



environmental exposure

the **CANCERSMART** GUIDE
to breast cancer
prevention

by Sean Griffin



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Prevention: setting a new priority for breast cancer



Across the country, breast cancer has affected the lives of Canadian women and their families as no other disease has.

According to Canadian cancer statistics, 22,400 women and 170 men were diagnosed with breast cancer in 2008. Of those, 5,400 died from the disease.¹ Each diagnosis touched additional lives among partners, children, parents, friends and co-workers.

Country-wide, 166,000 Canadian women are breast cancer survivors — one percent of all women in Canada.

Across Canada, 166,000 women are breast cancer survivors — **one per cent** of all Canadian women

It's a testament to the work of many thousands of Canadians who have fundraised for cancer research that many more people diagnosed with breast cancer do survive the disease. The innovations in cancer care and treatment made possible through research have changed the bleak statistics of the past. The number of women who die from breast cancer has dropped 25 per cent in just two generations.

Still, it is our belief that much more can be done about the prevention of breast cancer — to stop the disease before it starts.

Unlocking the many factors that play a role in the development of breast cancer and addressing them through effective prevention programs would be a gift to thousands of women across this country. It would also provide a tremendous public health benefit.

Breast cancer is a complex disease, with many factors involved in its development, including individual biological makeup, occupational history and exposure to hundreds of substances, often in combination with one another. But as the material presented in this booklet shows, environmental factors are implicated in nearly three-quarters of the breast cancer diagnoses across Europe and North America.

That points to a new priority — putting more research funding into identifying and clarifying the environmental links to cancer, and providing Canadians with precautionary steps they can take to limit environmental exposures, through personal and workplace action and government regulation.

We hope this booklet will help highlight that priority. But it also has a more practical purpose: to give readers a glimpse of some of the latest evidence, to provide some practical strategies for reducing exposures, and pose some ideas for policy changes. We hope you will find it useful.



Searching for the breast cancer key — the environmental factor



1938, when the first cancer society was established in Canada, little was understood about the causes of breast cancer. Health advocates were mainly concerned with getting people into their doctors' offices in the hope that cancers could be caught early. Since then, research has

opened more windows on the disease and some risk factors have been clearly established, such as early onset of puberty, a late first pregnancy or not having children at all. Some genetic links have also been identified, such as the gene mutations BRCA1 and BRCA2.

Still, the genetic or known risk factors can't explain the increase in the incidence of breast cancer or even the majority of cases that do occur.²

Studies with twins have underlined the importance of **environmental factors** in breast cancer

One of the most intriguing studies completed in the last several years was one involving twins in the Nordic countries of Sweden, Denmark and Finland. Using the national registries of twins available in the three countries, researcher Paul Lichtenstein and his team studied 44,788 pairs of twins to determine if their common genetic history resulted in the same cancer risk. If one twin developed cancer, did his or her twin develop it too?

Their findings were striking: only about a third of cancers were the result of genetic factors. The number was lowest for breast cancer, where only 27 per cent of the risk was the result of inherited factors.³

Even where genetic factors are known to be involved, the role of the environment has become even more prominent than in the past. Studies have shown that women who carry the BRCA1 or BRCA2 gene who were born after 1940 have almost three times the risk of developing breast or ovarian cancer at age 50 as women who are also carriers of the genes but were born before 1940.⁴

In fact, most of the factors that play a role in breast cancer are environmental — our body weight, alcohol use and physical activity, occupational exposures in the workplace, exposure to toxic ingredients in pesticides, consumer products and cosmetics, and second-hand smoke, among many others.

What that demonstrates is that the majority of breast cancers are potentially preventable. With prevention-focussed research and prevention programs, we might be able to reverse the upward direction that breast cancer graphs have been taking over the past 30 years.



Some of the most familiar cancer prevention programs have focussed on diet and lifestyle, just two of the environmental factors involved in breast cancer. But it is only in the last decade that more attention has been focussed on an area that may prove to be just as important a public health priority — reducing exposures to the toxic chemicals and pollutants that are in our workplaces and our community environments. It is those exposures that are the primary focus of this guide.

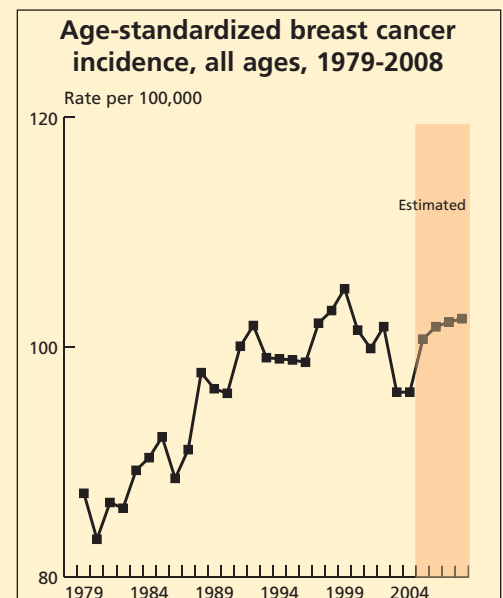
In a study published by the American Cancer Society in 2007, researchers identified 216 different substances that were associated with breast cancer in at least one animal study.⁵ The list is extensive and includes dozens of chemicals used only in research and chemicals that have been banned but still linger in the environment, such as the pesticide DDT and PCBs.

But many of the chemicals on the list are found in consumer products, while a number of others show up frequently in Canadian workplaces.

The newest horizon in research has focussed on chemicals known as xenoestrogens (see sidebar on page 7) that mimic the effect of the female hormone estrogen. A number of industrial and consumer chemicals, such as bisphenol-A, nonyl phenols and phthalates, can affect the body in ways similar to natural estrogen and may have a significant role in the development of breast cancer.

New research is demonstrating that many of these substances can be active at extremely low levels — in parts per billion or even lower — and may also act together, creating what are known as synergistic effects. A recent Spanish study that looked at the combined effects on women of 16 different pesticides demonstrates that effects may also be cumulative, creating a greater impact over time.⁶ Most important, chemical exposures that could later lead to breast cancer may occur, not when a woman is an adult, but at critical times of development — at puberty, for example, or even during fetal development.

Clearly, more research is needed to give us more information about the role of synthetic chemicals and their effect on women throughout the various stages of their lives. But in the meantime, a precautionary approach to reducing environmental and workplace exposures is the most effective form of prevention. That means taking action to reduce or eliminate exposures when we know there is a hazard, even if there isn't yet conclusive proof.



About the graph

AS THE LINE SHOWS, the incidence of breast cancer has risen since 1979. To ensure that an aging population doesn't skew the figures, the statistics are "age-standardized" — in other words, the percentage of population in each age group is adjusted each year to make it the same as a selected base year (in this case 1991).

The descending line in 2003-04, which follows a similar pattern in the U.S., may be related to a drop in hormone replacement therapy use after 2002. But as the graph indicates, projections point to a further increase in breast cancer incidence over the long term. (Source: *Canadian Cancer Statistics, 2008*)



HRT, cosmetics and more: breaking the exposure link



Unlike many other organs of the body, the human breast is not developed at birth and doesn't actually become fully mature until the first full-term pregnancy. At many critical periods, from fetal development through puberty and into motherhood, a woman's body is vulnerable to changes in developing breast cells that might be caused by environmental exposures, such as ionizing radiation (X-rays) or exposure to chemicals. Even low dose exposures of the anti-miscarriage drug DES, for example, or bisphenol-A during certain periods in fetal development can potentially create the first in a cascade of events that can lead to cancer in later life.

