The Ribbon

BCERF

Volume 10 • Number 2 • Spring 2005

A Newsletter of the Cornell University Program on Breast Cancer and Environmental Risk Factors (BCERF)

The Agricultural Health Study

In 1993 enrollment began for the largest health study of the US farming community, the Agricultural Health Study (AHS). Twelve years later, data from the 89,658 enrollees in Iowa and North Carolina are beginning to generate the most comprehensive assessments of the link between individual pesticides and cancer risk ever published. The risk of various cancers is just one set of health endpoints monitored in this ground-breaking study; other health problems addressed include diseases of the nervous system, as well as respiratory and reproductive health. In ***The Ribbon*** *we will focus on the work being done in this study to better understand pesticide exposures and any cancer-related outcomes. (Dr. Suzanne Snedeker specifically addresses the AHS work on pesticide exposure and breast cancer risk, in her Research Commentary on page 5.) We will also highlight the work being done as part of the AHS to help understand and reduce pesticide exposure.*

There have been various epidemiological attempts to better understand the relationship between pesticide exposure and cancer risk. These, together with laboratory work, have presented a patchwork of data linking some pesticides with increased risk of some cancers. The large scale and comprehensive design of the AHS are meant to specifically address the weaknesses and gaps in prior research.

Enlisting the long-term support of a large portion of the farming communities of two states, Iowa and North Carolina – both with strong agricultural sectors with diverse agricultural methods and products – enables researchers to employ the strengths of prospective cohort studies. The chemical exposure and lifestyle information that is collected from these participants is the most detailed ever: participants responded to about 250 questions in the initial survey. Fifty pesticides were selected based on their widespread use and/or previous studies indicated their potential association with health risks, and 30 more were added, based on participant "write-ins." Follow-up surveys every five years provide scientists with updated information. Including spouses in the research is an important aspect that is providing data on women and pesticide use and exposure never before collected. There is also a small percentage of female certified (North Carolina) and licensed (Iowa) pesticide applicators included in the study. Overall, two-thirds of participants are applicators and one-third are spouses. With children also registered, the understanding of the health of farm families is being greatly enhanced by the AHS.

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Cancer findings: early results

Previous research indicates that farmers experience some cancers to a lesser extent than the general population and some cancers to a greater extent. Fewer farmers die (results from mortality studies) from lung, esophagus, bladder and colon cancers, possibly the result of smoking less, eating a healthier diet and getting more physical exercise than the average American. But studies also suggest that farmers as a group experience higher rates of Hodgkin's disease, leukemia, multiple myeloma, non-Hodgkins lymphoma, and cancers of the lip, stomach, prostate, skin, brain, and connective tissue.

The AHS is now at the stage at which disease rates can be assessed, and the study is producing some important cancer findings. These findings reflect about five years of follow-up, following several years of enrollment and data collection (see box, "Study Timeline"). The two ways in which cancer rates are analyzed in the AHS are: 1) the comparison of cancer rates amongst enrollees with those of the general population, and 2) the comparison of cancer rates of those using specific pesticides with those who do not. A major finding – one that correlates with previously existing data – is that this population of farmers experiences lower overall cancer rates than the general population. The rates found thus far of all cancers, except prostate cancer, were lower. However, early findings do suggest an association between use of specific pesticides and an increased risk of specific cancers. It is important to

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note that discovering these associations does not mean a causal relationship has been found. The AHS employs a rigorous strategy of criteria for causal inference (see table, "Causal Inference in AHS: What are we looking for?" and more detail below).

Study Timeline

1993-1997	Recruit and survey participants
1998-2003	Measure pesticide exposure and test pesticide exposure formula Collect genetic samples
2004-2008	**Assess disease rates and risk factors**
2009-2013	Evaluate disease mechanisms

These early findings of association between specific pesticide exposures and increased cancer risk include: prostate cancer and methyl bromide; immune/blood cancers and alachlor; lung cancer and chlorpyrifos and some evidence of increased risk of breast cancer associated with the use of several pesticides (on this topic please see *Research Commentary* is this issue).

Prostate cancer and pesticide exposure. This analysis found that the risk of prostate cancer was 14% higher among pesticide applicators than in the general populations of Iowa and North Carolina. Of the 45 pesticides analyzed for a relationship with prostate cancer, several showed an increased risk in men over 50 and in those with a family history of this disease. Researchers will be examining whether there exists a genetic-environment interaction in which men with a family history of prostate cancer are especially susceptible to carcinogenic effects of these pesticides. The pesticides that showed this relationship include chlorpyrifos, coumaphos, fonofos, phorate, permethrin and butylate.

