

Evidence Links Chronic Illnesses and Pesticide Exposure

Linking chronic diseases with exposure to specific pesticides is a complex endeavor, as very low-level exposures can result in effects long after the initial exposure occurs. In some cases, it is pesticide exposure among parents that results in health effects in their children. Still, for some health effects there is more than a suggestive correlation. Examples of diseases where studies indicate a strong linkage between pesticide exposure and illness include:¹

- **Childhood Cancers** Pesticides are a risk factor for several types of cancer in children.² Home

Use of pesticides in the home can increase risk of childhood leukemia by as much as 11 times and brain cancer by as much as ten times.³

extermination increases the risk of non-Hodgkin lymphoma, leukemia, and Wilm's tumor.⁴ Living on a farm increases the risk of bone cancer and leukemia,⁵ and having parents who are farmers or farmworkers increases a child's risk of

bone cancer, brain cancer, soft tissue sarcoma, and Wilm's tumor.⁶

- **Breast Cancer** Evidence on the links between pesticide exposure and breast cancer is mixed, with many studies showing no correlation and others showing strong linkages. Recent research in Colombia, for example, showed an association between levels of DDE in the blood and risk for breast cancer, and dieldrin exposure has also been linked with significantly elevated breast cancer risk.⁷

A 2001 study of the combined effect of four organochlorine pesticides found that the mixture of these estrogenic chemicals enhanced the spread of breast cancer cells.⁸

The Lymphoma Foundation of America recently compiled dozens of studies documenting increased risk of lymphoma from pesticide exposure.⁹ Increased risk of developing non-Hodgkin lymphoma was found among people exposed to lindane, DDT, organophosphorus insecticides and various herbicides including 2,4-D.¹⁰

- **Other Cancers** Living in an agricultural area where pesticides are used increases the risk of several types of cancer in adults, including, among others, leukemia,

brain cancer, ovarian cancer, pancreatic cancer and stomach cancer.¹¹ A growing body of evidence links pesticide exposure to cancer specifically among farmworkers and farmers.¹² Multiple studies have shown that farmers are more likely to develop leukemia, brain, prostate, and skin cancer and non-Hodgkin's lymphoma than the general population.¹³

- **Parkinson's Disease** Strong evidence links Parkinson's disease to pesticide exposure. Most studies are of people exposed through their work, especially to herbicides.¹⁴ There is also evidence of increased risk of Parkinson's from exposure to pesticides in the home,¹⁵ living in a rural area,¹⁶ and using well water.¹⁷ Parkinson's has also been linked to elevated levels of organochlorine pesticides in brain tissue.¹⁸

- **Low Birth Weight** A strong relationship has been found between prematurely delivered and low birth weight babies and mothers' blood levels of DDE, the metabolic breakdown product of DDT.¹⁹ Similar links between low birth weights and several other pesticides have been documented, including increased birth weights in New York City following the ban of residential uses of the pesticides chlorpyrifos and diazinon.²⁰

Children born to women who live in a high pesticide use area while pregnant have an increased risk of various birth defects.²¹

- **Birth Defects** Children born to women who live in a high pesticide use area while pregnant have an increased risk of various birth defects, including cleft lip/palate, limb reduction defects and neural tube defects (e.g., spina bifida and anencephaly).²¹ If the mother is not exposed to pesticides but the father works in agriculture, a child runs a higher risk of being born with hypospadias (undescended testicles), cleft lip/palate and other birth defects.²²

- **Declining Sperm Counts** A 1992 study documented a 40% decline in sperm count worldwide over the second half of the 20th century. While there is no widely agreed explanation for these global declines, some studies have linked pesticide exposure with decreased sperm quality, and linked higher sperm density with lower pesticide exposures.²³ Hormone disruption is considered a possible contributor to lower sperm counts, and dozens of pesticides are known or suspected hormone disruptors. The list includes widely used carbamates such as aldicarb and carbaryl, common organophosphorus pesticides (e.g., malathion and chlorpyrifos), and persistent chlorinated pesticides such as endosulfan, lindane and DDT.²⁴