At many critical periods, a woman's body is vulnerable to changes in developing breast cells

The effect of cigarette smoking on breast cancer is particularly helpful in understanding the critical timing of exposure. Although smoking has long been recognized as a cause of lung cancer, the link to breast cancer was elusive at first. Most studies among smokers showed no relationship between smoking and breast cancer. But when researchers looked further back into women's lives, the results were significantly different. A 2002 study found that women who began smoking within five years of their first menstrual period were 70 per cent more likely to develop breast cancer than non-smokers.⁷

Although we don't know the precise effects in each case, we do know that the toxic substances in cigarette smoke created profound changes at a critical time of development — and those changes later led to or contributed to the development of breast cancer.

It's also important to understand that breast cancer is not a direct connection between a single chemical or exposure and the disease. Breast cancer is actually the collective name for an array of cancers that can develop through different chemical and hormonal pathways and can result from the interplay of environmental exposures and genetic and other factors. And because the disease is most common in older women, there can often be a long period of time — known as the latency period — between various exposures and the actual appearance of cancer. That makes it extremely difficult to track the disease back to a specific exposure or even a period of exposures.

But it doesn't mean that preventative action isn't possible. Taking steps to limit exposure to substances that have been shown in scientific studies to increase the risk of breast cancer can be part of an effective strategy. It's especially important in protecting the health of those



most vulnerable, including prospective mothers and their babies as well as adolescent girls.

The chemicals and forms of radiation outlined over the next few pages are among those associated with breast cancer by the 2007 Cancer Society report. We've focussed particularly on those chemicals to which Canadians can reduce their exposure or avoid altogether. The review is in two sections, the first covering xenoestrogens and the second covering other carcinogens. A later section covers occupational exposures and strategies for reducing them.

Hormone replacement therapy (HRT): In 2002, a major study known as the Women's Health Initiative (WHI), was cut short after preliminary results showed a 28 per cent increase in the incidence of breast cancer for those women taking a combined dose of synthetic estrogen and progesterone.⁸ The WHI concluded that women should not take combined HRT because the risks were too great, with no demonstrated benefits. A 2006 follow-up to the study reported that there was no increased risk of breast cancer for those using estrogen-only therapy for up to seven years (the length of the WHI study). But the researchers that carried out the study cautioned that doctors should only prescribe the estrogen-only therapy for severe menopausal symptoms and then only for the shortest possible time.

Oral contraceptives: Oral contraceptive use for more than five consecutive years is associated with an increased breast cancer risk in a number of studies.⁹ Some have shown a greater risk for current users who started early in life or who have a family history of breast cancer.¹⁰ Post-menopausal women who have been off the pill for 10 years or longer do not have any increased risk of breast cancer.

ENDOCRINE DISRUPTERS

Xenoestrogens a new link to breast cancer

AMONG THE THOUSANDS of synthetic chemicals in use in Canada, some are known as xenoestrogens, because they act like the hormone estrogen but come from outside the body. Xeno- (pronounced "zeeno") is from the Greek word *xenos*, meaning foreign).

Xenoestrogens are part of a larger group of chemicals known as endocrine-disrupting chemicals (EDCs), so called because they interfere with the natural hormones of the body, either by mimicking or enhancing those effects or in some cases blocking them.

The familiar chemical bisphenol-A, used in some plastics and the linings of food cans, is a xenoestrogen.

Ethoxylated nonyl phenols, used in cosmetics and cleaning products, are also xenoestrogens. So, too, is the drug DES, which was given to women in the 1950s and 1960s to prevent miscarriage. It was finally removed from use after it was shown to cause vaginal cancer as well as breast cancer in the daughters of women who were prescribed it.

Breast cancer is known as a hormonally-mediated cancer because natural hormones — such as estrogen, progesterone and prolactin — play such an important part in its development. New research has focussed on xenoestrogens and their role as promoters of breast tumours. Animal research with BPA, for example, has shown that exposure to the chemical causes changes in the mammary tissue of the fetus that could lead to breast cancer later in life.



Bisphenol-A highlights issue of low-dose exposures

Several studies found that BPA induced changes to the mammary gland that could lead to cancer

Bisphenol-A: BPA was first identified as a xenoestrogen in 1938 when researchers were searching for synthetic hormone treatments. Abandoned for that purpose, it was later found to have numerous applications in plastics production and is currently used widely to make polycarbonate plastic, epoxy linings for food cans and packaging. In April 2008, the federal government declared BPA a toxic substance under the Canadian Environmental Protection Act based on studies that showed it was associated with a range of harmful health effects, including breast cancer.

Many recent studies on BPA have focussed on pre-natal exposure of laboratory rats and mice to BPA in the womb, simulating conditions that could occur when pregnant women are exposed to BPA. Several of those studies found that the BPA induced changes in the mammary gland of the animals that could lead to pre-cancerous lesions, or even cancer in later life.^{11,12}

Health Canada regulations adopted in November 2008 ban the sale and importation of polycarbonate baby bottles but polycarbonate water bottles for adults as well as sippy cups for toddlers are still permitted for sale in Canada. A recent study published in the journal *Environmental Health Perspectives* found that study participants' urinary levels of BPA increased by 67 per cent after only one week of drinking cold beverages from polycarbonate cups.¹³

Reducing exposure: See table on facing page.

Nonyl phenol: Nonyl phenol and nonyl phenol ethoxylates, or NPEs, are endocrine-disrupting chemicals. They're used in many applications, including consumer cleaning products and personal care products, such as shampoos. Nonyl phenols have been shown to mimic the effects of estrogen and one study showed an increased risk of breast cancer for rats treated with one particular form of the chemical.¹⁴ NPEs were declared toxic under the Canadian Environmental Protection Act in 2002 and a phase-out program was initiated in 2003 to reduce their use in cleaning products.

Reducing exposure: Our review of Material Safety Data Sheets shows that most of the cleaning products that formerly contained NPEs had been re-formulated by 2009. However, nonyl phenols are still used in personal care products, particularly shampoos, and are usually identified as "nonoxynol" or nonoxynol followed by a number, such as "nonoxynol-2." Wherever possible, avoid using those products.

Parabens: The group name parabens is used to describe six different compounds, often



used individually or in combination as preservatives in personal care products. In 2004, British researcher Philippa Darbre found high levels of parabens in tumours of breast cancer patients. Since then, parabens have been identified as xenoestrogens and additional studies have shown that they can cause breast cancer cells to proliferate under experimental lab conditions.¹⁵

Reducing exposure: Parabens are extensively used in the cosmetics industry and are identified on labels by their individual names, such as butylparaben and propylparaben. There are some companies that are manufacturing without parabens. Among them are Aubrey Organics, Burt's Bees, Saje Natural Products and Tom's of Maine.

Phthalates: Phthalates include a group of endocrine-disrupting chemicals widely used as softeners in plastics and stabilizers in cosmetics, perfumes and personal care products. Two phthalates, butylbenzyl phthalate (BBP) and dibutyl phthalate (DBP) have been shown to be estrogenic¹⁶ while BBP and another phthalate, di-ethyl hexyl phthalate (DEHP) can cause breast cancer cell proliferation under lab conditions.¹⁷ In 2009, DEHP was added to Health Canada's Cosmetics Hotlist, prohibiting its use in cosmetics products, but DBP and BBP are still permitted for cosmetics use.

Reducing exposure: Phthalates are not listed on cosmetics labels — they are included under the catch-all term fragrance or parfum — making it difficult to determine which products contain BBP, DBP or DEHP. However, a number of companies have pledged to make phthalate-free products and a list is available from the www.safecosmetics.org. Although it is intended for U.S. consumers, many of the products are available in Canada through retail stores or online distributors.