One of the 45 pesticides tested, methyl bromide showed a "dose-response trend." In other words, the risk of prostate cancer increased with increased exposure to this soil fumigant. The highest exposure categories had a 3.5 times greater risk of prostate cancer. Fortunately, use of this soil fumigant, which is considered to be a potential occupational carcinogen by the National Institute for Occupational Safety and Health, is declining. This year the AHS will determine whether these initial findings on prostate cancer can be replicated.

See also Dr. Snedeker's, "Some Pesticide Applicators at Higher Risk for Prostate Cancer," in Vol. 8, No. 3 issue of *The Ribbon* http://envirocancer.cornell.edu/newsletter/newsletter.cfm

Immune/blood cancers and alachlor. About half of the applicators in the AHS reported using the herbicide alachlor, which is classified by the US Environmental Protection Agency (EPA) as a probable human carcinogen. The AHS analysis did not find a relationship between alachlor exposure and those cancers in which previous animal studies had shown one (lung tumors in mice, and thyroid gland, stomach and nasal passage tumors in the rat models). But it did show a relationship between alachlor exposure and risk of blood and immune system cancers. These cancers include leukemia, multiple myeloma and non-Hodgkin's lymphoma collectively. Increased risk was observed with increased exposure.

Chlorpyrifos and lung cancer. In an AHS analysis of exposure to chlorpyrifos, one of the most widely used insecticides in the US, researchers found an association between use of this pesticide and the incidence of lung cancer, but not with any other cancer. In the highest exposure group, there was a 2.18 relative risk of lung cancer. This finding is of particular interest because farmers in general, and also those within the AHS cohort, have lower rates of lung cancer than the general population, probably because of lower smoking rates. (The chlorpyrifos-lung cancer association in this analysis was determined controlling for all other known cancer risk factors, including smoking.) In addition to its agricultural uses, chlorpyrifos was widely used in US households until 2000, and exposure to chlorpyrifos is the focus of an intensive exposure study within the AHS (see below).

Dr. Michael Alavanja of the National Cancer Institute (NCI) is the Director of the AHS. He describes the important junction at which the study has arrived:

> *The AHS will now be generating ten to fifteen cancer etiology papers per year, and this will continue for the next four years (2005-2008). In all cases we will attempt to prevent false positive conclusions by limiting the interpretation of our findings until we observe dose-response findings in both Iowa and North Carolina and we can replicate the finding at two points in time. We are also planning molecular epidemiology to try to understand the mechanism of action of any positive finding.*

The table below describes this approach: ideally all boxes will be "filled in" as shown. However, Dr. Alavanja cautions, initial dose-response findings in both states,

Causal Inference in AHS: What are we looking for?

	Initial Findings	Replication later in time	Biological Evidence in Humans
Iowa	Dose-response	Dose-response	Yes
North Carolina	Dose-response	Dose-response	Yes
License type*	Dose-response	Dose-response	Yes

** Private vs. commerical*

across pesticide applicator license type, replicated in time, would suggest a causal relationship, even in the absence of biological evidence.

New insights regarding pesticide exposure

One of the major challenges in studying the effects of pesticide exposure on human health is the difficulty in precisely assessing real-life exposures. Pesticides are widely used without a detailed understanding of all the various ways they might enter the body and in what quantities they do so. As part of its study of the Iowa and North Carolina farming populations, the AHS has prioritized the improvement of scientific methods to better understand pesticide exposure. This work has revealed much information that enables scientists to more accurately determine potential health effects of pesticide exposure, and also assists in the development of better controls and practices to decrease exposure.

For example, early on in the study members of the research team looked closely at the characteristics of people who self-reported a "high pesticide exposure event." Closely examining these 14% of the study population enabled the epidemiologists to determine what home and farm features or practices are associated with incidents or experiences leading to unusually high personal exposures. These characteristics ranged from how, where and when work clothing was laundered and the types of pesticides being used, to whether the family was experiencing financial stress. After taking into account education and total number of lifetime applications made, researchers saw that women had significantly fewer events than men who applied pesticides. Job characteristics more common among those who reported a high pesticide exposure event included repairing pesticide application equipment oneself, and having first used pesticides more than 10 years ago. While the demographic, work practice and job characteristics identified in this investigation were not necessarily the cause of the high pesticide exposure, identifying these factors is a first step in the eventual prevention of these potentially hazardous events. Computer modeling – used as a tool in the AHS for exposure estimates and analyses, in addition to biological measurements – showed that following all pesticide label requirements could prevent many of these high exposure events.

