Cancer in Children and Home, Garden, Pet, and other Non-agricultural Pesticide Exposure

Summay of
Selected Studies

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Table of Contents

Explanation of Tables 3-4

Cancer in Children 5-7

References 8

Footnotes 8-9

About the Table

This table is a selective summary of studies of cancer in children (age less than 15) with potential exposure to pesticides. Most are from articles published in English in peer-reviewed journals. The studies are listed in chronological order by author – the most recent first.

The children's exposure could be from their parents – e.g. work as farmers, agricultural workers, sprayers, exterminators, formulators, or living on a farm, in an agricultural spray area. Pesticide exposure could be from household, lawn/garden, pet, or use by parents or care givers.

How the Studies Are Done

Epidemiology is the study of diseases and their causes in human populations. The studies in this table compare children with cancer to see if they have higher pesticide exposure than children without cancer. Or they study children with pesticide exposure to see if they have an increase in cancer. The children with cancer or pesticide exposure are the cases, and the children without cancer or pesticide exposure are the controls.

It is impossible to determine every factor that might have an effect on cancer in humans. The cancer might have occurred anyway, by chance. Or the increase could be from something other than pesticides – something the researcher didn't think of, or ask about. An increase could be from pesticides in combination with unknown or unstudied factors. Finding an increase in risk does not mean that pesticides "cause" cancer.

How Study Results are Reported

Study results are reported as odds ratios. Three types of relationships are possible:

1. Children with cancer were more likely to have exposure to pesticides than children without cancer. If so, pesticide exposure increases the risk, and the ratio will be greater than one (>1). The greater the ratio, the greater the risk.. A ratio of 1.4 means a 40% increase in risk. A ratio of 2.0 means a doubling of the risk, or a 200% increase. At least a doubling of the risk is considered more important than ratios less than 2.0.

2. Children with cancer were equally likely to have exposure to pesticides as children with cancer. If there is no difference in risk, the ratio will be is equal to one (= 1).

3. Children with cancer are less likely to have exposure to pesticides than children without cancer. If so pesticide exposure decreases the risk and the ratio will be less than one (< 1). The smaller the number the lower the risk. A ratio of 0.80 means that children with cancer are 20% less likely to have been exposed to pesticides. A ratio of 0.40, that they are 60% less likely.

Are the Study Results "Significant"?

Tests of statistical significance determine how strong the association with cancer and pesticides is. They test whether the rsults could have occurred by chance. The most common tests are the "p" value, and confidence intervals.

1. "p" value: This tests whether the findings could have occurred by chance 5% of the time or less. The 5% is always written as a decimal – 0.05. If the "p" value is less than or equal to 0.05 (≤ 0.05), it is considered statistically significant – unlikely to have occurred by chance.

The smaller the "p" value the more significant the findings. For example $p \leq 0.01$ (read as p less than or equal to point 0, 1) means that it could have occurred by chance 1% of the time or less.

2. Confidence intervals: The confidence interval shows how close the ratio found in the study is to the "true" or expected value. Most of the time, it is 95% – meaning that 95% of the time the study results will be within the calculated interval. Another way of saying this is that 5% of the time the results will lie outside the calculated interval.

Because it is an interval, there are two numbers. If the lower number of the confidence interval is less than or equal to one (≤ 1), than the increase in risk is not significant. If the lower number of the interval is greater than one (> 1) then the increase in risk is considered significant.

If the number of cases is small, the confidence interval can be very wide. When there is a very wide interval between the lowest and the highest number, the less confidence you have in the findings. It usually means that the number of cases found were very small.

The larger the number of people in the study (the sample size), the narrower the confidence interval, and the more significant the findings.

Common Ratios

FR	Fecundability Ratio	SMR	Standardized Mortality Ratio
OR	Odds Ratio	SHR	Standardized Hospital Ratio
PMR	Proportionate Mortality Ratio	SMbR	Standardized Morbidity Ratio
PCMR	Proportionate Cancer Mortality Ratio	SIR	Standardized Incidence Ratio
PR	Prevalence Ratio	SPR	Standard Proportional Ratio
RR	Relative Risk (or Rate Ratio)	SRR	Standardized Rate Ratio