BISPHENOL-A

Ways to put a lid on BPA exposures

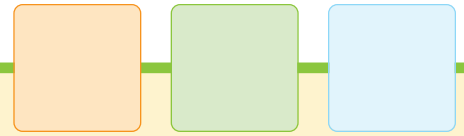
AVOID USING POLYCARBONATE bottles, beverage cups and food containers. They are usually hard, coloured plastic, with the number 7 in the recycling triangle and the letter PC or OTHER underneath. They may also carry the trade name Lexan. Since many newer bottles made from an alternative material are also labelled with the number 7, it's a good idea to make sure they're specifically identified as BPA-free before purchasing them.

USE FRESH OR FROZEN fruits and vegetables wherever



possible to avoid the BPA from can linings. When buying canned goods, choose those that are sold in bottles or jars instead of cans. One food processing company, Eden Organics, makes most of its products available in non-BPA cans. The exceptions are tomato-based products, which are too acidic for the alternative lining that is used with the other products.

BUY BEVERAGES IN GLASS BOTTLES rather than cans. BPA migration from beverage cans tends to be lower than from food cans but levels are highly variable depending on the contents and the manufacturer.



More research needed on EMF association with breast cancer

Radiation: There are basically two forms of radiation:

Ionizing radiation, which has sufficient energy to break apart atoms, is present in X-rays and emissions from radioactive materials;

Non-ionizing radiation, which does not have the energy to break electrons from atoms and includes a wide range of frequencies, from infrared light to extremely low frequency radiation from electrical sources. EMF (which stands for electromagnetic field, the field generated by electrically charged objects) is the general term frequently used to describe non-ionizing radiation from electrical equipment as well as power lines and cell towers and radio frequency signals from transmitters and signalling equipment.

EMFs from overhead transmission lines have been associated with breast cancer

Ionizing radiation: Ionizing radiation is strongly linked to breast cancer although most of the exposures of concern are those from the past when the radiation dose of X-ray equipment was substantially higher than it is today. Modern X-ray machines have reduced exposure dramatically and digital equipment will reduce it further as it comes into general use. However the radiation dose from CT scans is much higher and their use should be weighed carefully, especially for younger women.

Electromagnetic fields (EMFs): EMFs from overhead electrical transmission towers have been associated with breast cancer, particularly for pre-menopausal women. One Swedish study followed women over a 25-year period and found an elevated risk for women under the age of 50 living in the power corridor.¹⁸ Epidemiological studies have also found links with occupational exposures,¹⁹ which are discussed in more detail in the occupational exposures section beginning on page 14.

The evidence from electronic equipment, cell phones and home appliances is less conclusive.²⁰ Concern over possible risk has been raised about cellular and cordless phones because of their widespread use and a growing number of reports about their potentially adverse effects. So far, no association with breast cancer has been shown, although a growing body of evidence is demonstrating a link to brain cancer and childhood leukemia.

Electrical appliances used close to the body, such as electric blankets, have been considered in research on EMFs. One recent study of electric blanket use did show an increased risk for African-American women²¹ but most studies have shown no association.^{22,23} It's clear that more research is needed to determine why there is a difference in results and what mechanism may be involved.



Identifying carcinogens and reducing exposure



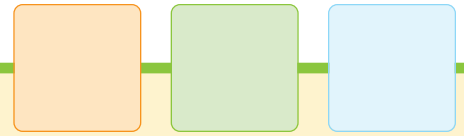
The substances listed over the following three pages are carcinogens associated with breast cancer.

Garden pesticides: The pesticides 2,4-D, widely used as a weed killer for residential lawns, and malathion, the ingredient in many garden insecticides, are both endocrine-disrupting chemicals. The International Agency for Research on Cancer classifies 2,4-D and dichlorvos, an insecticide, as possible human carcinogens. In a 2005 study among Latina agricultural workers in California, both malathion and 2,4-D as well as another pesticide, chlordane, were associated with an elevated incidence of breast cancer.²⁴ Dichlorvos, the active ingredient in one insecticide strip sold in Canada, was found to induce mammary tumours in laboratory animals.

Reducing exposure: Avoid using products that contain 2,4-D, malathion or dichlorvos (active pesticide ingredients are listed on the package). Corn gluten, now widely available in garden stores is a non-toxic alternative for suppressing weeds in lawns. Many non-toxic insecticides, including insecticidal soaps, are available as substitutes for malathion and dichlorvos.

Heterocyclic amines (HAs); polycyclic aromatic hydrocarbons (PAHs): HAs are compounds formed when meat or fish is cooked, particularly at high temperatures. PAHs are byproducts or combustion from varied sources, including engines, cigarettes and also grilled meats. Some HAs and PAHs are associated with breast cancer.²⁵ A 2007 study found that post-menopausal women who regularly consumed smoked and barbecued meats had a 47 per cent higher risk of developing breast cancer.²⁶ Researchers suggested that HAs and PAHs from high temperature cooking were probably factors in the elevated risk.

Reducing exposure: Study results suggest that limiting consumption of red meats, especially barbecued, grilled and processed meats, is important in reducing the risk from this source. Low-heat methods of cooking meats, including poaching, boiling and slow oven-roasting, have also been shown to reduce the levels of heterocyclic amines produced in all cooked meats and fish.



ETS, alcohol and solvents: strategies to cut exposure

Alcohol: Ethanol, the form of alcohol found in alcoholic beverages, is classified as a known human carcinogen by the International Agency for Research on Cancer. Consumption of alcohol has been associated with an elevated risk of breast cancer in numerous studies,^{27,28} most of which have shown the risk increasing with higher levels of consumption, regardless of the type of drink consumed. For premenopausal women, the elevation in risk is slight for those consuming the equivalent of one drink or less per day. However, even that moderate consumption potentially poses a higher risk for post-menopausal women,²⁹ although other benefits potentially derived from consumption of small amounts of alcohol — reduction in the risk of stroke and coronary heart disease — may be an offsetting factor.³⁰

Reducing exposure: Both the Canadian Cancer Society and the American Cancer Society recommend that women limit their intake to one drink per day or less. One drink is considered to be equivalent to a 341-ml bottle of beer, 175 millilitres of wine or 30 ml of distilled liquor such as vodka.

Environmental tobacco smoke: As noted earlier, active smoking is linked to an increase in breast cancer, and second-hand smoke or environmental tobacco smoke (ETS), is similarly associated with breast cancer, particularly for premenopausal women. The April 2009 report of the Canadian Expert Panel on Tobacco Smoke and Breast Cancer Risk concluded: “The association between second-hand smoke and breast cancer in younger, primarily premenopausal women who have never smoked is consistent with causality.”³¹ There are

CARCINOGENS LISTS

IARC is recognized world authority

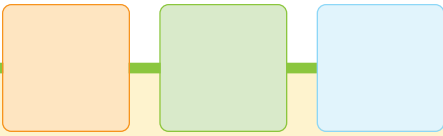
IN SIMPLE TERMS, CARCINOGENS are substances that can cause cancer. They may be chemicals, physical agents such as dusts, radiation, or even certain viruses.

There are various U.S. and European agencies that identify carcinogens, but the World Health Organization’s International Agency for Research on Cancer (IARC) is the recognized international authority. IARC classifies known or suspected carcinogens as Group 1 (known human carcinogens), Group 2A (probable human carcinogens) and

Group 2B (possible human carcinogens), based on evidence from laboratory experiments with animals and human epidemiological evidence. Those classified in Group 1 have been shown conclusively to cause human cancers — with the evidence often coming from the workplace.

IARC publishes regular reports, called monographs, that outline the latest research findings on carcinogens and update listings.