Other analyses looked at exposure hazards of families of pesticide applicators. The design of the AHS takes into account that farmers "living where they work" presents potential exposures for spouses and children. Researchers found that 21% of homes are within 50 yards of the pesticide mixing area, that 27% of applicators store pesticides in their homes (including attached garage or basements), and that most pesticide-contaminated clothing is washed in the same machine as other laundry. At least half of the wives reported working the fields, 40% reported mixing or applying pesticides, and more than half of the children over age 11 did farm chores, some of which may have put them into contact with pesticides.

Researchers are taking this farm/home and work practice information and developing ways to determine the health implications of the resulting exposures. For example, scientists at the EPA conducted five-day continuous sampling of a group of volunteers in the AHS population, in order to gain a detailed understanding of exposure to two pesticides, 2, 4-D and chlorpyrifos. Biological samples from volunteering spouses and children were also collected. Exposure to these two pesticides is also being analyzed in a project that compares average exposures between different sub-populations in the AHS, for example between the two states, between male and female, and between farmers and commercial applicators. All of these data will enable a more complete analysis of exposures to these two widely used pesticides and any subsequent health outcomes.

Studies like these both refine exposure information for the AHS specifically, and develop methodologies for future pesticide exposure research. AHS computer models predicting pesticide exposure have already been found to be an effective predictor of exposure in a non-AHS population. AHS efforts also include comparisons between African-American farmers' and white farmers' pesticide use practices in North Carolina, and analyses of the use protective equipment and application method. Comparisons of work practices and attitudes toward risk between the two states are proving to be instructive. All of this research also clearly contributes to improved health and safety education and communication tailored to the farming community.

Keeping in touch with enrollees and communicating widely: current projects and future possibilities

The AHS has a strong, multi-faceted communication component. Ongoing communication with enrollees is a high priority. Two state-based entities, the University of Iowa College of Public Health and the Battelle Centers for Public Health Research and Evaluation in North Carolina, responsible for carrying out the study in their respective states, keep study participants closely informed of AHS progress. Julia Storm, an Agromedicine Information Specialist at North Carolina State University who has collaborated with the AHS on producing educational materials, says of the two state offices: "they are doing an excellent job putting the information that comes out of the study into a practical light for the farm families enrolled."

Storm and collaborators recently completed a project to communicate AHS study data to members of the cohort and other important audiences: those who may not be

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involved in the study, but for whom the information is critically important for improving health and safety in the broader agricultural community. This includes all farmers and farm families, pesticide safety educators, health professionals, and policy makers. The project, funded by the National Institute for Occupational Safety and Health through the Southern Coastal Agromedicine Center of the North Carolina Agromedicine Institute, produced three detailed, full-color, fold-out brochures about the study that are now available (these were the source of much information for this article; see ordering information on back cover). Julia Storm has also developed a PowerPoint presentation entitled "Understanding the Agricultural Health Study" that will soon be available for educators to use (if interested, please contact Storm at julia_storm@ncsu.edu). In addition, she assisted collaborators at the Eastern Area Health Education Center associated with the East Carolina University School of Medicine in developing an online continuing medical education course on pesticides and health that will be available in summer of 2005.

In 2004, Dr. Amy Brown, an Associate Professor at the University of Maryland, formed the AHS Risk Communication Work Group together with Dr. Snedeker and Ms. Storm, to offer a proposal to the AHS National Advisory Panel (NAP), of which Dr. Brown is a member. The Work Group proposed strategies to further enhance and expand AHS risk communication efforts to pesticide applicators across the country (in addition to those already receiving information in Iowa and North Carolina) as well as to health care providers. Information from AHS developed for lay audiences, such as this article and the outreach materials developed by Storm, is currently shared through the American Association of Pesticide Safety Educators (AAPSE) listserv and thus reaches the state pesticide educators responsible for the majority of pesticide applicator training in the US. The proposal advocates strengthening the relationship between AHS and AAPSE and offers seven additional recommendations to increase the understanding of risks associated with pesticide application and of measures applicators can take to minimize their risks. Dr. Brown presented the proposal at the annual meeting of the NAP in March 2005, and it is currently under review by the Panel.