Evidence Links Chronic Illnesses and Pesticide Exposure

Notes

- 1 In developing these bullets we relied heavily on the work of Dr. Marion Moses and the more detailed summary of health effects she developed for S. Kegley, A. Katten and M. Moses, *Secondhand Pesticides: Airborne Pesticide Drift in California*, Pesticide Action Network North America, California Rural Legal Assistance Foundation and Pesticide Education Center, 2003 (San Francisco CA). See also:
 - a) <http://www.pesticides.org/educmaterials.html>
 - b) G. Solomon, O. Ogunseitan, J. Kirsch, *Pesticides and Human Health*, Physicians for Social Responsibility and Californians for Pesticide Reform, 2000 (San Francisco, CA), see <http://www.psrla.org/pesthealthmain.htm>.
- 2 a) N.T. Fear, E. Roman, G. Reeves, and B. Pannett, Childhood cancer and paternal employment in agriculture: The role of pesticides, *Br. J. Cancer*, 1998, 77(5): 825–29.
 - b) P. Kristensen, A. Anderson, and L.M. Irgens, Cancer in offspring of parent engaged in agricultural activities in Norway: Incidence and risk factors in the farm environment, *Intl. J. Cancer*, 1996, 65(1): 39–50.
 - c) C.R. Sharpe, E.L. Franco, and B. de Camargo, Parental exposures to pesticides and risk of Wilms' tumor in Brazil, *Am. J. Epidemiol.*, 1995, 141(3): 210–17.
- 3 J.M. Pogoda and S. Preston Martin, Household pesticides and risk of pediatric brain tumors, *Environ Health Perspect*, 1997, 105(11): 1214–20.
- 4 a) J.K. Leiss and D.A. Savitz, Home pesticide use and childhood cancer: A case-control study, *Am J Pub Health*, 1995, 85(2): 249–52.
 - b) X. Ma, P.A. Buffler, R.B. Gunier, et al., Critical windows of exposure to household pesticides and risk of childhood leukemia, *Environ Health Perspect*, 2002, 110(9): 955–60.
 - c) A.F. Olshan, N.E. Breslow, J.M. Falletta, et al., Risk factors for Wilms' tumor: Report from the National Wilms' Tumor Study, *Cancer*, 1993, 72(3): 938–44.
- 5 a) P.C. Valery, W. McWhirter, A. Sleight, et al., Farm exposures, parental occupation, and risk of Ewing's sarcoma in Australia: A national case-control study, *Can Causes Contr*, 2002, 13(3): 263–70.
 - b) E.A. Holly, P.M. Bracci, B.A. Mueller, et al., Farm and animal exposures and pediatric brain tumors: Results from the United States West Coast Childhood Brain Tumor Study, *Can Epid Biomark Prev*, 1998, 7(9): 797–802.
 - c) G.R. Bunin, J.D. Buckley, C.P. Boesel, et al., Risk factors for astrocytic glioma and primitive neuroectodermal tumor of the brain in young children: A report from the Children's Cancer Group, *Can Epid Biomark Prev*, 1994, 3(3): 197–204.
- 6 a) L. Hum, N. Kreiger, and M.M. Finkelstein, The relationship between, parental occupation and bone cancer risk in offspring, *Int J Epid*, 1998, 27(5): 766–71.
 - b) P. Kristensen, A. Andersen, L.M. Irgens, et al., Cancer in offspring of parents engaged in agricultural activities in Norway: Incidence and risk factors in the farm environment, *Int J Can*, 1996, 65(1): 39–50.
