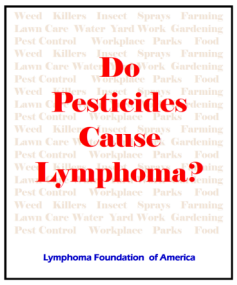

12 additional medical studies on lymphoma and pesticides

Since the publication of *Do Pesticides Cause Lymphoma?* additional studies have been added to the report and are published below:

Alavanja, M. C., Hofmann, J. N., Lynch, C. F., Hines, C., Barry, K., Barker, J., Buckman, D., Thomas, K., Sandler, D. P., Hoppin, J., Koutros, S., Andreotti, G., Lubin, J. H., Blair, A., Freeman, L. E. *Non-Hodgkin Lymphoma Risk and Insecticide, Fungicide and Fumigant Use in the Agricultural Health Study.* Published: October 22, 2014 http://dx.doi.org/10.1371/journal.pone.0109332

Pesticide use has previously been linked to non-Hodgkin lymphoma (NHL), chronic lymphocytic leukemia (CLL) and multiple myeloma (MM). The researchers found that pesticides from different chemical and functional classes were associated with an excess risk of nonhodgkin lymphoma and its many subtypes. Their findings are among the first to suggest links between DDT, lindane, permethrin, diazinon and terbufos with nonhodgkin lymphoma.

Burns, C.J., Beard, K.K., and Cartmill, J.B. *Mortality in chemical workers potentially exposed to 2,4-dichlorophenoxyacetic acid (2,4-D) 1945-94: an update* Occupational and Environmental Medicine 58(1): 24-30, Jan., 2001

This study is an update of an earlier study of Dow Chemical Company workers who manufactured 2, 4-D. The authors believe that chemical company workers are more heavily exposed to 2,4-D than farmers are, though it is possible that the reverse is true, since chemical workers are provided with excellent protective equipment. No excess of non-Hodgkin lymphoma was found among the workers, though there was a slightly increased occurrence of amyotrophic lateral sclerosis (ALS), a serious neurological disorder. Dow Chemical Company

Cantor, K.P., Strickland, P.T., Brock, J.W., Bush, D., Helzlsouer, K., Needham, L.L., Zahm, S.H., Comstock, G.W., & Rothman, N. *Risk of non-Hodgkin's lymphoma and prediagnostic serum organochlorines: df-hexachlorocyclohexane, chlordane/heptachlor-related compounds, dieldrin, and hexachlorobenzene* Environmental Health Perspectives 111 (2): 179-183, Feb. 2003

Using serum samples that had been collected from Maryland residents in 1974, the authors investigated rates of non-Hodgkin lymphoma twenty-five years later. They found no significant increase in lymphoma in relation to any of the chemicals studied, all of which were chlorinated hydrocarbons suspected of causing cancer. The authors state, however, that it is still possible that an association between chlorinated hydrocarbons and lymphoma may exist, since so many studies of farmers have shown an increased risk. National Cancer Institute, Johns Hopkins Bloomberg School of Public Health, Centers for Disease Control and Prevention. Funding: Dept. of Health and Human Services, Research Career Award

Cocco, P., Kazerouni, N., and Zahm, S.H. *Cancer mortality and environmental exposure to DDE in the United States* Environmental Health Perspectives 108 (1): 1-4, Jan., 2000

In 1968, the U.S. Environmental Protection Agency studied the amounts of DDE present in the fatty tissues of Americans from 22 states. (DDE is a breakdown product of DDT, a pesticide which was banned in 1973.) The researchers compared the death rates from various cancers to the DDE levels by state during the period 1975 - 1994. They found no increase in deaths from non-Hodgkin's lymphoma in those states whose citizens had higher DDE levels in fact, in many cases these states had lower death rates from NHL. The authors point out that if

incidence statistics had been available, the study results might have shown a higher correlation with DDE levels, since many people survive for long periods of time with non-Hodgkin's lymphoma. This hypothesis is supported by the fact that some correlation between DDE levels and liver cancer was seen; liver cancer is more likely to lead to rapid death than NHL. University of Cagliari, Caglilari, Italy; National Cancer Institute.