Watch the web site <www.aghealth.org> for the wealth of information expected to be published in the coming years, during AHS's intensive five-year period (2004-2008) of assessing disease rates and risk factors.

The Agricultural Health Study is supported by:
- The National Cancer Institute (NCI)
- The National Institute of Environmental Health Sciences (NIEHS)
- The U.S. Environmental Protection Agency (EPA)
- National Institute for Occupational Safety and Health (NIOSH)
- The National Center on Minority Health and Health Disparities (NCMHD) funds an effort to study cancer and non-cancer disease outcomes among African-American farmers in North Carolina.

Iowa Office of the Agricultural Health Study: 1-800-217-1954
North Carolina Office of the Agricultural Health Study: 1-800-424-7883

Ordering Information on back cover

Agricultural pesticides named in this issue of *The Ribbon*

Examples of common trade names[1]

PESTICIDE	TRADE NAME
Insecticides	
Aldrin*	
Carbaryl	Sevin, Carbamine
Chlordane*	
Chlorpyrifos	Lorsban, Dursban
Chlordane*	
Coumaphos	Co-Ral
Diazinon	Spectracide, Dianon
Dichlorvos	Vapona, Duravos
Dieldrin*	
DDT*	
Fonofos	Dyfonate
Heptachlor*	
Lindane	Forlin, Gamaphex
Malathion	
Parathion (ethyl or methyl)	
Permethrin / Pyrethroids	Ectiban, Atroban, Permetrina, Ambush, Pounce, Asana
Phorate	Thimet, Rampart
Terbufos	Counter
Herbicides	
Alachlor	Lasso, Chimiclor
Atrazine	Aatrex, Atranex
Butylate	Sutan, Genate
Cyanazine	Bladex, Match
Glyphosate	Roundup, Jury
Paraquat	
2,4,5-TP*	Silvex
2,4,5-T*	
2,4-D	
Fungicide	
Captan	Orthocide, Clomitane
Fumigant	
Methyl Bromide	Brom-O-Gas, Brom-O-Sol

[1] This list corresponds to pesticides mentioned in this issue of *The Ribbon*, but is not a comprehensive list of all pesticides studied in the AHS. Trade names were compiled from the AHS questionnaire used to assess pesticide use patterns in spouses. The "Spouse Questionnaire" is available at: http://aghealth.org/qnaires/spouse.html

* Pesticides no longer on the market.

Pesticide Use and Breast Cancer Risk among Farmers' Wives in the Agricultural Health Study

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Engel, Lawrence S., Hill, D.A., Hoppin, J.A., Lubin, J.H., Lynch, C.F., Pierce, J., Samanic, C., Sandler, D.P., Blair, A., Alavanja, M.C. *Pesticide Use and Breast Cancer Risk among Farmers' Wives in the Agricultural Health Study.* Am J Epidemiol 161: 121-135, 2005.

Most studies that have evaluated whether pesticide exposure from farming activities affects cancer risk have been conducted in male farmers. Because male farmers can have a higher incidence of lymphomas, leukemias, multiple myeloma, and stomach, brain, and prostate cancer, there has been great interest in deciphering whether these cancers are linked to exposures to specific pesticides, and if pesticide exposures may be linked to cancers in farmwomen. The few cancer studies conducted on women who live or work on a farm have yielded limited information because only small groups of women were included, and most studies did not collect in depth information on exposures and corresponding health effects to different types of pesticides or to individual pesticides. This large scale, long-term study of Iowa and North Carolina farmwomen is the most comprehensive effort to date devoted to addressing the complex question of whether specific pesticides do or do not increase the risk of breast cancer. This study, part of the Agricultural Health Study (AHS), overviewed in this issue of *The Ribbon*, is unique on many levels.

Unique Aspects of this Study

First, the study followed over 30,454 farmer's wives in two states over a long period of time. Women with no history of breast cancer were enrolled during 1993-1997, and information was gathered by questionnaire on use of pesticides by the women and by their husbands. By the year 2000, 309 women were diagnosed with breast cancer. During this time, only 0.2% of the women originally enrolled moved out of their state.