 - c) E.A. Holly, D.P. Aston, P.K.A. Ahn, et al., Ewing's bone sarcoma, parental occupational exposures and other factors, *Am J Epid*, 1992, 135(2): 122–29.
 - d) M. Feychting, N. Plato, G. Nise, and A. Ahlbom, Paternal occupational exposures and childhood cancer, *Environ Health Perspect*, 2001, 109(2): 193–96.
 - e) C. Magnani, G. Pastore, L. Luzzatto, et al., Parental occupation and other environmental factors in the etiology of leukemias and non-Hodgkin's lymphomas in childhood: A case-control study, *Tumori*, 1990, 76(5): 413–19.
 - f) C.R. Sharpe, E.L. Franco, B. deCamargo, et al., Parental exposures to pesticides and risk of Wilm's tumor in Brazil, *Am J Epid*, 1995, 141(3): 210–17.
- 7 a) P. Olaya-Contreras, J. Rodriguez-Villamil, H.J. Posso-Valencia, and J.E. Cortez, Organochlorine exposure and breast cancer risk in Colombian women, *Cad Saude Publica*, 1998, 14 (suppl 3): 124–32.
 - b) A.P. Hoyer, P. Granjean, T. Jorgensen, et al., Organochlorine exposure and risk of breast cancer, *Lancet*, 1998, 352(9143): 1816–20.
- 8 J. Payne, M. Scholze, and A. Kortenkamp, Mixtures of Four Organochlorines Enhance Human Breast Cancer Cell Proliferation, *Environ Health Perspect*, 2001, 109: 391–397, see <http://ehpnet1.niehs.nih.gov/docs/2001/109p391>.
- 9 S. Osborn, *Do Pesticides Cause Lymphoma?* Lymphoma Foundation of America, 2001, see <http://www.lymphomaresearch.org>.
- 10 a) S.H. Zahm, D.D. Weisenburger, et al., A case-control study of non-Hodgkin's lymphoma and the herbicide 2,4-dichlorophenoxyacetic acid (2,4-D) in eastern Nebraska, *Epidemiology*, 1990, 1(5): 349–56.
 - b) S.H. Zahm, and A. Blair, Pesticides and non-Hodgkin's lymphoma, *Cancer Res*, 1992, 52(Suppl 19): 5485s–5488s.
 - c) A. Blair, K.P. Cantor, et al., Non-hodgkin's lymphoma and agricultural use of the insecticide lindane, *Am J Ind Med*, 1998, 33(1): 82–7.
- 11 a) D. Godon, P. Lajoie, J.P. Thouez, et al., Pesticides and cancer in a Quebec rural farming population: A geographical interpretation, *Soc Sci Med*, 1989, 29(7): 819–33.
 - b) M. McCabe, M. Nowak, R. Hamilton, et al., Cancer of lymphatic tissues in cane-growing areas of Queensland, *Med J Aust*, 1984, 141(7): 412–14.
 - c) D. Waterhouse, W.J. Carman, D. Schottenfeld, et al., Cancer incidence in the rural community of Tecumseh, Michigan: A pattern of increased lymphopoeitic neoplasms, *Cancer*, 1996, 77(4): 763–70.
 - d) M.E. Loevinsohn, Insecticide use and increased mortality in rural central Luzon, Philippines, *Lancet*, 1987, 1: 1359–62.
 - e) A. Ahlbom, I.L. Navier, S. Norell, et al., Nonoccupational risk indicators for astrocytomas in adults, *Am J Epid*, 1986, 124(2): 334–37.
 - f) A. Aschengrau, D. Ozonoff, P. Coogan, et al., Cancer risk and residential proximity to cranberry cultivation in Massachusetts, *Am J Publ Health*, 1996, 86(9): 1289–96.
 - g) A. Donna, P. Crosignani, F. Robutti, et al., Triazine herbicides and ovarian epithelial neoplasms, *Scand J Work Env Health*, 1989, 15: 47–53.
 - h) A. Donna, P-G. Betta, F. Robutti, et al., Ovarian mesothelial tumors and herbicides: A case-control study, *Carcinogenesis*, 1984,