In the 2007 report for the American Cancer Society, researcher Ruthann Rudel identified 216 mammary carcinogens, based on IARC listings, as well as those of the U.S. National Toxicology Program.



Safer choices for paint strippers

PRODUCT/USAGE	TOXIC INGREDIENT	BETTER CHOICES
Behr, The Stripper	Methylene chloride	3M Safest Stripper
Recochem Paint and Varnish Remover	Methylene chloride, toluene	Removall Multi-purpose Paint Stripper
Polystrippa Super Strippa	Methylene chloride	
Polystrippa Super Strippa Semi-Gel	N-methyl-2-pyrrolidone	
Napier Furniture Stripper	(reproductive toxin)	

numerous pathways by which ETS can contribute to the development of breast cancer, most notably the carcinogens in tobacco smoke that can cause genetic cell damage to human breast cells. Benzene and 4-aminobiphenyl, two known human carcinogens, are actually found at higher levels in ETS than in mainstream tobacco smoke.

Reducing exposure: Although workplace regulations against smoking have dramatically reduced the main source of ETS, exposure in social settings and at home from a spouse who smokes are still major concerns for women. Second hand smoke from social events is a problem particularly for young women who may be affected at a critical time of development or during pregnancy.

Methylene chloride: Methylene chloride is a chlorinated solvent used as the base for many consumer and industrial paint strippers and removers. It is classified by IARC as a possible human carcinogen, based on numerous studies that reported mammary gland tumours among animals exposed to methylene chloride.³² A study among Canadian General Electric workers in 1986 also found an excess of breast cancers among workers who had been exposed to methylene chloride.³³

Reducing exposure: (See table above.)

Perchloroethylene: Perchloroethylene, also known as tetrachloroethylene, is found in a number of consumer aerosol lubricants used for consumer sewing machines as well as automotive applications. Often called “perc,” it is also the solvent used by most dry cleaners and while they are now required to use closed systems to prevent venting to the environment, perchloroethylene is absorbed by the clothing. Perc is classified as a probable human carcinogen by IARC and associated with an increased risk of breast cancer based on studies among women exposed to perchloroethylene-contaminated drinking water.

Reducing exposure: Avoid use of lubricants containing perc, including Liquid Wrench Non-Flammable Super Lubricant and Jig-a-Loo Invisible Lubricant. Check dry cleaners for one that uses an alternative, non-perc cleaning system, such wet cleaning.



Unlocking the workplace connection to breast cancer



Because of its widespread prevalence in Europe and North America, breast cancer is probably the most researched cancer of all. But surprisingly little of that research has focussed on occupational risks, despite the substantial body of evidence linking breast cancer with ionizing radiation, carcinogenic chemicals and other hazards routinely found in the workplace.

Even more significant are the records for workers' compensation. Nowhere in Canada has any provincial workers' compensation authority recognized a case of breast cancer as occupationally related and granted compensation to the diseased worker. That's not because there have not been breast cancer cases related to occupational exposures — it's because doctors don't generally track patients' occupational histories and the requirement that the claimant prove that her cancer was the result of occupational exposures is almost impossible to meet. For years, firefighters were not compensated for occupationally-related cancers. Neither were smelter workers who developed bladder cancer following years of working the pots in aluminum smelting. It was only after workers and unions submitted claims based on research studies that the first cases were compensated. The process had an added benefit in that it encouraged prevention initiatives aimed at reducing exposures.

In 2009, Denmark became the **first country** in Europe to compensate occupational breast cancer

In March, 2009, Denmark became the first country in Europe to recognize breast cancer as an occupational disease, based initially on the excess risk faced by night shift workers from light at night. That has not yet happened with breast cancer in the Canadian workplace, but the evidence of occupational exposures related to breast cancer is substantial and deserves recognition.

Carcinogenic chemicals: Numerous studies have pointed to an increased risk for long-term occupational exposure to toxic chemicals such as pesticides,³⁴ metalworking fluids,³⁵ and organic solvents,³⁶ as well as benzene. A 2000 study of occupational breast cancer risks in B.C. found a number of occupations where there were an excess of breast cancer cases and concluded: "The results of our study... suggest excess breast cancer risk in a number of occupations/industries, particularly those that entail exposures to solvents, low-frequency electromagnetic fields, and pesticides."³⁷



In Ontario, researchers Dr. Jim Brophy and Margaret Keith found that women who had done farm work had nearly three times the normal risk of developing breast cancer. They suggested that farm pesticide exposures during the women's adolescent development were a key factor in the development of breast cancer later in life. Their research also found that women who had done farm work and went on to employment in the auto industry had four times the risk of developing breast cancer, suggesting that new exposure to toxic materials in the industrial workplace elevated the risk further.

Diesel exhaust: Exposure to diesel exhaust has been clearly identified as a factor in breast cancer,^{38,39} with the most recent research revealing new pathways by which diesel exhaust emissions promote breast tumours. In a September 2009 article in *Toxicology Letters*, researchers at Ohio State University showed that diesel exhaust, which contains fine particulate matter induces the formation of new blood vessels that provide a blood supply to breast and other tumours.

Earlier research has shown that diesel exhaust contains polycyclic aromatic hydrocarbons (PAHs) that are carcinogenic. Other studies have found that certain particles from diesel exhaust have estrogenic properties. A key concern with diesel exhaust is the fine particles, particularly those below 0.1 micron (about 1/100 of the width of a human hair), can be absorbed deep into the lungs and can enter the circulatory system.

The diesel exhaust levels used in the Ohio State University research were designed to be equivalent to the exposure levels people would encounter in heavy truck traffic areas. They were even lower than those working near standing diesel equipment would be exposed to. That's of particular significance for women working as border service agents in border crossings, truck weigh scales or other areas where there is continual exposure to diesel exhaust. While new Canadian emission regulations on sulphur content of diesel fuel that came into effect in 2007 have reduced the levels of particulate matter in diesel, it is still a significant source of fine respirable particulate matter.

MALE BREAST CANCER

Work exposures an important link

BREAST CANCER IN MEN occurs much less frequently than among women — about one per cent of the female breast cancer incidence — but its incidence is rising, especially in the US and Canada.⁴⁰

Canadian cancer statistics recorded about 170 cases across the country in 2008. The average age of diagnosis is 67,⁴¹ which is about six years later than for women and often comes at an advanced stage, which reduces long-

term survival rates for men who develop the disease.

Although genetic factors, including the BRCA1 and BRCA2 gene mutations, account for a small percentage of male breast cancer (MBC) cases, they don't provide an explanation for the majority of the MBC diagnoses made each year in Canada.

Occupational factors may be particularly important for male breast cancer. Several epidemiological studies have shown a significantly increased risk of breast cancer for those working with gasoline⁴² or electricians, linemen and communications workers who are exposed to electromagnetic fields.⁴³



Shift work, light at night key areas for prevention

Light at night: One of the most potentially significant risk factors to emerge from recent research is the effect of light at night, which has major implications for rotating shift workers as well as for those routinely working at night, including nurses, commercial janitorial service workers, flight attendants, supermarket stockers, police officers and many others. Regular or intermittent exposure to light at night suppresses the hormone melatonin, which regulates the body's circadian rhythms and also plays an important role in protecting the body against cancer. Circadian rhythms are the body's rhythms throughout a 24-hour period, controlled by hormones in response to external influences such as daylight and darkness.

