutants. Thus, children breathe in more pollutants.

The developing foetus is at risk. Parental exposures to environmental agents may have an adverse effect on the unborn. Occupational exposures to various hazardous agents

have been associated with increase in various adverse health outcomes including spontaneous abortions, neurological impairment, auto-immunity, and cancer.

Environmental Health Threats to Children

Air pollution

The respiratory system is most vulnerable to air pollutants, although air-borne lead, pesticides and volatile organic compounds can be absorbed and cause damage to other target organs. There is strong evidence that human health is affected by the low levels of air pollution that are commonly found in Toronto and other areas of Ontario (Health Canada, 1997a, TPH, 1999a). A strong association has been found between the level of air pollutants (e.g. particulate matter, ozone, and nitrogen and sulphur oxides) and health effects in children. Health effects consist of acute effects such as upper and lower respiratory diseases in both healthy and asthmatic children. These are reflected in higher hospital admissions. Long-term effects such as reduced lung function are more difficult to quantify, but of greater concern. Data also suggests that respiratory effects of air pollution do not exhibit a threshold below which adverse effects do not occur (Health Canada, 1997a).

Environmental pollutants are major contributors to asthma, the most common admission diagnosis for children in US hospitals, which have doubled between 1980 and 1993 (ATSDR, 1997). In Toronto, diseases of the respiratory system are the second largest cause for discharge for children between 0 and 9 years old (TPH, 1996). Both indoor and outdoor air pollution can cause or contribute to respiratory illnesses. Pollution episodes not only aggravate symptoms in asthmatics, but also cause symptoms in non-asthmatics. Ground-level ozone is linked to reduced lung capacity in healthy children, an increased rate of respiratory infections such as pneumonia and bronchitis, as well as an increase in hospitalisation for asthma and chronic lung disease (TPH, 1999a). About 6 percent of respiratory admissions are associated with air pollution (TPH, 1996). Thurston et al. (1994) found 24 percent of respiratory admissions related to summer haze conditions in Toronto. In Southern Ontario, Burnett et al. (1994) found an association between incidences of high levels of air pollution and hospital admissions for respiratory complaints. For children under one year old, 15 percent of admissions was associated with air pollution events (Burnett, et al. 1994).

Endocrine Disrupters

An emerging concern is the potential of low levels of some pollutants to affect the hormonal system. If exposures occur during critical periods of foetal development, there is a potential for birth defects and other effects on development and growth of children. It is also possible that endocrine disrupters could also play a role in cancers. (TPH, 1999b, US EPA, 1996)

Lead poisoning

An important example of how pollutants in the environment can have adverse effects on children is seen with lead. It is the neurological effects of low levels of lead in children, which indicated the need control exposures to lead. Lead poisoning in children causes IQ deficiencies, reading and learning disabilities, impaired hearing, reduced attention spans, hyperactivity, anti-social behaviour and other problems. Prolonged exposure to even a small amount of lead may have some impact on intellectual and neurological development of the foetus, infant and young children as well as reproductive effects in adults (Health Canada, 1997b). With the banning of lead in many products such as gasoline, paint, solder, water pipes, lead levels in children have been reduced. The home is where children are higher risk of exposure (Health Canada, 1997a). The primary source of lead is food, soil and dust. Tap water also picks up lead. Consumer products such as lead crystal, toys, PVC blinds and imported canned food can become a source of lead in the home (Health Canada, 1997b). People who live in older homes or near industrial sources of lead are more at risk of high exposure (Health Canada, 1997b). The control of the use of lead has resulted in a decline in blood levels in children in Ontario from 12 ug/dL in 1984 to 3.5 ug/dL in 1992. Although 10 ug/dL is used to indicate potential lead poisoning, adverse developmental and behavioural effects have been observed at blood lead levels which are typical of the general population, and as low as 0.5 ug/dL. It has been suggested that there is no threshold for some of the observed effects (Health Canada, 1996).

Indoor Air

Indoor air pollution can be a major threat to health, especially among those who are sensitive to air contaminants. Adverse health effects from indoor air pollution include: eye, throat, nose and mucous membrane irritation, general malaise, impaired ability to concentrate, headache, the onset or aggravation of respiratory symptoms such as cough or wheezing (PHRED, 2000).