Evidence Links Chronic Illnesses and Pesticide Exposure

- 5: 941–42.
- i) D.M. Schreinemachers, Cancer mortality in four northern wheat-producing states, *Environ Health Perspect*, 2000, 108(9): 873–81.
- j) A. Paldy, N. Puskas, and I. Farkas, Pesticide use related to cancer incidence as studied in a rural district of Hungary, *Sci Total Env*, 1988, 73(3): 229–44.
- 12 P.K. Mills and S. Kwong, Cancer incidence in the United Farm Workers of America (UFW) 1987–1997, *Am J Ind Med*, 2001, 40: 596–603.
- 13 J. Dich, S.H. Zahm, et al., Pesticides and cancer, *Can Causes Cont*, 1997, 8(3): 420–43.
- 14 a) P.K. Mills and S. Kwong, Cancer incidence in the United Farm Workers of America (UFW) 1987–1997, *Am J Ind Med*, 2001, 40: 596–603.
- b) S.H. Zham and A. Blair, Cancer among migrant and seasonal farmworkers: An epidemiologic review and research agenda, *Am J Ind Med*, 1993, 24: 753–66.
- c) S.H. Zham, M.H. Ward, and A. Blair, Pesticides and cancer, *Occup Med: State of the Art Reviews*, 1997, 12: 269–89.
- 15 P.G. Butterfield, B.G. Valanis, P.S. Spencer, et al., Environmental antecedents of young-onset Parkinson's disease, *Neurology*, 1993, 43(6): 1150–58.
- 16 a) S.J. McCann, D.G. LeCouteur, A.C. Green, et al., The epidemiology of Parkinson's disease in an Australian population, *Neuroepidemiology*, 1998, 17(6): 310–17.
- b) A.H. Rajput, R.J. Uitti, W. Stern, et al., Geography, drinking water chemistry, pesticides and herbicides and the etiology of Parkinson's disease, *Can J Neurolog Sci*, 1987, 14: 414–18.
- c) S.C. Ho, et al., Epidemiologic study of Parkinson's disease in Hong Kong, *Neurology*, 1989, 39(10): 1314–18.
- d) C.M. Tanner, B. Chen, W-Z. Wang, et al., Environmental factors in the etiology of Parkinson's disease, *Can J Neuro Sci*, 1987, 14: 419–23.
- e) B. Ritz and F. Yu, Parkinson's disease mortality and pesticide exposure in California 1984–1994, *Int J Epid*, 2000, 29(2): 323–29.
- f) A. Priyadarshi, S.A. Khuder, E.A. Schaub, et al., Environmental risk factors and Parkinson's disease: A meta-analysis, *Env Res*, 2001, 86(2): 122–27.
- g) K. Marder, G. Logroscino, B. Alfaro, et al., Environmental risk factors for Parkinson's disease in an urban multiethnic community, *Neurology*, 1998, 50(1): 279–81.
- h) W. Koller, B. Vetere-Overfield, C. Gray, et al., Environmental risk factors in Parkinson's disease, *Neurology*, 1990, 40(8): 1218–21.
- i) G.F. Wong, C.S. Gray, R.S. Hassanein, et al., Environmental risk factors in siblings with Parkinson's disease, *Arch Neurol*, 1991, 48(3): 287–89.
- 17 a) C.H. Tsai, S.K. Lo, L.C. See, et al., Environmental risk factors of young onset Parkinson's disease: A case-control study, *Clin Neurol Neurosurg*, 2002, 104(4): 328–33.
- b) M. Behari, A.K. Srivastava, R.R. Das, et al., Risk factors of Parkinson's disease in Indian patients, *J Neurol Sci*, 2001, 190(1–2): 49–55.
- c) M. Zorzon, L. Capus, A. Pellegrino, et al., Familial and environmental risk factors in Parkinson's disease: A case-control study in north-east Italy, *Acta Neurol Scand*, 2002, 105(2): 77–82.