Fabbro-Peray, P., Daures, J.P., and Rossi, J.F. *Environmental risk factors for non-Hodgkin's lymphoma: a population-based case-control study in Languedoc-Roussillon, France* Cancer Causes and Control 12(3): 201-212 (April, 2001)

445 people with lymphoma were compared to 1025 randomly selected people. Researchers questioned all individuals about their exposures to pesticides, and also analyzed the data in relation to occupation. Results showed that persons in agricultural occupations had a 50% higher lymphoma risk than persons in other occupations, whether or not they stated they had been exposed to pesticides. People in non-agricultural occupations had no increased risk, even those who had been exposed to some pesticides. The authors' conjecture that factors in agricultural life, such as exposure to solvents and animal viruses, may contribute to lymphoma risk. Departement de Informatoin Medicale, Gaston Doumerge, Nimes, France; Service des Maladies du Sang, Lapeyronie, Montpellier, France

Hardell, L.; Eriksson, M.; Lindstrom, G.; Van Bavel, B.; Linde, A.; & Carlberg, M. *Case-control study on concentrations of organohalogen compounds and titers of antibodies to Epstein-Barr virus antigens in the etiology of non-Hodgkin lymphoma* Leukemia and Lymphoma 42(4): 619-629, Aug., 2001

Samples of fatty tissue were taken from 82 people with non-Hodgkin's lymphoma and 83 people with no cancer. The samples were analyzed for the presence of several chlorinated hydrocarbons, including chlordanes (often used as pesticides) and PCBs (industrial chemicals which persist in the environment and appear in food, such as fish and dairy products). In addition, the researchers checked each person's blood for antibodies against Epstein-Barr virus (EBV). Results showed a greater risk of non-Hodgkin's lymphoma for exposure to chlordanes, PCBs, TBDE (a chemical used in flame-retardant materials), and hexachlorobenzene, a fungicide. The highest risk of non-Hodgkin's lymphoma occurred in people who had high levels of the organochlorines and also had elevated antibodies against EBV. These findings suggest that a combination of EBV infection and chemical exposures may be a more serious risk factor than either of these alone. Medical Center, Sweden; University Hospital, Sweden; Swedish Institute for Infectious Disease Control and Microbiology Tumour Biology Center, Stockholm

Hardell, L.; Lindstrom, G.; van Bavel, B.; Hardell, K.; Linde, A.; & Carlberg, M. *Adipose tissue concentrations of dioxins and dibenzofurans, titers of antibodies to Epstein-Barr virus early antigen and the risk for non-Hodgkin lymphoma* Environmental Research 87(2): 99-107, Oct., 2001

33 people with non-Hodgkin's lymphoma were compared to 39 people with no cancer, both for dioxins and dibenzofurans in fatty tissues and for antibodies against Epstein-Barr virus (EBV). Dioxins and dibenzofurans are contaminants of chlorinated pesticides such as 2,4-D; these contaminants tend to remain in fatty tissues for many years. 2,4-D was withdrawn from the Swedish market in 1990, yet many people still have these contaminants in their tissues. Results were not dramatic. However, people with higher concentrations of dioxins and higher levels of antibodies against EBV tended to have a higher risk of non-Hodgkin's lymphoma. In people who have EBV infections, exposure to pesticides may be riskier than for others. Medical Center, Sweden; University Hospital, Sweden; Swedish Institute for Infectious Disease Control and Microbiology Tumour Biology Center, Stockholm

Hardell, L.; Eriksson, M.; Nordstrom, M. *Exposure to pesticides as risk factor for non-Hodgkin's lymphoma and hairy cell leukemia: pooled analysis of two Swedish case-control studies* Leukemia and Lymphoma 43 (5): 1043-1049, May, 2002

Using Swedish cancer registry records, researchers compared 442 men with non-Hodgkin's lymphoma and 121 men with hairy-cell leukemia (now considered a type of lymphoma) with twice as many healthy men found through the population registry. All were questioned about their exposures to pesticides over their lifespans. Results showed increased risk of lymphoma from exposure to a wide range of pesticides and also from exposure to organic solvents. Phenoxy herbicides, glyphosate, fungicides, and chemicals used to treat wood were all found to be risk factors for lymphoma. The highest incidence of lymphoma occurred within 10 years of exposure to the chemicals, though some cases occurred later. The researchers conjecture that a combination of the chemical exposures and latent infection with viruses such as Epstein-Barr virus (EBV) may be the cause of the larger number of lymphoma cases during the first 10 years after pesticide exposure. University Hospital, Sweden; Dept. of Oncology, University Hospital, Lund, Sweden