Secondly, information was gathered on the use of 50 different pesticides. This is without precedent. While studies in the past have focused on organochlorine pesticides and breast cancer risk, this study evaluated both contemporary and phased out persistent pesticides. Investigators were able to evaluate the risk of each pesticide and different types of pesticides (herbicides, insecticides, fungicides and fumigants), as well as ten different chemical classes. Some of the chemical classes and examples of pesticides include organochlorines (DDT, chlordane and dieldrin), phenoxyherbicides (2,4-D, 2,4,5-T, 2,4,5-TP], triazines (atrazine and cyanazine), organophosphates (dichlorvos and chlorpyrifos) and many other pesticides for which we have had no or little information.

Thirdly, detailed information was obtained on how long and often the agricultural pesticides were used, how long the family had lived on the farm, how far their house was from where the pesticides were used, and other exposures such as laundering of work clothing, and household use of pesticides. Information was also obtained on other factors that can affect breast cancer risk, such as reproductive history, whether the women was pre- or post menopausal, parity (number of children), family history of breast cancer, as well as body size, physical activity, diet, smoking, alcohol use, and other lifestyle factors. Breast cancer risk was evaluated with respect to both to the wife's use of pesticides, and to the husband's pesticide use in the wives who never used pesticides.

Summary of Results by Pesticide Type

The results of this large-scale study of breast cancer risk in farmer's wives from Iowa and North Carolina suggests the use of the majority of 50 pesticides studied did not increase breast cancer risk. However, use of some specific pesticides did show a small to moderate increase in the wives' breast cancer risk.

Phenoxy herbicides. The most consistent evidence was for a phenoxy herbicide no longer used called 2,4,5-TP. Risk was increased 1.9 fold in women from Iowa, and 2.1 fold in North Carolina women whose husbands used this pesticide. This pesticide was known to be contaminated with dioxin. There is some evidence from an industrial accident of dioxin exposure in Italian women that exposure to this environmental contaminant early in life may lead to a higher breast cancer risk later in life. How and to what extent dioxin may influence breast cancer risk at critical life stages is an area of ongoing research. It should be noted that in the AHS, breast cancer risk was not increased through the farmer wives' use or husbands' use of the phenoxyherbicide in current use called 2,4-D. This

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result suggests it is more likely that the increased breast cancer risk associated with the use of 2,4,5-TP may be due to dioxin contamination of this herbicide, than to the herbicide itself. The 2,4-D in current use is not contaminated with dioxin.

Organochlorine insecticide and fungicide. The use of the persistent organochlorine insecticide dieldrin and the fungicide captan were also associated with a 2.0 to 2.7 fold (respectively) increase in breast cancer risk in the women enrolled in this study. This was observed only in the farmwomen whose husbands used these pesticides. Use of dieldrin or captan by the women themselves did not affect their breast cancer risk.

One criteria for evaluating cancer risk is whether incidence of the disease increases as exposure increases. Dieldrin was one of the pesticides identified in this study as having higher breast cancer risk with increasing cumulative years of use. To date, only a few studies have evaluated whether dieldrin exposure is related to breast cancer risk in humans, with some studies showing an association (Høyer *et al.* 1998), while others have not. This study suggests further research is needed to clarify whether this very persistent organochlorine insecticide affects breast cancer risk.

Captan has been classified by EPA as a "probable carcinogen" because it is known to induce tumors in the digestive track in mice, and to a lesser extent induce kidney and uterine tumors in rats. It has not been associated with causing mammary (breast) tumors in animal cancer bioassays. This is the first report of a positive association of captan use with human breast cancer. While captan can cause damage to DNA (mutagen), the biological mechanism for increasing breast cancer risk is not known.

Other organochlorine insecticides. While there was some evidence of increased breast cancer risk for several organochlorine insecticides (aldrin, carbaryl, chlordane, heptachlor, lindane and malathion), the risks were low, not consistent from state to state, and need further conformation before firm conclusions can be made.

Use of many other pesticides, including DDT, and high-use pesticides such as atrazine, alachlor, 2,4-D, and glyphosate, failed to show a significantly higher risk breast cancer risk in farmwomen.