A 2005 study in *Cancer Research* found that breast cancer cells proliferated in laboratory rats following nighttime exposure to artificial light.⁴⁴ In 2007, an IARC Working Group convened to review the data on night shift work concluded: "Shift work that involves circadian disruption is probably carcinogenic to humans (Group 2A)."⁴⁵

One Danish researcher noted that the clear evidence of an elevated risk was particularly alarming because of the increasing frequency of irregular hours and shifts for many women workers.⁴⁶ Denmark's 2009 landmark compensation of breast cancer as occupationally related was based on recognition of 37 cases of breast cancer, all involving women who had

EXPOSURE CONTROL

Workplace inventory good place to start

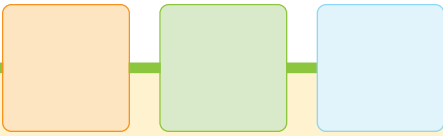
FOR THOSE POTENTIALLY EXPOSED to carcinogens in the workplace, the joint occupational health and safety (OHS) committee — a legal requirement under provincial legislation — is an important place to start. Committees often face difficulties because of a lack of support and resources but they are key to controlling workplace exposures and ensuring enforcement of regulations.

Federal Workplace Hazardous Materials Information System (WHMIS) legislation gives workers the right to know what toxic chemicals are being used and what hazards may be associated with them, including cancer. Provincial workplace safety legislation provides regulations to control workplace exposures, including occupational exposure limits and requirements for engineering controls and protective equipment.

INVENTORY WORKPLACE hazardous materials. It's important that OHS committees take inventories of hazardous materials in the workplace so that exposure control plans can be developed to reduce occupational exposures and toxic substances can be replaced with safer substitutes. The WorkSafeBC Regulation, as well as federal regulations, require employers to provide a safer substitute, wherever possible, for materials designated by the International Agency for Research on Cancer as known or suspected carcinogens.

PURSUE COMPENSATION for breast cancer wherever possible. As the experience of other workplace cancers has shown, action by unions and OHS committees in pursuing compensation in cases where there are known occupational risks factors is the first step towards eventual recognition.

It's also important to recognize that workplace cancer is more than a workplace issue. It is also a public health issue.



worked night shift for at least one night a week for the previous 20-30 years. Many of the women who received compensation were nurses or airline flight attendants. Denmark is now considering adding breast cancer to its list of established occupational diseases.

The new IARC findings and Denmark's action in recognizing occupational breast cancer emphasize the need not only for compensation, but also for precautionary action in the workplace to reduce the risk. What is needed is new directed research to determine what steps can be taken to protect night shift workers and to develop new occupational health and safety regulations based on the findings.

EMFs: More elusive is the link between breast cancer and electromagnetic fields (EMFs) from electrical and electronic equipment. Studies from both the U.S. and Europe have shown, for example, that women working in garment industries who are exposed to EMFs from sewing machines have an increased risk of breast cancer.⁴⁷ At the same time, other studies looking at various EMF exposures have shown no significant association. A further complication is that researchers have not been able to reach consensus on a mechanism that would link EMFs with breast cancer. Early research suggested that exposure to EMFs might suppress levels of melatonin, but later studies have not generally supported the theory.

The Bioinitiative Report calls for revamped safety standards to control exposure to EMFs

However, a recent international review of some 2000 studies, called the Bioinitiative Report, concluded, based on the weight of evidence, that EMF exposure is a risk factor for breast cancer (as well as leukemia and other cancers). It called for revamped safety standards to control both workplace and residential exposures, including a new standard for exposure to EMFs based on its potential biological effects.⁴⁸

This is an issue for Canadian workplaces since occupational exposure limits for EMFs — where they even exist — are out of date and do not reflect the data from the most recent research.

Occupational groupings: Epidemiological research has shown that women in some occupations, such as teachers, sales data entry clerks, airline attendants and nurses, have an elevated risk of developing breast cancer.⁴⁹ The associations are often consistent across different states and provinces, suggesting that occupational factors are involved in the higher incidence of breast cancer for women working in those occupations.

Although night shift has now been established as a key factor in some cases, pinpointing the exact causes within most occupations is a complex task— especially since cancers may take years or even decades to develop, by which time women are often in different occupations. But it's vital that more research be carried to identify occupational risks, so that both prevention initiatives and new health and safety regulations can be developed to reduce that risk. Occupational groups offer an important area in which interventions around disease prevention and risk reduction can be made and should be a high priority for the public health system.



Nutrition and exercise can enhance prevention



E

nvironmental factors and strategies for reducing exposures can be very different for women, depending on where they work or the products they use. But there are protective steps that virtually all women can take to reduce their risk. The following are those for which there is the strongest evidence.

Regular exercise, including brisk walking, has been shown to reduce the risk of breast cancer

Body weight: The roles that and diet and body weight play in breast cancer risk are complex. However, there is strong evidence that, for postmenopausal women, the risk of breast cancer increases in tandem with an increasing body mass index (BMI) and weight gain after menopause is a clearly identified risk factor.⁵⁰ Studies have shown that increased body fat in postmenopausal women results in higher circulating levels of estrogen, which in turn increase the risk of breast cancer.⁵¹ The evidence is not as clear for premenopausal women, in part because overall estrogen levels prior to menopause are determined primarily by the ovaries, with body fat playing only a minor role in estrogen production. Still, maintaining a healthy body weight — especially after menopause when weight gain clearly adds to breast cancer risk — is an important prevention step.

Diet: The association between diet and breast cancer has been widely researched but results have been conflicting. One of the most extensive diet studies ever carried out, looking into the effectiveness of a low-fat diet in reducing breast cancer risk for postmenopausal women, found no significant benefits from the diet.⁵² However, another study published the same year showed a 24 per cent reduction in recurrence for breast cancer patients who adopted the low-fat diet.

There are components of diet for which the evidence of a protective benefit is stronger, however. Recent research is confirming earlier evidence that a diet rich in fruits and vegetables, especially cruciferous vegetables (broccoli, kale, cabbage and cauliflower), can reduce the risk of breast cancer.^{53,54}

Exercise: Regular exercise, including brisk walking for at least one to three hours a week, has been shown to reduce the risk of breast cancer. A study of 74,000 women in the U.S.



found that exercising between 1.25 and 2.5 hours per week had a 18 per cent reduction in breast cancer risk, with a further slight reduction for those who engaged in brisk walking for 10 hours or more per week.⁵⁵ The effect is most evident for postmenopausal women, but recent research has also shown a reduction in the risk of pre-menopausal breast cancer for young women who exercised regularly through their teenage years and into adulthood.⁵⁶

Vitamin D: Many thought a Vitamin D supplement could be the answer to breast cancer prevention when a 2007 study among Nebraska women showed a dramatic reduction in risk for those taking combined Vitamin D and calcium supplements.⁵⁷ But a major follow-up study was unable to show any benefit,⁵⁸ although other more long-term research has shown a reduction in risk when Vitamin D supplements are given to girls between 10 and 19.⁵⁹ Most Vitamin D is produced naturally from exposure to sunshine, but Canadians' levels tend to be low for much of the year. Given those low levels and Vitamin D's demonstrated benefit in reducing the risk of colon cancer, supplements are probably beneficial. The Canadian Cancer Society recommends 1000 International Units (IUs) daily during the fall and winter when there is little sunshine to generate Vitamin D naturally.

Screening: Although not a prevention step, mammography screening has been a key factor in detecting breast cancer at an early stage and increasing the probability of survival. Several studies have shown that mammograms for women 50 and over have reduced mortality significantly,⁶⁰ even 15 years after initial screening. In 2002, the International Agency for Research on Cancer concluded that there was sufficient evidence to demonstrate the effectiveness of screening for women 50-69.⁶¹

ONLINE SOURCES

Websites offer more on nutrition, research

NUMEROUS ONLINE SITES are available that provide more information on nutrition and breast cancer prevention, but it's often difficult to separate the hype from considered science. One useful source is a detailed fact sheet provided by the Women's Health department of the Medical Center at the University of California San Francisco. Entitled Nutrition and Breast Cancer, it outlines the nutritional and protective benefits of various foods as shown in recent research studies. It's online at: http://cancer.ucsf.edu/crc/nutrition_breast.pdf.

