Home Pesticide Use and Childhood Cancer: A Case–Control Study

Jack K. Leiss, PhD, and David A. Savitz, PhD

ABSTRACT

The association between childhood cancer and home pesticide use was examined in a case–control study of children under 15 years of age. Parents of 252 children diagnosed with cancer in the Denver area between 1976 and 1983 and of 222 control subjects were interviewed regarding use of home pest extermination, yard treatment, and pest strips. The strongest associations were found for yard treatments and soft tissue sarcomas (odds ratios [ORs] around 4.0) and for use of pest strips and leukemias (ORs between 1.7 and 3.0). These results suggest that use of home pesticides may be associated with some types of childhood cancer. (*Am J Public Health.* 1995;85:249–252)

Introduction

Associations between home pesticide use and cancer in children were first suggested by case reports of childhood tumors and leukemias following the use of insecticides and herbicides in the home and yard.[1–3] Subsequently, four case–control studies found associations between home pesticide use and childhood cancer. Gold et al. reported an odds ratio (OR) of 2.3 for insecticide extermination in the household among children with brain tumors (age < 20 years).[4] Lowengart et al. found odds ratios of 4.0 for use of household pesticides and 5.6 for garden pesticides among children with leukemia (age ≤10 years).[5] Buckley et al. found a dose–response relationship and odds ratios up to 3.5 for insecticide extermination and acute nonlymphocytic leukemia (age < 18 years).[6] Most recently, Davis et al. found odds ratios of up to 6.2 for several age- and pesticide-specific exposures among children with brain cancer (age ≤ 10 years).[7] The strong effects reported in these studies are striking because their exposure measures are particularly subject to nondifferential misclassification likely to produce bias toward the null. However, differential recall of case and control subjects was a potential source of bias away from the null in all these studies. It should also be noted that associations have been found between a parent's occupational exposure to pesticides and childhood cancers.[6,8,9]

Given recent reports that exposure of children to household pesticides,[10,11] including known or suspected carcinogens,[12,13] may be high, further investigation is warranted. The present study examines the association between home pesticide use and cancers, including lymphomas (Hodgkin's disease and non-Hodgkin's lymphomas) and soft tissue sarcomas, in children under 15 years of age.

Methods

The data were collected in a study of childhood cancer and electromagnetic field exposure.[14] All cases of childhood cancer (ages 0–14 years) diagnosed among residents of the 1970 Denver standard metropolitan statistical area from January 1, 1976, through December 31, 1983, were eligible. Information on cases was obtained from the Colorado Central Cancer Registry and review of area hospital records. Control subjects were identified through random-digit dialing and were matched to case subjects by age (±3 years), sex, and geographic location (telephone exchange area). Control subjects were restricted to children who had lived in their current residences at the time that their matched case subject was diagnosed (up to 9 years prior to selection) and were assigned the age of diagnosis of their matched case subject.

Exposure data were collected through parental interviews. For each residence in which the subject lived with the respondent for 6 months or more, beginning with the mother's pregnancy, the respondent was asked the dates of occupancy (month and year) and (1) whether the residence was "ever exterminated for insects or pests, so that [they] had to leave the house for a few hours"; (2) whether the yard around the residence was "ever treated with insecticides or herbicides to control insects or weeds"; and (3) whether they ever used "hanging pest strips for insect control in that home." The total number of times that the house was exterminated and the yard was treated were also asked. Further details of subject recruitment and data collection are reported elsewhere.[14]

Exposure was dichotomized as "any use" vs "no use" for each pesticide type and exposure period. The association of pesticide use with childhood cancer was assessed separately for each type of pesticide use (i.e., home extermination, yard treatment, pest strip) and for each of three exposure periods (3 months prior to birth through birth, birth through 2 years prior to diagnosis, and 2 years prior to diagnosis through diagnosis). The first

Jack K. Leiss is with the Department of Biostatistics and Carolina Population Center, and David A. Savitz is with the Department of Epidemiology and Carolina Population Center, University of North Carolina, Chapel Hill.

Requests for reprints should be sent to Jack K. Leiss, PhD, State Center for Health and Environmental Statistics, PO Box 29538, Raleigh, NC 27626-0538.

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TABLE 1—Prevalence of Home Pesticide Use among Control Subjects during the Exposure Period (Birth to 2 Years Prior to Diagnosis), by Selected Characteristics in a Case–Control Study of Childhood Cancer, Denver, Colo, 1976 through 1983

	Type of Pesticide Use					
	Home Extermination		Yard Treatment		Pest Strips	
Characteristic	No.	%	No.	%	No.	%
All control subjects	45	25.7	118	63.4	47	26.6
Race						
White	35	22.6	103	64.0	40	25.8
Non-White	9	47.4	9	47.4	5	25.0
Mother's age, y						
≤19	2	28.6	2	16.7	3	42.9
20+	42	25.2	111	63.8	42	25.0
Father's education, y						
≤15	27	28.4	51	54.3	26	27.4
16+	17	21.5	62	71.3	19	23.8
Per capita income, $						
≤7000	32	28.3	62	54.9	29	25.2
>7000	12	19.7	51	75.0	16	26.7
Maternal smoking						
Smoker	10	25.0	28	68.3	7	18.0
Nonsmoker	32	24.6	82	60.7	34	25.8

Note. Characteristic categories may not add to totals because of missing values for the characteristics.