Organophosphate insecticides. Three organophosphate insecticides (chlorpyrifos, dichlorvos, and terbufos) were associated with a higher risk of breast cancer only in premenopausal women, and only in women who used these pesticides. Use of these pesticides by their husbands had no effect on their spouses' risk of breast cancer (relative risk: chlorpyrifos 2.2; dichlorvos 2.3; terbufos 2.6). In past studies, there has not been consistent evidence of environmental chemicals increasing breast cancer risk in premenopausal versus postmenopausal women. While there is some evidence that dichlorvos induces a type of mammary tumor in rodents, in general few studies have been done to evaluate whether this chemical class of commonly used insecticides affects breast cancer risk in women. BCERF researchers recommended the need for further investigations of organophosphates' potential to affect breast cancer risk in Critical Evaluations published in *Comments in Toxicology* several years ago, and we are encouraged that investigations of pesticides and breast cancer risk are now expanding to include organophosphates. Organophosphates have been reviewed extensively by the EPA. Chlorpyrifos, a known neurotoxin, had been used for many years in homes for termite control. While this use is being phased out, its use to protect crops is still allowed, with continued potential exposure to farm families.

A higher breast cancer risk for the women's use of diazinon (relative risk 1.7), and husbands' use of parathion (relative risk 4.2) and parquat (relative risk 3.9) was only observed in a very small group of women with a family history of breast cancer. This suggests more work needs to be done to confirm this preliminary finding, and to see if there is a gene-environment interaction that may explain these links between family history, breast cancer risk and use of these pesticides.

Further Considerations

While this study stands as one of the few sources of information on the breast cancer risk of a wide assortment of pesticides used currently and in the past, it does have limitations. This study did not report on actual exposure to the pesticides, but used questionnaires to estimate past use in wives and husbands. There may have been problems in accurately recalling past use, resulting in either under or over estimating actual lifetime usage patterns.

The majority of the pesticides that were identified as having a higher breast cancer risk in wives were linked to use of the pesticides by their husbands. The only pesticides identified as being used by the farmwomen themselves that were associated with a higher breast cancer risk were three organophosphates used by premenopausal women. There were no other instances where pesticides used by the farmwomen resulted in a higher breast cancer risk. Why was there an inconsistency? Is this because actual exposures were lower in women because they tended to use protective equipment more than husbands, or that their frequency of use was lower compared to their husbands? This is not known, but other studies in North Carolina farmwomen have suggested that in women who apply pesticides, risk was elevated in women who did not use protective clothing and gloves. Therefore, more information is needed on patterns of protection taken by both the wives and husbands to see if this influenced breast cancer risk associated with individual pesticides.

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BCERF's EnviroCancer Connections Event Addresses Biomonitoring

Maggie Carey, MPH, Environmental Health Educator, BCERF

On February 14, 2005 a collaborative event between New York State breast cancer survivor groups and BCERF utilized Cornell's long-distance learning technology for reaching out across the state. The New York State Breast Cancer Network (NYSBCN) partnered with BCERF to plan this event and identify a focal topic: biomonitoring. The NYSBCN has 23 member organizations, located in communities throughout New York, from Buffalo to Long Island.

Dr. Suzanne Snedeker, BCERF Associate Director for Translational Research, led the program that was broadcast live to Cornell Cooperative Extension facilities in New York City and Albany. In all, those two offices and the Cornell Ithaca campus hosted thirty-two participants for this long-distance learning event.

Dr. Snedeker began with a 30-minute presentation on "Environmental Chemicals and Breast Cancer." She then presented background and facilitated an interactive discussion on biomonitoring. Biomonitoring is a general term used to describe the measurement of the chemical contaminants in the body. For example, the Centers for Disease Control and Prevention (CDC) measure levels of chemicals in blood and urine in a sample of the general population as part of the National Health and Nutrition Examination Survey (web reference below).

Participants appreciated the opportunity to approach this complex topic. As one reported, "this was highly enlightening on current trends in research and current knowledge." General feedback from the participants indicates that the event was very well received, and many participants expressed interest in future long-distance learning events on additional topics. We at BCERF are pleased that this outreach technology can serve as yet another way of reaching NYS residents.

Web sites of interest regarding biomonitoring:

- **http://www.cdc.gov/exposurereport/2nd/** to download or order the 2003 report mentioned above.
- **http://www.cdc.gov/nceh/tracking** This is the CDC's Environmental Public Health Tracking Program, a nation-wide program linking environmental hazards, exposures, and health effects.
- **http://www.cdc.gov/biomonitoring/biomonitoring_grants.htm**
  This is an overview of the CDC's program on providing grants for states to improve their biomonitoring programs.