Study Type Num. Cases	Source and/or Type of Exposure	Type of Cancer	Findings (95% CI)	Year Author
Case report Preterm female	Germany Heavy abuse permethrin aerosol in pregnancy	Congenital leukemia Permethrin induced MLL cleavage in vitro	11q23/MLL rearrangement	2003 Borkhardt
154 Astrocytoma 158 Primitive neuroecto-dermal tumors (PNET)	1986-1989. US and Canada Exposure to insecticides, herbicides, agricultural and nonagricultural fungicides	Astrocytoma Paternal exposure all classes Maternal exposure insecticides, herbicides, nonagric. fungicides Maternal expos. agric.fungicides PNET paternal expos. herbicides	OR 1.4–1.6 1.3–1.6 1.0 1.5	2003 VanWijngaar-den
Case-control 162 case 162 controls	1995-1999 Northern California Household pesticides	Leukemia Pest control services at any time 1 yr before to 3 yr after birth 2nd year after birth Insecticide exposure 3 mo before pregnancy During pregnancy During first year of life During second year of life During third year of life Herbicide exposure	OR 2.8 (1.4-5.7) 3.6 (1.6-8.3) 1.8 (1.1-3.1) 2.1 (1.3-3.5) 1.7 (1.0-2.9) 1.6 (1.0-2.7) 1.2 (0.7-2.1) No sig. association	2002 Ma
136 Cases 266 Controls	UK Mosquito control	Acute Leukemia -infants [1] Mosquitocides (propoxur)	OR 9.68 p = 0.003	2001 Alexander
Case-control 538 cases and matched controls	Pediatric Oncology and Child. Cancer Group[2] Home use of pesticides 1992-1994	Neuroblastoma Professional extermination Pesticide use in the home Any pesticide use in the garden Herbicide use in the garden Insecticide use in the garden Garden use chn diag. > 1 yr Ant or roach control products Mother applied pesticides Father applied pesticides	OR 1.4 (0.9-2.1) 1.6 (1.0-2.3) 1.7 (0.9-2.1) 1.9 (1.1-3.2) 1.3 (0.7-2.3) 2.2 (1.3-3.6) 1.8 (1.0-3.1) 2.2 (1.3-3.8) 1.1 (0.8-1.5)	2001 Daniels
177 cases 2006 controls	1988-1994 West Germany	Wilms tumor Pesticide exposure	OR No association	2001 Schuz
466 cases 2,458 controls	1993-1997 West Germany	Astrocytoma Wood preservative exposure Exposure to pesticides	OR 1.91 (1.22-3.01) No association	2001 Schuz
Case-control 268 each	US / Canada Children's Cancer Group[2] Home pesticide use and	Non-Hodgkin lymphoma Increase freq. home pesticide use Use on most days Exterminations within the home Postnatal exposure	OR 7.3 Trend sig. p = 0.05 3.0 p = 0.002 2.4 p = 0.001	2000 Buckley

2358 cases [3] 2,588 controls	1993-1997 West Germany Household pesticide exposure	Non-Hodgkin lymphoma Home use insecticides by PCO[4] Frequency parents' home use Leukemia Home use insecticides by PCO[4] Pesticide use in gardens	OR 2.6 (1.2-5.7) p for trend = 0.02 1.2 (0.8-2.3) 1.0 (0.8-1.2)	2000 Meinert
Case-control 224 cases and 218 controls	Los Angeles Home Pesticide Use 1984-1991 Flea/Tick Products	Brain cancer Prenatal expos. any flea/tick prod. Prenatal exp. child < 5 at diag. Prenatal expos. sprays/foggers only Mother prep/cleanup Mother prep/cleanup and child <5 Never followed label instructions Did not evacuate after spray/dust More than one pet treated Number of pets treated Prenatal termite treatments Lice treatment (childhood) Yard and garden pesticides[5]	OR 1.7 (1.1-2.6) 2.5 (1. 2-5.5) 10.8 (1.3-89.1) 2.2 (1.1-4.2) 5.4 (1.3-22.3) 3.7 (1.5-9.6) 1.6 (1.0-2.6) 3.5 (1.1-11.4) Trend sig. p= 0.04 2.7 (0.5-14.2) No increase No increase	1997 Pogoda
173 cases 219controls	1988-1992 Germany Home/garden pesticide	Leukemia Pesticide use home garden	OR 2.52 p < .05	1996 Meinert
Case-control 2,52l	1976-1983 Denver, Colorado Home pesticide use	Soft tissue sarcoma Yard treatment[6] Yard treatment[7] Yard treatment[8] Leukemia Pest strips[16] Pest strips[14] Pest strips[15] Yard treatment[14] Yard treatment[16] Yard treatment[15] Brain cancer Pest strips[14] Pest strips[16] Pest strips[15] Home extermination[15] Home extermination[16] Home extermination[14] Lymphomas Home extermination[15] Home extermination[14] Home extermination[16] Pest strips[16] Pest strips[15] Pest strips[14]	OR 3.9 (1.7-9.2) 4.1 (1.0-16.0) 0.8 (0.5-1.2) 3.0 (1.6-5.7) 2.6 (1.7-3.9) 1.7 (1.2-2.4) 1.1 (0.8-1.5) 1.1 (0.6-1.9) 0.9 (0.5-1.8) 1.8 (1.2-2.9) 1.5 (0.9-2.4) 1.4 (0.7-2.9) 1.4 (0.6-2.7) 1.3 (0.7-2.1) 1.1 (0.4-3.0) 1.8 (1.1-2.9) 1.6 (0.9-2.9) 1.2 (0.4-3.9) 1.4 (0.7-2.5) 1.3 (0.4-2.7) 1.1 (0.6-1.9)	1995 Leiss
Case-control 75 cases, 113 controls	1985-1987 France (Paris region) Household Exposure	Brain cancer Home treated during pregnancy Home treated during childhood	OR 1.8 (0.8-4.1) 2.0 (1.0-4.1)	1994 Cordier