TABLE 2—Characteristics of Case and Control Subjects in a Study of Childhood Cancer, Denver, Colo, 1976 through 1983

	% Case Subjects (n = 252)	% Control Subjects (n = 222)
Mother's race: White	88	89
Females	42	41
Mother aged 20+ y	92	95
Father college graduate	37	48
Per capital income ≤$7000	71	62
Mother smoked	29	22
Age at diagnosis		
≤5	47	NA
11+	30	NA

Note. NA = not applicable.

period excludes adopted subjects. The latter two periods exclude subjects whose age at diagnosis was less than 2 years. Frequency-of-use measures proved uninformative in preliminary analysis and are not reported here.

Crude and adjusted exposure odds ratios and 95% confidence intervals were calculated using the Mantel-Haenszel method.[15,16] Adjustment for confounding was done in two stages. First, adjusted odds ratios were calculated, with age at diagnosis, father's education, per capita income, residential stability, mother's age, race, sex, maternal smoking, residential wire code (magnetic field exposure),[14] and year of diagnosis controlled separately. If only one of the adjusted odds ratios differed substantially (i.e., generally by 10% or more) from the crude one, this adjusted odds ratio was reported. If more than one adjusted odds ratio differed from the crude one, the adjusted odds ratio was calculated by logistic regression,[17] with the relevant confounders controlled for. Associations based on fewer than five exposed case subjects were not adjusted.

Results

Interviews were obtained from parents of 252 case subjects (70.8% of eligible cases) and 222 control subjects (79.9% of eligible controls). Reasons for nonresponse among eligible case subjects included untraceability (17.1%), respondent refusal (8.7%), and physician refusal (1.1%). All but one noninterviewed eligible control were refusals.[14]

Among control subjects, home extermination was twice as prevalent among non-Whites as among Whites; yard treatment was 50% more prevalent in homes where the father had a college education or where per capita income was greater than $7000, and use of pest strips was 50% more prevalent in homes where the mother did not smoke than in other homes (Table 1). Parents of control subjects had somewhat more education and higher income than those of case subjects (Table 2).

Table 3 shows the associations between home pesticide use and cancer by type of pesticide use, exposure period, and type of cancer.

Home Extermination

Home extermination was not associated with total cancers in any of the exposure periods (Table 3), whereas an inverse association was found for leukemias (OR = 0.3 to 0.9). Elevated exposure to home extermination was found for brain tumors and lymphomas (OR = 1.1 to 1.8). The confidence intervals for these estimates are broad, indicating imprecision, with most results based on fewer than 10 exposed cases. There were too few exposed cases of soft tissue sarcomas to allow any inferences regarding this outcome.

Yard Treatment

Strong associations with yard treatment (Table 3) were found only for soft tissue sarcomas for the periods following birth and preceding diagnosis (OR around 4.0). Odds ratios for the other cancer types were near or below the null.

Pest Strips

Use of pest strips showed the most consistent evidence of an association with childhood cancer (Table 3), with elevated odds ratios (1.1 to 3.0) for all outcomes except soft tissue sarcomas. The number of exposed cases for lymphomas and soft tissue sarcomas was small.

TABLE 3—Exposure[a] to Pesticides from Home Extermination, Yard Treatment, and Pest Strips, Case–Control Study of Childhood Cancer, Denver, Colo, 1976 through 1983, by Exposure Period and Type of Cancer