Also from California's Bay area — which incidentally has among the highest rates of breast cancer in the

United States — comes the Breast Cancer Fund's State of the Evidence 2008 report. For those who want further information on the environmental factors associated with breast cancer, it provides a comprehensive outline of the current evidence as well as a review of the latest research. It's available as a free pdf download from the Breast Cancer Fund's website. Go to www.breastcancerfund.org, click on Resources and then click on Publications.

For more information on steering clear on carcinogens and endocrine-disrupting chemicals in cosmetic products, the U.S. Campaign for Safe Cosmetics, which is closely associated with the Breast Cancer Fund, is a useful source. It offers reports on ingredients in cosmetic and personal care products. The website address is: www.safecosmetics.org



Policy changes crucial to realize prevention potential



For the last two generations women in Canada have watched the incidence of breast cancer edge steadily upward from 83.3 per 100,000 in 1980 to 102.5 per 100,000 in 2008 — a 23 per cent increase. As the graph on page 3 indicates, the differences can't be explained by an aging population because the figures have been “age-standardized” to take that into account. The risk that a woman will develop breast cancer during her lifetime is one in nine today, higher than it was in 1980.

Throughout this booklet, we've outlined some of the steps women can take to reduce that risk. But individual Canadians can only do so much. Much of the incidence of breast cancer is preventable, but prevention is most effective if it is applied broadly throughout society. That requires new approaches and policy changes at all levels of government and public health agencies.

What are some of those key policy changes?

Funding prevention research: According to the most recent data from the Canada Cancer Research Alliance, only 1.9 per cent of a total \$390 million in research funding went to prevention research in 2006.⁶² Much more of the money raised for breast cancer research should be used to identify the environmental links to breast cancer — including diet, occupational exposures and other factors — and explore ways to eliminate them.

Improving cancer surveillance: Too often the links to cancer go undetected because they are not considered at the time a woman is diagnosed. Physicians should be encouraged to document cancer patients' occupational histories and to make that information available to provincial cancer registries.

Applying the precautionary principle: in 2003 the California city of San Francisco took the pioneering step of introducing new legislation that requires the city to apply the precautionary principle in all decisions relating to health and the environment. In the past, decisions were based on risk assessment — on establishing a tolerable level of harm. But the new precautionary legislation attempts to limit harm to the lowest level possible. It requires that steps be taken to protect health and the environment even where the scientific proof of harm



may not have been conclusively established and requires that all alternatives be assessed and considered. The city has used the law, for example, to set purchasing policy to ensure that the safest, environmentally-preferable products are being purchased.

The Quebec and Ontario governments have used the precautionary principle in adopting legislation on cosmetic pesticides. Under the law, certain pesticides such as those containing 2,4-D, cannot be sold. The weight of evidence indicates a potential for harm to human health even though there may not yet be conclusive proof.

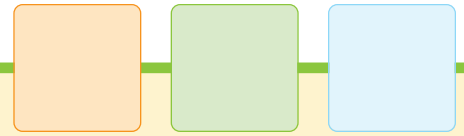
Making the precautionary principle the framework for all levels of government in setting health and environmental policy would greatly enhance not only prevention of cancer but many other chronic diseases as well.

Ensuring precautionary regulation of chemicals: An estimated 80,000 chemicals are in use throughout North America, barely 10 per cent of which have been fully tested for their health and environmental effects. Because of the efforts of scientists as well as health and environmental advocates here and in Europe, new government initiatives, including REACH in Europe and the Chemicals Management Plan (CMP), have been launched to undertake more rigorous assessment of industrial and consumer chemicals. But it is critically important that the assessment of chemicals translate into effective regulations, such as improved occupational exposure limits, restrictions on ingredients in products intended for children or even elimination from use of some particularly toxic chemicals. The action taken by Health Canada to ban the sale of polycarbonate baby bottles containing bisphenol-A was an example of precautionary regulation. But other chemicals that have been declared toxic have not been regulated and workplace regulation has not been properly addressed under the CMP.

Precautionary action should be an **essential part** of the federal Chemicals Management Plan

Guaranteeing the right to know: Several health advocacy groups, including Toxic Free Canada and the Canadian Cancer Society, have urged government to bring in hazard labelling legislation that would guarantee consumers the right to know what hazardous ingredients may be in the products they buy. Similar legislation already exists in California and Europe and requires product labelling of ingredients and identification of any known hazardous ingredients, such as carcinogens. In California, the legislation has been particularly successful in encouraging manufacturers to re-formulate products in order to avoid having to disclose hazardous ingredients.⁶³

In the workplace, workers do have the right to know about exposure to hazardous substances. But occupational exposure limits (OELs) are still set without direct participation of workers and the public, which often results in exposures far higher than those considered safe by health based research. OELs should be based on health protection, not economic impact, and should include worker and public involvement, recognizing that workplace exposure is a public health issue.