Mao, Y.; Hu, J.; Ugnat, A.M.; & White, K. *Non-Hodgkin's lymphoma and occupational exposure to chemicals in Canada* Canadian Cancer Registries Epidemiology Research Group Annals of Oncology 11 (Suppl. 1): 69-73 (2000)

Like the United States, Canada has seen an increase in non-Hodgkin's lymphoma over many of years. The authors used information from Canada's cancer surveillance system to locate and study 1,469 men and women with non-Hodgkin's lymphoma. These were matched with 5073 people with no cancer. All subjects and controls were questioned about a variety of occupational and environmental exposures. Results showed increased risks of non-Hodgkin's lymphoma for both men and women who had been exposed to pesticides and herbicides, with increasing risk for people who were exposed for longer times. Men and women exposed to herbicides for over 15 years developed lymphoma 50% more often than those who had not been exposed (OR of 1.5). Men and women exposed to pesticides for over seven years had 1.3 times the risk of those who had not been exposed (OR of 1.3). 46% of exposed males reported exposures at home and 43% at work, while among women, 65% were exposed at home and 28% at work. The authors conclude that exposure to these and other chemicals plays an important role in the development of non-Hodgkin's lymphoma in Canada. Moreover, herbicide and pesticide use in residential settings is of concern. Canadian Cancer Registries Epidemiology Research Group

Persson, B., and Fredrikson, M. *Some risk factors for non-Hodgkin's lymphoma* International Journal of Occupational Medicine and Environmental Health 12(2): 135-142 (1999)

199 people with lymphoma were compared to 479 people who did not have lymphoma in two regions of Sweden. All were questioned about their occupations, their leisure-time activities, and their exposures to a variety of substances. Increased risk of non-Hodgkin's lymphoma was found among those exposed to phenoxy herbicides weed killers and DDT ,but not other pesticides. Some of the highest risk levels found in this study were among people who had been exposed to wood preservatives, certain solvents, and aviation.gasoline. As has been found in some other studies, exposure to raw wood was also associated with extra risk of non-Hodgkin's lymphoma. Dept. of Occupational and Environmental Medicine, Centre for Public Health Sciences, Link, Sweden

ARTICLES

Baris, D. and Zahm, S.H. *Epidemiology of lymphomas* Current Opinions in Oncology 12(5): 383-394, Sept., 2000

This is a wide-ranging overview of research on possible and probable causes of lymphoma. Diet and lifestyle factors, infectious agents, hair dye, radiation, and other factors are discussed. With regard to pesticides, the authors discuss the varying results obtained by researchers, and suggest that better data on the pesticides used, the timing of exposure, and multiple exposures would improve research on pesticides and non-Hodgkin's lymphoma. National Cancer Institute

Kojya, S.; Maatsumura, J.; Ting, L.; Hongyo, T.; Inazawa, J.; Kirihata, M.; and Aozasa, K. *Familial nasal NK/T-cell lymphoma and pesticide use* American Journal of Hematology 66(2): 145-147, Feb., 2001

Both a Japanese father and his son developed natural killer cell/T-cell lymphoma within a 26-month time span. In both cases, the initial tumor occurred in the nose. The men had worked as farmers in a greenhouse, where they used pesticides, including dichlorvos and methidathion. The grandfather of the family also had lymphoma, though his initially appeared in the neck. Researchers studied the genetic markers in the two younger men blood and in their lymphoma cells, and found that their lymphoma cells were virtually identical. Members of the family who did not work in the greenhouse had no lymphoma. The researchers hypothesize that the family may have a genetic predisposition to lymphoma, which was activated by exposure to pesticides and the damage to lymphocyte chromosomes which pesticides can cause. University of the Ryukyus Faculty of Medicin, Okinawa; Osaka University Medical School; Tokyo Medical and Dental University; Osaka Prefectural University. Funding: Vehicle Racing Commemorative Foundation, the Ministry of Education, Science, and Culture, Japan

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