		Total Cancers			Leukemias			Brain Tumors			Lymphomas			Soft Tissue Sarcomas		
Source of Exposure and Exposure Period	No. of Exposed Control Subjects	No. of Exposed Case Subjects	OR	95% CI	No. of Exposed Case Subjects	OR	95% CI	No. of Exposed Case Subjects	OR	95% CI	No. of Exposed Case Subjects	OR	95% CI	No. of Exposed Case Subjects	OR	95% CI
Home extermination																
Last 3 months of pregnancy	27	32	1.0	0.6, 1.8	4	0.4	0.1, 1.2	8	1.3	0.7, 2.1	4	1.2	0.4, 3.9	1	0.3	0.0, 1.8
Birth through 2 years prior to diagnosis	45	50	1.0	0.6, 1.6	6	0.3	0.1, 0.8	12	1.4	0.6, 2.7	9	1.8	1.1, 2.9	2	0.5	0.1, 2.4
2 years prior to diagnosis through diagnosis	22	30	1.2	0.6, 2.3	7	0.9	0.5, 1.4	5	1.1	0.4, 3.0	6	1.6	0.9, 2.9	1	0.7	0.1, 5.3
Yard treatment																
Last 3 months of pregnancy	79	76	0.8	0.5, 1.1	27	1.1	0.6, 1.9	12	0.6	0.3, 1.1	6	0.5	0.2, 1.2	10	0.8	0.5, 1.3
Birth through 2 years prior to diagnosis	118	117	0.9	0.6, 1.3	36	0.9	0.5, 1.8	17	0.5	0.2, 0.9	15	0.8	0.3, 1.8	14	4.1	1.0, 16.0
2 years prior to diagnosis through diagnosis	98	100	1.0	0.6, 1.4	33	1.1	0.8, 1.5	16	0.5	0.4, 0.8	10	0.6	0.4, 1.0	10	3.9	1.7, 9.2
Pest strips																
Last 3 months of pregnancy	26	45	1.5	1.0, 2.8	21	3.0[b]	1.6, 5.7	10	1.5	0.9, 2.4	5	1.4	0.7, 2.5	2	0.6	0.1, 2.6
Birth through 2 years prior to diagnosis	47	61	1.3	0.8, 2.0	21	1.7	1.2, 2.4	13	1.4	0.7, 2.9	7	1.3	0.4, 2.7	2	0.5	0.1, 2.3
2 years prior to diagnosis through diagnosis	37	46	1.2	0.8, 2.0	18	2.6	1.7, 3.9	9	1.8	1.2, 2.9	4	1.1	0.6, 1.9	0	. . .	. . .

Note. OR = odds ratio; CI = confidence interval.

[a]Exposure was measured as any use vs no use of home extermination, yard treatment, or pest strips while the case or control subject was living in the home. Odds ratios were adjusted for age at diagnosis, father's education, per capita income, residential stability, mother's age, maternal race, sex, maternal smoking, wire code (magnetic field exposure), and/or year of diagnosis when these factors proved to be confounders. Odds ratios based on fewer than five exposed cases were not adjusted.

[b]This is the unadjusted value. Adjusted odds ratio was 2.3, but this was apparently caused primarily by missing values for the potential confounders, since the unadjusted value excluding subjects with missing values for the potential confounders was 2.6.

Discussion

Home Extermination

We found evidence of an association between home extermination and lymphomas but not other cancers. The pesticides most likely to be used for home extermination include chlordane, heptachlor, Diazinon, and chlorpyrifos (Dursban).[7,13,18–20] We are not aware of any previous studies of these chemicals and lymphomas in children. Davis et al.'s[7] finding of a strong association between home extermination and brain cancer was not confirmed in our study.

Yard Treatment

We found strong but imprecise associations between yard treatment and soft tissue sarcomas. This is consistent with the hypothesis that 2,4-D, the yard herbicide most likely to be used by our study population,[21] may be associated with soft tissue sarcomas in adults.[22]

The yard insecticides most likely to be used by our study population,[12] carbaryl and Diazinon, along with the yard herbicide 2,4-D, have been associated with non-Hodgkin's lymphomas in occupational exposures among adults.[22–25] Our data do not support an association between yard treatments and childhood lymphomas, but the estimates are imprecise. Davis et al.'s report of strong associations between use of herbicides and insecticides in the yard and brain tumors in children[7] was not corroborated by our data.

Exposure to yard treatment was not associated with leukemias in our study. Exposure to carbaryl and Diazinon have been associated with leukemia in adult men.[26] We are unaware of any studies of yard treatment or of use of these chemicals and childhood leukemia.

Pest Strips

We found relatively strong associations between use of pest strips and leukemias. Dichlorvos, the insecticide used in pest strips,[27] is a known carcinogen in animals[24,27] and has been associated with leukemia in adult men.[26] Reeves et al. reported several cases of childhood leukemia following exposure to dichlorvos.[2] Our findings of an association between use of pest strips and brain tumors are consistent with those of Davis et al.[7]

Conclusion

The major weakness of this study, as with previous studies of home pesticides and childhood cancer,[4–7] is the crudeness of the exposure measures. Future studies should aim for more specific measures of exposure in terms of age, duration, intensity, and particular chemical agents. In this regard, the stronger and more consistent associations with pest strips may reflect better measurement of this exposure. Recall bias also provides a possible explanation of our positive findings. The heterogeneity of effects across exposures and cancer types suggests that this was not a major source of bias in our study, however, because recall bias would be expected to elevate all risks. On the other hand, the crudeness of the exposure measures would be expected to cause underestimation of the odds ratios through nondifferential misclassification. Finally, nonresponse and the method of control selection[14] could have biased our results. There was little evidence of confounding in our data.

Two major conclusions can be drawn from this study. First, some types of home pesticide use may be associated with some types of childhood cancer. Second, more study is needed to clarify which specific exposures, if any, are associated with which particular childhood cancers. □

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