Children spend most of their times indoors. Cockroaches, house mites, moulds, are major asthma triggering antigens found primarily in indoor air. Concentrations of certain pollutants can be higher indoors than outdoors. These include environmental tobacco smoke and solvents and other volatile organic compounds emitted from various household products. Indoor use of pest control products can be a significant source of exposure to pesticides in children. Combustion sources can result in high levels of carbon monoxide or nitrogen oxides indoors. Home remodelling, household products and furnishings are other important sources of indoor air pollution. More energy efficient housing can lead to the build-up of naturally occurring radioactive radon gas.

Well known is the link between environmental tobacco smoke and respiratory or other diseases in children (TPH, 1999b). Health effects of exposures to moulds are significant, and may contribute up to 20% of cases of asthma (Miller, as cited in Pollution Probe, 1998). A study of 30 Canadian communities found higher rates of respiratory disease in

damp and mouldy homes: 45% increase in asthma, 32% bronchitis, 52% chest illness, 58% wheeze, and 89% cough (Miller and Day, 1997).

The relationship between indoor air quality and asthma is of concern because the percentage of children under the age of 15 suffering form asthma may have increased from 2.5 percent in 1978 to 11.2 percent in 1994 (TPH, 1999a). Better awareness of indoor air pollution and its control could help reduce this disease burden.

Pesticides

Pesticides pose a risk to children. There have been reports of children developing behavioural changes, encephalopathy, ataxia, seizures, and coma after application of insect repellents or pediculocides. About 4 percent of poisonings in children are due to pesticides (TPH, 1998).

The 1993 report of the US National Research Council Committee on Pesticides in the Diet of Infants and Children concluded that children are particularly at risk of consuming toxic amounts of pesticides. Estimates of pesticide exposure show that on a body-weight basis children are often exposed to higher levels than adults are. A study of the organophosphate pesticide chlorpyrifos after commercial application for cockroach control in an apartment building showed residues on floors and children's toys two weeks after spraying. It was estimated that exposures to children would have been 21-119 times above acceptable levels (Davis & Ahmed, 1998). Infants and children are at greater risk from exposure to pesticides on lawns and pets (Grossman, 1995). A study in the state of Washington showed that farm children had a higher potential for exposure to pesticides than non-farm children in the region did (Loewenherz, 1997; Simcox et al, 1995). Two thirds of household-dust samples taken on farms contained pesticides at levels of 1ug/g or more (Simcox et al, 1995). Long term effects of low level exposure to pesticides include cancer, central nervous system damage, or respiratory illness. Parental exposures or use of pesticides in the home have been associated with cancers including childhood brain tumours, leukaemia, lymphomas, and testicular cancer. They have also been associated with birth defects including neural tube deformities (Daniels, et al., 1997).

Recent studies have investigated non-occupational human exposures to pesticides (OCFP, 1999). Leiss, et al. (1995) demonstrated an association between yard treatments and soft tissue sarcomas (odds ratio 4.0) and the use of pest strips and leukaemia (OR 1.7–3.0) in children. Similar findings have been reported by Gold, et al. (1979), who report an association between exposure to insecticide extermination and brain tumours (OR 2.3). Lowengart, et al. (1987) reported an association between household pesticides and leukaemia (OR 4.0) and garden pesticides and leukaemia (OR 5.6). More recently, Davis, et al. (1993) found odds ratios up to 6.2 for several pesticide specific exposures among children with brain cancer. Relative risk was associated with the use of pesticide sprays during pregnancy, childhood use of lice shampoos, and childhood contact with pesticides on pets and the use of "no-pest" strips. In a case study of children exposed in utero to chlorpyrifos, Sherman (1995) found neurological and genital defects. A study in Mexico showed deficits in tests of stamina, co-ordination, recall and ability to draw in 4-

5 years old children living in an agricultural area with high use of organophosphate pesticides as compared to children living in an area of low pesticide use (Eslenazi, et al., 1999). It has also been suggested that some commonly used home pesticides could trigger allergic reactions or exacerbate asthma (Grossman, 1995).