BCERF Web New Look, New Launch

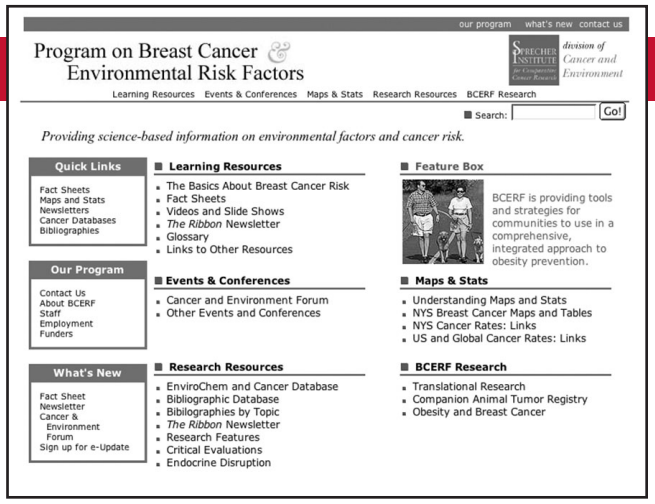
The BCERF web site has a new look and new tools so you can use our resources more efficiently. As BCERF grew, our library of resources outgrew our former site. We redesigned our site to improve our ability to give you science-based information on environmental factors and cancer risk.

What's New

Find What You Need
Use the **Search** tool for Fact Sheets and articles from *The Ribbon*. Search for the resource you need several ways, including by keyword.

Get Where You Need to Go
The new site outline is streamlined and logical. Everything is easier to find. Move through the site easily without losing your place in stacks of pages.

See Connections
Collections are an innovative system for grouping resources including Fact Sheets and bibliographies. Collections cover topics including Basics of Breast Cancer and Chemicals in Food and Water. Use a Collection as your recommended reading list.



More Coverage of Current and Recent Research
We're featuring more current research being conducted by BCERF and others around the world. You'll find project overviews and links to more information about research currently underway and just completed.

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Science-based • Clear • Easy-to-use • http://envirocancer.cornell.edu

The Ribbon is published by the Cornell Program on Breast Cancer and Environmental Risk Factors in New York State. Funding provided by the New York State Departments of Health and Environmental Conservation.

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Design
West Hill Graphics, Ithaca, NY

THE AGRICULTURAL HEALTH STUDY *continued from page 4*

Ordering Information:

Understanding the Agricultural Health Study
A summary of the first 12 years of a long-term study of Iowa and North Carolina pesticide applicators and farm families

To order the 3-part publication series, designed for the agricultural community and Extension educators, contact:
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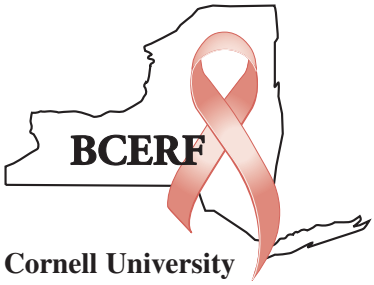
Refer to Publication #'s AG-Med-24, AG-Med-25, AG-Med-26
Note: Publications are free, but shipping is charged for delivery outside of North Carolina. Call for information regarding shipping charges based on quantity desired and delivery destination.

RESEARCH COMMENTARY

PESTICIDE USE AND BREAST CANCER RISK AMONG FARMERS' WIVES *continued from page 6*

The study is based on 309 cases of breast cancer. While this is one of the largest studies of pesticide use and breast cancer risk, when looking at many individual pesticides, the number of breast cancer cases attributed to each of the 50 pesticides was often small. When the number of breast cancer cases associated with the use of a particular pesticide is small, the strength (the power) of the ability to detect an effect decreases. Therefore, these results should be considered preliminary. As more women develop breast cancer over the next five years, these added cases will give a better estimate of risk associated with specific pesticides.

Høyer, A.P., Grandjean, P., Jorgensen, T., Brock, J.W., Hartvig, H.B. *Organochlorine exposure and breast cancer risk,* The Lancet, 352: 1816-1820, 1998.



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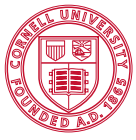

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