82 cases 164 controls	1985-89 NSW Australia Household exposure	Brain cancer Pesticide treatment home	OR No increase	1994 McCredie
14 cases < 40 56 controls	1980-1985. The Netherlands Pesticide use by patient or parent	Haematopoietic malignancies Intensive pest. use by the patient Intensive pest. use by father Swimming in polluted pond	OR 6.0 (0.6-49.3) 3.2 (1.0-10.1) 5.3 (1.3-17.4)	1994 Mulder
Case-control 271 children	Children's pesticide exposure	Acute myeloid leukemia Postnatal home exposure [9]	OR 1.80 (1.11-2.89)	1994 Steinbuch
Case-control 234 cases	1984-1986 US and Canada Household insecticide exposure	Wilms Tumor Home extermination ever Home extermination once/year Home exterm. ≥2 times /year	OR 2.16 (1.24-3.75) 2.41 (1.14-5.09) 2.19 (0.94-5.08)	1993 Olshan
Case-control [10] 31 boys, 14 girls ≤10 years	1985 -1989 Missouri Parental use of household pesticides	Brain Cancer[11] Use of bomb indoors Flea collar use on pets Use of No-Pest strip[12] Any termite treatment Garden use of carbaryl Garden use of diazinon Yard herbicide use Garden/orchard insect. use Kwell (lindane) for lice Pesticide use on pets	OR 6.2 (11.4-28.3) 5.5 (1.5-20)[13] 4.4 (1.4-14.3)[14] 5.2 (1.2-22.2)[15] 2.9 (1.3-7.1)[15] 3.0 (1.-3-7.4) 2.4 (1.1-5.6)[16] 4.6 (1.1-17.9)[15] 3.4 (1.2-9.3)[16] 2.6 (1.1-5.9)[16] 4.6 (1.0-21.3)[15] 1.9 (0.6-6.9)[16] 4.8 (0.9-24.7)[15] 1.8 (0.5-6.6)[16]	1992 Davis
Cancer Incidence 1,270 [16]	1979-1986 St. Jude's Hospital	Leukemia, lymphoma, solid tumor Having a garden using fertilizers, herbicides, pesticides	X^2=17.2 p= 0.03	1991 Schwartz-baum
Case-control 123 ≤ 10 years old	1980-1984 Los Angeles California Home and garden pesticide use [17]	Acute lymphocytic leukemia Indoor use either parent ≥1/wk Garden use either parent ≥1/mo Mother household use Mother garden use Father household use Father garden use	OR 3.8 (1.37-13.02) 6.5 (1.47-59.33) 3.2 p=0.02 9.0 p=0.02 4.0 p=0.02 5.0 p=0.07	1987 Lowengart
Case-control 110 children < 20 yrs old	1975-1982 Columbus, Ohio Household insecticides	Brain cancer Mothers use during pregnancy or prior to conception	OR Increased risk	1985 Sinks
Case-control[18] 84	1965-1975 Baltimore, MD. Home insecticide use	Brain cancer Compared to healthy controls Compared to cancer controls	OR 2.3 p=0.10 1.2 p=0.84	1979 Gold
7 Case reports	1975 Ohio Chlordane exposure	Neuroblastoma[19] Aplastic anemia[20] Leukemia[21]	—	1978 Infante

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Footnotes

1. Infant leukemia frequently involves breakage/recombination of the MLL gene in utero. A study of MLL gene fusions in pregnant women with and without exposure to carbamate insecticides, including Baygon (propoxur).
2. Children's Cancer Study Group. United States: Colorado, District of Columbia, Illinois, Indiana, Iowa, Michigan, Minnesota, New Jersey, New York, North Carolina, Ohio, Oregon, Pennsylvania, Tennessee, Texas, Utah, Wisconsin; Canada: British Columbia, Nova Scotia, Ontario.
3. 1,184 children with leukemia, 234 with non-Hodgkin's lymphoma, and 940 with a solid tumor.
4. Pest control operators (commercial exterminators).
5. Includes use of insecticides, herbicides, fungicides, or snail killer.
6. 2 years prior to diagnosis through diagnosis.
7. Birth through 2 years prior to diagnosis.
8. Last three months of pregnancy.
9. Exposure to household pesticide products used to control rodents.
10. Controls 108 children (57 boys, 51 girls) with other cancers (71 acute lymphocytic leukemia, 9 sarcomas, 8 lymphomas, 21 other types) from state registry, and 85 healthy children (50 boys, 35 girls) known by families of children with brain cancer.
11. Twenty astrocytomas, 11 medulloblastomas, 14 a mix of other types.
12. Active ingredient dichlorvos (DDVP).
13. Compared to friend controls
14. Compared to cancer controls.
15. Pennsylvania, New Jersey, Delaware
16. 629 with leukemia, 237 with lymphoma, 404 with solid tumors.
17. Home exposure of mothers during pregnancy and nursing, and fathers during pregnancy of the index child.
18. Compared to 76 children without cancer, and 112 children with other types of cancer.

19. Diagnosed in 5 children at same pediatric hospital; all had prenatal and/or extensive environmental exposure to chlordane.
20. In a 15 year old boy with exposure to chlordane and Isotox
21. In a 9 year old girl.