There may be a lot of avoidable home pesticide exposure since many people use pesticides out of annoyance or fear rather than actual need (Grossman, 1995). Greater awareness of the potential adverse effects and of alternative pest control methods or integrated pest management (IPM) would help reduce the risks from pesticide use. Among other ways, these risks can be addressed through restrictions on the spraying of pesticides in the home or institutional settings, education on the minimising use and exposure to pesticides, and encouragement for the use and development of non-toxic alternatives. Various municipalities in Ontario are implementing strategies to reduce or phase-out the use of pesticides in green spaces (TPH 1999a; Watts & Macfarlane, 1997). Reduction in use of pesticides by the private sector would complement municipal initiatives. Toronto has undertaken a demonstration project for the control of cockroaches in apartment building using IPM (TPH, 1998). Good housekeeping and the use of bait traps (Roach Coach) were shown effective long-term strategies for controlling cockroaches.

Water

Swimming and playing in polluted waters exposes children to a variety of pollutants, but possibly of greater concern is the consumption of contaminated fish. Learning disabilities and delayed development has been documented in children whose mothers had high levels of PCBs due to consumption of contaminated fish. Similarly, data suggests that the levels of mercury in Great Lakes fish present a hazard to the offspring of women who eat a large amount of fish. This is of special concern for aboriginal peoples and others who have a diet high in fish and wildlife (Heath Canada, 1997a). Due to their immature immune system, young children are also more sensitive to microbial contamination. High use of nitrogen fertilisers continues to contaminate water with nitrates. Drinking water contaminants pose a risk to children, particularly infants, who drink more fluids per body weight (Health Canada, 1997a; US EPA, 1996).

Conclusions

No single factor is strongly associated with poor health in children. Rather, it is likely that a number of factors interact. The relative strength of individual factors is not known, since many are not mutually exclusive. For this reason, it is often difficult to obtain conclusive association between exposures to environmental pollutants and adverse health outcomes. Given the multiplicity of factors involved, a multifaceted approach to intervention is likely to be the most effective.

There are clear links between air pollution episodes and hospital admissions for respiratory illnesses. On days with poor air quality (e.g. smog alert days) exposures to

pollutants can be reduced by staying indoors when levels of pollutants are at their peak - during rush-hour, and in the afternoon.

Although there has been large reductions in exposures to lead, data suggest that harmful effects can occur below the acceptable threshold of 10 ug/L in blood. Given that the major exposures to lead are in and around the home, raising awareness of avoidable sources of exposure to lead would help reduce body burdens of lead.

Indoor air quality has also been associated with asthma and other respiratory diseases in children. A large effort has been made to raise awareness of the adverse impacts of environmental tobacco smoke (ETS). Greater awareness of other common indoor air quality problems and methods to reduce them would help reduce incidence of these complaints.

There is insufficient information to quantify the risk of pesticide use in the home and disease in children. Nevertheless, greater awareness of the potential adverse effects and of alternative pest control methods would help eliminate avoidable risks from pesticide use.

Aboriginal peoples and others who have a diet high in fish and wildlife are particularly at risk to exposures to mercury and PCBs. Continued efforts are needed to reduce the burden of these pollutants in ambient water to prevent the contamination of this food source.

Exposures to environmental pollutants have subtle but important effects on the health of children. Given the widespread nature of exposure, the total impact on society can be large. Avoidance or elimination of exposures to environmental contaminants can contribute to the improved health status of children in the province. Greater awareness of these risks and ways to avoid or eliminate them can help improve child health in Ontario.

Recommendations

It is recommended that the Mandatory Health Programs and Services Guidelines on Child Health be revised to include:

1. In its objectives – to increase awareness of the potential effects of exposure to environmental contaminants on children's health and of ways by which these exposures can be reduced;
2. In its requirement and standards – The Board of Health shall co-operate with provincial and federal governments, coalitions/networks of youth, parents, childcare providers and health and social service providers to increase awareness of environmental health risks and their prevention. This shall include at minimum:
    a. distribution of information on the prevention of environmental hazards around the home, day-cares, or schools, such as, lead, mould, pesticides, radon;
    b. distribution of information on the adverse effects of air pollution and the special risk to children with allergies and asthma or lung diseases;

c. distribution of information on changes to personal behaviour that can lead to reduction in environmental pollution.

References

ATSDR, 1997. Healthy children, toxic environments: Report of the Child Health Workgroup. Agency for Toxic Substances and Diseases Registry, Atlanta.

Burnett, R.T., et al., 1994. *Effects of low ambient levels of ozone and sulphates on the frequency of respiratory admissions to Ontario hospitals*. Environmental Research (65): 172-194.

Daniels, J.L., A.F. Olshan and D.A. Savitz, 1997. *Pesticides and childhood cancers*. Environmental Health Perspectives (105/10): 1068-1077.