- d) A. Smargiassi, A. Mutti, A. De Rosa, et al., A case-control study of occupational and environmental risk factors for Parkinson's disease in the Emilia-Romagna region of Italy, *Neurotoxicology*, 1998, 19(4–5): 709–12.
- 18 L. Fleming, J.B. Mann, et al., Parkinson's disease and brain levels of organochlorine pesticides, *Ann Neurol*, 1994, 36(1): 100–3.
- 19 M.P. Longnecker, M.A. Klebanoff, H. Zhou, J.W. Brock, Association between maternal serum concentration of the DDT metabolite DDE and pre-term and small-for-gestational-age babies at birth, *The Lancet*, 2001, 358: 110–114.
- 20 a) R.S. Procianny, and S. Schvartsman. Blood pesticide concentration in mothers and their newborn infants: Relation to prematurity, *Acta Paediatr Scand*, 1981, 70(6): 925–8.
- b) F.P. Perera, V. Rauh, et al., Effects of transplacental exposure to environmental pollutants on birth outcomes in a multiethnic population, *Environ Health Perspect*, 2003, 111(2): 201–5.
- c) R.M. Whyatt, V. Rauh, D.B. Barr, et al., Prenatal Insecticide Exposures, Birth Weight and Length Among an Urban Minority Cohort, *Environ Health Perspect*, 2004, doi:10.1289/ehp.6641, see <http://ehp.niehs.nih.gov/members/2004/6641/6641.html>.
- 21 a) J.E. Gordon and C.M. Shy, Agricultural chemical use and congenital cleft lip and/or palate, *Arch Env Health*, 1981, 36: 213–21.
- b) D.A. Schwartz and J.P. LoGerfo, Congenital limb reduction defects in the agricultural setting, *Am J Pub Health*, 1988, 78: 654–57.
- c) G.M. Shaw, C.R. Wasserman, C.D. O'Malley, et al., Maternal pesticide exposure from multiple sources and selected congenital anomalies, *Epidemiology*, 1999, 10(1): 60–66.
- d) A.E. Czeizel, Pesticides and birth defects [letter], *Epidemiology*, 1996, 7(1): 111.
- e) E.M. Bell, I. Hertz-Picciotto, and J.J. Beaumont, A case-control study of pesticides and fetal death due to congenital anomalies, *Epidemiology*, 2001, 12(2): 148–56.
- 22 a) V.F. Garry, D. Schreinemachers, M.E. Harkins, et al., Pesticide applicators, biocides, and birth defects in rural Minnesota, *Environ Health Perspect*, 1996, 104(4): 394–99.
- b) M. Restrepo, N. Munoz, N.E. Day, et al., Birth defects among children born to a population occupationally exposed to pesticides in Columbia, *Scand J Work Env Health*, 1990, 16: 239–46.
- c) A.M. Garcia, F.G. Benavides, T. Fletcher, et al., Paternal exposure to pesticides and congenital malformations, *Scand J Work Env Health*, 1998, 24(6): 473–80.
- 23 a) S.H. Swan, R.L. Kruse, et al., Semen quality in relation to biomarkers of pesticide exposure, *Environ Health Perspect*, 2003, 111(12): 1478–84.
- b) A. Abell, E. Ernst, et al., High sperm density among members of organic farmers' association, *Lancet*, 1994, 343(8911): 1498.
- 24 a) E. Carlsen, A. Giwercman, N. Keiding, N. Skakkebaek, Evidence for Decreasing Quality of Semen During Past 50 Years, *British Medical Journal*, 1992, 305:609–613.
- b) L.R. Fraser, et al., Effects of estradiol 17B and environmental estrogens on mammalian sperm function, Presented at the annual conference of the European Society of Human Reproduction and Embryology, Vienna, July 2002, see <http://conf.eshre.com/PDF/O-119.pdf>