Endnotes

- 1 Canadian Cancer Statistics 2008. Produced by the Canadian Cancer Society, National Cancer Institute, Public Health Agency of Canada and provincial and territorial cancer registries. Available online at: www.cancer.ca
- 2 Davis, DL, Bradlow HL, Wolff M, Woodruff T, Hoel DG, Anton-Culver H. *Medical hypothesis: xenoestrogens as a preventable cause of breast cancer*. Environmental Health Perspectives. October, 1993.
- 3 Lichtenstein, P., Holm, N. V., Verkasalo, P. K., Iliadou, A., Kaprio, J., Koskenvuo, M., Pukkala, E., Skytthe, A., and Hemminki, K. *Environmental and heritable factors in the causation of cancer: analyses of cohorts of twins from Sweden, Denmark, and Finland*. The New England Journal of Medicine. July 13, 2000.
- 4 Kortenkamp, Andreas. *Breast cancer and exposure to hormonally active chemicals: an appraisal of the scientific evidence*. Health and Environmental Alliance, UK, April, 2008.
- 5 Rudel RA, Attfield KR, Schifano JN, Brody JG. *Chemicals causing mammary gland tumors in animals signal new directions for epidemiology, chemicals testing, and risk assessment for breast cancer prevention*. Environmental Factors in Breast Cancer supplement to Cancer, American Cancer Society, May, 2007.
- 6 Ibarluzea JJ, Fernandez MF, Santa-Marina L, Olea-Serrano MF, Rivas AM, Aurrekoetxea JJ, Exposito J, Lorenzo M, Torne P, Villalobos M, Pedraza V, Sasco AJ and Olea N. *Breast cancer risk and the combined effect of environmental oestrogens*. Cancer Causes Control, August, 2004.
- 7 Band PR, Le ND, Fang R, Deschamps M. *Carcinogenic and endocrine disrupting effects of cigarette smoke and the risk of breast cancer*. Lancet, October 5, 2002.
- 8 National Institutes of Health news release. *NHLBI stops trial of estrogen plus progestin due to increased cancer risk, lack of overall benefit*. July 9, 2002. Available at: <http://www.nhlbi.nih.gov/new/press/02-07-09.htm>
- 9 Gray J, Evans N, Taylor B, Rizzo J, Walker M. *State of the evidence between breast cancer and the environment*. International Journal of Occupational and Environmental Health. Vol. 15, No. 1 January, 2009.
- 10 Deligeroroglou E, Michailidis E, Creatsas G. *Oral contraceptives and reproductive system cancer*. Annals of the New York Academy of Science, November, 2003.
- 11 Markey CM, Luque EH, Munoz de Toro M, Sonnenschein C, Soto AM. *In utero exposure to bisphenol-A alters the development and tissue organization of the mouse mammary gland*. Biology of Reproduction, No. 65, 2001.
- 12 Durando M, Kass L, Piva J, Sonnenschein C, Soto AM, Luque EH, Munoz de Toro M. *Prenatal bisphenol-A exposure induces preneoplastic lesions in the mammary gland in Wistar rats*. Environmental Health Perspectives, January, 2007.
- 13 Carwile JL, Luu HT, Bassett LS, Driscoll DA, Yuan C, Chang JY, Ye X, Calafat AM, Michels KB. *Use of polycarbonate bottles and urinary bisphenol-A concentrations*. Environmental Health Perspectives, Vol. 117 No. 9, September, 2009.
- 14 Acevedo, R., Villanueva, H., Parnell, P.G., Chapman, L.M., Gimenez, T., Gray, S.L., Baldwin, W.S. *The contribution of hepatic steroid metabolism to serum estradiol and estriol concentrations in nonylphenol treated MMTVneu mice and its potential effects on breast cancer incidence and latency*. Journal of Applied Toxicology, September-October, 2005.
- 15 Byford JR, Shaw LE, Drew MGB, Pope GS, Sauer MJ, Darbre PD. *Oestrogenic activity of parabens in MCF7 human breast cancer cells*. Journal of Steroid Biochemistry and Molecular Biology, January, 2002.
- 16 Jobling S, Reynolds T, White R, Parker MG, Sumpter JP. *A variety of environmentally persistent chemicals, including some phthalate plasticizers, are weakly estrogenic*. Environmental Health Perspectives, June, 1995.
- 17 Kim IY, Han SY, Moon A (2004). *Phthalates inhibit tamoxifen-induced apoptosis in MCF-7 human breast cancer cells*. Journal of Toxicology and Environmental Health, December, 2004.
- 18 Feychting M, Forssen U, Rutqvist LE, Ahlbom A. *Magnetic fields and breast cancer in Swedish adults residing near high-voltage power lines*. Epidemiology, July, 1998.
- 19 McElroy JA, Egan KM, Titus-Ernstoff L, Anderson HA, Trentham-Dietz A, Hampton JM, Newcomb PA. *Occupational exposure to electromagnetic field and breast cancer in a large, population-based, case-control study in the United States*. Journal of Occupational and Environmental Medicine, March, 2007.
- 20 Ahlbom A, Cardis E, Green A, Linet M, Savitz D, Swerdlow A. *Review of the epidemiologic literature on EMF and health*. Environmental Health Perspectives, Vol. 109, Supp. 6, December, 2001.
- 21 Zhu K, Hunter S, Payne-Wilks K, Roland CL, Forbes DS. *Use of electric bedding and risk of breast cancer in Africa-American women*. American Journal of Epidemiology, Vol. 58, No 8, 2003.
- 22 Kabat GC, O'Leary ES, Scoenfeld ER, Greene JM, Grison R, Henderson K, Kaune WT, Gammon MD, Britton JA, Teitelbaum SL, Neugut AI, Leske MC. *Electric blanket use and breast cancer on Long Island*. Epidemiology, September, 2003.
- 23 Zheng T, Holford TR, Mayne ST, Owens PH, Zhang B, Boyle P, Carter D, Ward B, Zhang Y, Zahm SH. *Exposure to electromagnetic fields from use of electric blankets and other in-home electrical appliances and breast cancer risk*. American Journal of Epidemiology, June, 2000.
- 24 Mills Paul K, Yang Richard. *Breast cancer risk in Hispanic agricultural workers in California*. International Journal of Occupational and Environmental Health, 11, 2005.
- 25 Zheng W, Gustafson DR, Sinha R, Cerhan JR, Moore D, Hong CP, et al. *Well-done meat intake and the risk of breast cancer*. J National Cancer Institute, Vol. 90, No. 22, 1998.
- 26 Steck SS, Gaudet MM, Eng SM, Britton JA, Teitelbaum SL, Neugut AI, Santella RM, Gammon, MD. *Cooked meat and risk of breast cancer—lifetime versus recent dietary intake*. Epidemiology, May, 2007.
- 27 Smith-Warner SA, Spiegelman D, Shiao-Shyuan Y, van den Brandt PA, Folsom AR, Goldbohm A, Graham S, Holmberg L, Howe GR, Marshall JR, Miller AB, Potter JD, Speizer FE, Willett WC, Wolk A, Hunter DJ. *Alcohol and breast cancer in women: a pooled analysis of cohort studies*. Journal of the American Medical Association Vol. 279 No 7, February 18, 1998.
- 28 Zhang SM, Lee I, Manson JE, Cook NR, Willett WC, Buring JE. *Alcohol consumption and breast cancer risk in the Women's Health Study*. American Journal of Epidemiology. Vol. 165 No. 6 January, 2007.
- 29 Feigelson HS, Calle EE, Robertson AS, Wingo PA, Thun MJ. *Alcohol consumption increases the risk of fatal breast cancer*. Cancer Causes and Control Vol. 12 No. 10 December 2001.
- 30 see Smith Warner, 1998 above.
- 31 Collishaw NE (chair). *Canadian expert panel on tobacco smoke and breast cancer risk*. Ontario Tobacco Research Unit special report, April 2009.
- 32 NTP Technical report on the toxicology and carcinogenesis studies of dichloromethane (methylene chloride) in F344/n rats and B6C3F1 mice. National Toxicology Program, 1986.
- 33 Shannon, H, Haines T, Bernholz C, Julian, J, Verma D, Jamieson E, Walsh C. *Cancer morbidity in lamp manufacturing workers*. American Journal of Industrial Medicine Vol. 14, Issue 3, 1988.
- 34 Brophy JT, Keith, MM, Gorey, KM, Luginaah I, Laukkanen E, Hellyer D, Reinhartz A, Watterson A, Abu-Zabra H, Maticka-Tyndale E, Schneider K, Beck M, Gilbertson M, Infante P. *Occupational and environmental histories of breast cancer patients: a Canadian case study*. Annals New York Academy of Sciences, Sept, 2006.
- 35 Thompson D, Kriebel D, Quinn MM, Wegman DH, Eisen EA. *Occupational exposure to metalworking fluids and risk of breast cancer among female autoworkers*. American Journal of Industrial Medicine. Vol. 47 No 2, 2005.
- 36 Hansen, J. *Breast cancer risk among relatively young women employed in solvent-using industries*. American Journal of Industrial Medicine. July, 1999.
- 37 Band, PR, Le ND, Fang R, Deschamps M, Gallagher RP, Yang P. *Identification of occupational cancer risks in British Columbia: a population-based case-control study of 995 incident breast cancer cases by menopausal status, controlling for confounding factors*. Journal of Occupational Medicine, March, 2000.
- 38 Courter LA, Pereira C, Baird WM. *Diesel exhaust influences carcinogenic PAH-induced genotoxicity and gene expression in human breast epithelial cells*. Mutation Research/Fundamental and Molecular Mechanisms of Mutagenesis. December, 2007.
- 39 Furuta C, Suzuki AK, Taneda S, Kamata K, Hayashi H, Mori Y, Li C, Watanabe G, Taya K. *Estrogenic activities of nitrophenols in diesel exhaust particles*. Biology of Reproduction 70, 2004.
- 40 Contractor KB, Kaur K, Rodrigues GS, Kulkarni DM, Singhal H. *Male breast cancer: is the scenario changing?* World Journal of Surgical Oncology, June 16, 2008.
- 41 Giordano, SH. *A review of the diagnosis and management of male breast cancer*. The Oncologist No. 10, 2005.
- 42 Hansen J. *Elevated risk for male breast cancer after occupational exposure to gasoline and vehicular combustion products*. American Journal of Industrial Medicine. Vol. 37, Issue 4, February, 2000.