Davis, D.L. and A.K. Ahmed, 1998. *Exposures from indoor spraying of chorpyrifos pose greater health risks to children than currently estimated*. Environmental Health Perspectives (106/6): 299-301.

Davis, J.R., et al., 1993. *Family pesticide use and childhood brain cancer*. Archives of Environmental Contamination and Toxicology (24); 87-92, as cited in OCFP, op.cit.

Eskenazi, B. A. Bradman and R. Castorina, 1999. *Exposures of children to organophosphate pesticides and their potential adverse health effect.* Environmental Health Perspectives (107 Supp 3): 409419.

Gold, E., et al., 1979. *Risk factors in brain tumors in children*. American J. of Epidemiology (109): 309-319, as cited in OCFP, op.cit.

Grossman, J., 1995. *What is hiding under the sink – dangers of household pesticides*. Environmental Health Perspectives (103/6). http://ephnet1.niehs.nih.gov/

Health Canada, 1996. State of knowledge report on environmental contaminants and human health in the Great Lakes basin. Health Canada, Environmental Health Directorate, Ottawa.

Health Canada, 1997a. Health and the environment: The health and environment handbook for health professionals. Health Canada, Ottawa, and Ontario Ministry of Health, Toronto.

Health Canada, 1997b. Health and environment – Partners for life. Health Canada, Ottawa.

Leiss, J.K. and D.A. Savitz, 1995. *Home pesticide use and childhood cancer: A case control study*. American J. of Public Health (85): 249-252, as cited in OCFP, op. cit.

Loewenherz, C., et al. 1997. *Biological monitoring of organophosphorus pesticide exposure among children of agricultural workers in central Washington State* Environmental Health Perspectives (105/12). http:ehpnet1.niehs.nih.gov/

Lowengart, R.S., et al., 1987. *Childhood leukemia and parent's occupational and home exposures*. J. of the National Cancer Institute (79): 39-46, as cited in OCFP, op.cit.

Miller, J.D. and J.H. Day, 1997. *Indoor mould exposures: epidemiology, consequences, and immunology*. Canadian Journal of Allergy and Clinical Immunology (2/1): 25-32.

OCFP, 1999. Pesticides and human health. The Ontario College of Family Physicians Environmental Health Committee Newsletter for Family Physicians. http://www.cfpc.ca/ocfp/commun/pest.html

PHRED, 2000. Report on the health status of residents of Ontario. Public Health Research, Education and Development Program.

Pollution Probe, 1998. The air children breathe: The effects on their health. Report of an educational forum held 19-20 January 1998, Toronto. Pollution Probe and Canadian Institute of Child Health, Toronto.

Sherman, J., 1995. *Chlorpyrifos (Dursban) associated with birth defects.* Int. J. of Occupational Medicine and Toxicology (4/4), as cited in OCFP, op.cit.

Simcox, N.J. et al., 1995. *Pesticides in household dust and soil – exposure pathways for children of agricultural families*. Environmental Health Perspectives (103/12). http:ehpnet1.niehs.nih.gov/

Thurston, G.D., et al., 1994. *Respiratory admissions in summertime haze air pollution in Toronto, Ontario: considerations of the role of acid aerosols*. Environmental Research (65): 271-290.

TPH, 1996. Outdoor air quality in Toronto and respiratory health. Report to the Board of Health, 11 July 1996. Toronto Public Health, Toronto.

TPH, 1998. Cockroach control in the housing sector: Evaluation of an integrated pest management demonstration project for an apartment complex. Toronto Public Health, Toronto

TPH, 1999a. Environmental issues in the City of Toronto. Report to the Board of Health, 2 September 1999. Toronto Public Health, Toronto

TPH, 1999b. State of Children's Environmental Health in Toronto, Phase 1: Background Research for the Needs Assessment. Toronto Public Health, Toronto

US EPA, 1996. Environmental health threats to children. US Environmental Protection Agency, Washington, D.C.

Watt, M. and R. Macfarlane, 1997. Reducing reliance: A review of pesticide reduction initiatives. Pesticide Action Network, Penang.

Wilkins, K. and Y. Mao, 1993. *Trends in rates of admission to hospital and death from asthma among children and young adults in Canada during the 1980s*. Canadian Medical Association Journal (148/2): 185-190.