- 43 Demers P, Thomas DB, Rosenblatt KA, Jimenez LM, McTiernan A, Stalsberg H, Stemhagen A, Thompson WD, Curner MG, Satariano W. *Occupational exposure to electromagnetic fields and breast cancer in men*. American Journal Epidemiology, August, 1991.
- 44 Blask DE, Brainard GC, Dauchy RT, Hanifin JP, Davidson LK, Krause JA, Sauer LA, Rivera-Bermudez MA, Dubocovich ML, Jasser SA, Lynch DT, Rollag MD, Zalatan F. *Melatonin-depleted blood from premenopausal women exposed to light at night stimulates growth of human breast cancer xenografts in nude rats*. Cancer Research, December, 2005.
- 45 IARC adds night shifts to cancer risk list. eCancer News, March 16, 2009. Available at: <http://www.ecancermedicalscience.com/news-insider-news.asp?itemId=460>
- 46 Hansen J. *Light at night, shiftwork and breast cancer risk*. Journal of the National Cancer Institute. Vol. 93 No. 20 October 17, 2001.
- 47 see Band, PR, 2000 above.
- 48 Carpenter D, Sage C et al. *Bioinitiative Report: a rationale for a biologically-based public exposure standard for electromagnetic fields (ELF and RF)*. A collaboration of international scientists. August, 2007. Available at: www.bioinitiative.org
- 49 Goldberg MS, Labreche F. *Occupational risk factors for female breast cancer: a review*. Occupational and Environmental Medicine, 53, 1996.
- 50 Cornell University. *Breast Cancer and Environmental Risk Factors*. Fact Sheet 42, August 2001. Accessed at: <http://envirocancer.cornell.edu/Factsheet/general/fs42.bodytype.cfm>
- 51 Endogenous Hormones and Breast Cancer Collaborative Group. *Body mass index, serum sex hormones and breast cancer risk in postmenopausal women*. Journal of the National Cancer Institute, Vol. 95 No. 16 August 20, 2003.
- 52 Prentice, Ross et al. *Low-fat dietary pattern and risk of invasive breast cancer. The Women's Health Initiative randomized controlled dietary modification trial*. Journal of the American Medical Association Vol. 295 No. 6, February 8, 2006.
- 53 Zhang C, Ho SC, Chen Y, Fu J, Cheng S, Lin F. *Greater vegetable and fruit intake is associated with a lower risk of breast cancer among Chinese women*. International Journal of Cancer, Vol. 125, Issue 1, February, 2009.
- 54 Lee A, Fowke JH, Lu W, Ye C, Zheng Y, Cai Q, Gu K, Gao Y, Shu X, Zheng W. *Cruciferous vegetables, the GSTP1 Ile105 Val genetic polymorphism, and breast cancer risk*. American Journal of Clinical Nutrition, Vol. 87, No.3 March, 2008.
- 55 McTiernan A, Kooperberg C, White E, Wilcox S, Coates R, Adams-Campbell LL, Woods N, Ockene J. *Recreational physical activity and the risk of breast cancer in premenopausal women*. Journal American Medical Association Vol. 290, No. 10, September 10, 2003.
- 56 Maruti S, Willett WC, Feskanuch D, Rosner B, Colditz GA. *A prospective study of age-specific physical activity and premenopausal breast cancer*. Journal of the National Cancer Institute, Vol. 100, Issue 10, May 21, 2008.
- 57 Lappe JM, Travers-Gustafson D, Davies KM, Recker RR, Heaney RP. *Vitamin D and calcium supplementation reduces cancer risk: results of a randomized trial*. American Journal of Clinical Nutrition. May, 2007.
- 58 Chlebowski RT, Johnson KC, Kooperberg C, Pettinger M, Wactawski-Wende J, Rohan T, Rossouw J, Lane D, O'Sullivan M, Yasmeeen S, Hiatt RA, Shikany JM, Vitolins M, Khandekar J, Hubbell FA. *Calcium plus Vitamin D supplementation and the risk of breast cancer*. Journal of the National Cancer Institute Vol. 100, No. 22, November, 2008.
- 59 Knight, JA, Lesosky M, Barnett H, Raboud JM, Vieth R. *Vitamin D and reduced risk of breast cancer: a population-based case control study*. Cancer Epidemiology, Biomarkers and Prevention. March, 2007.
- 60 Nystrom L, Andersson I Bjurstam N Frisell J, Nordenskjold B, Rutqvist LE. *Long term effects of mammogram screening: updated overview of the Swedish randomised trials*. Lancet, Vol. 359, Issue 9310, March 16, 2002.
- 61 IARC Handbook of Cancer Prevention, Vol. 7. *Breast Cancer Screening*. Lyon, France: IARC, 2002.
- 62 Canadian Cancer Research Alliance. *Cancer research investment in Canada, 2006*. Published August, 2008. Available online at: http://www.cra-acrc.ca/default_en.htm
- 63 Rechtschaffen C, Williams P. *The continued success of Proposition 65 in reducing toxic exposures*. Environmental Law Reporter, December, 2005.

About CancerSmart and Toxic Free Canada

CancerSmart is a project of Toxic Free Canada (formerly the Labour Environmental Alliance Society), which was established in 1998 to bring workers and environmentalists together in cooperative projects to eliminate toxins in our homes, workplaces, schools and communities.

Much of Toxic Free Canada's work is based on the link between human health and the environment. In 2000, we launched our innovative Cleaners and Toxins program to begin reducing the use of hazardous cleaning materials in industrial plants, school districts and health care facilities. We were recognized with a 2002 Pollution Prevention award from the Canadian Council of Ministers of the Environment. Since then, we have helped many more school districts and other facilities

move to safe, environmentally-preferable green cleaning.

The effectiveness of that work prompted the CancerSmart program, which combines cancer prevention through reduced exposure to environmental and occupational toxins with education about environmental effects. The CancerSmart Consumer Guide, first published in 2004, is now in its third edition and has sold nearly 40,000 copies in both French and English editions.

CancerSmart materials have been widely used in schools, integrated health programs as well as union health and safety programs. Toxic Free Canada has also partnered with the Canadian Breast Cancer Foundation to present community workshops on toxic substances and with the Canadian Cancer Society in community initiatives to promote pesticide reduction bylaws.



Funded by the community activities

of thousands of people across Canada, breast cancer research has made great strides in the detection of breast cancer and the quality and effectiveness of treatment.

But why is the disease so prevalent today? **Why are there so many cases that can't be explained by the usual risk factors?** Exploring the environmental links to cancer may provide many of the answers — and open up new opportunities for the prevention of breast cancer.

Environmental Exposure looks at environmental factors implicated in breast cancer, from diet and hormone therapy use, to chemicals in everyday consumer products and cosmetics, and occupational exposures to carcinogens in the workplace.

Produced by the publishers of the CancerSmart Consumer Guide, it offers new insight from the latest research studies along with practical advice on reducing environmental exposure. Whether it's advice on which consumer products to avoid, what steps to take in the workplace, or what regulations to adopt, **Environmental Exposure is a significant contribution to breast cancer prevention.**

