Nature Environment and Pollution Technology
An International Quarterly Scientific Journal

ISSN: 0972-6268	Vol. 12	No. 3	pp. 467-470	2013

Survey Based Research Paper

Pesticide Exposure and Cancers in Barpeta District, Assam - A Case for Control Study

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Nat. Env. & Poll. Tech.
Website: www.neptjournal.com
Received: 24-3-2013
Accepted: 1-5-2013

Key Words:
Pesticides
Occupational exposure
Cancer
Barpeta district

ABSTRACT

Occupational exposure of carcinogenic pesticides in agricultural fields of Barpeta district, Lower Assam, is a matter of concern. The aim of this study is to investigate the relationship between exposures of carcinogenic pesticides and occurrence of cancer in the agricultural region of Barpeta district. A structured questionnaire was employed in a field based case-control study to gather information on demographics, occupation, pesticide exposure, agricultural practices, family history and medical history along with smoking habit. One hundred cases of different cancers were identified in the field. The control (100) were chosen from the same environment in terms of age, sex, smoking and other food habit. To control confounders, multiple logistic regression analysis was used. To assess the dose-respond relationship between exposure and disease, the chi-square test for trend was used. One hundred (100) historically confirmed cancer cases were detected from the year 2008-2010. Sex and age matched one hundred controls were included in the study. Pesticide exposure independently associated with different types of cancer in the region. Lung cancer (OR = 1.138, 0.790-1.48, P = 0.769), Throat cancer (OR = 1.426, 0.564-3.78, P = 0.735), leukaemia (OR =1.167, 0.261-5.909, P = 0.056), stomach cancer (OR = 1.069, 0.281-4.385, P = 1.00). Pesticide exposure strongly associated with cancer after controlling smoking. Cancer was associated with pesticide exposure after controlling the confounders. Smoking and eating during pesticide application were identified as modifying factors for increasing the risk of cancer. The poor pesticide work practices identified during this study. Proper training and educational campaigns are essential for handling pesticides.

INTRODUCTION

Occupational exposure of carcinogenic pesticides in agricultural fields in Barpeta district of lower Assam, is a matter of concern. Cancer is a multifactorial disease. It includes physical, chemical and biological agents-such as radiation, viruses, diet and obesity, tobacco smoking, environmental pollutants, etc. Pesticides, which are widely used in agriculture, comprise wide variety of chemicals mainly used to control the insects, molds and weeds. The hazard from exposure depends upon the magnitude and severity of exposure and toxicity of chemicals (Gupta et al. 1984, Blair et al. 2009).

Indiscriminate use of various pesticides in agricultural fields as well as storage products create deleterious effects on human health. Majority of the pesticides are carcinogenic in nature and it may also cause long term effects like asthma, bronchitis, heart trouble, kidney damage, etc. to workers. Among the long term health effects cancer is the disease caused by many pesticides (Fleming et al. 1999. Riley et al. 2003). Since, the workers are directly exposed to a variety of pesticides for longer periods, particularly the illiterate farmers, unknown about the nature of pesticides, may be affected easily.

Human beings directly or indirectly exposed to the pesticides and other agrochemicals via food, water, gardening and household use. Farmers and their families are in direct contact with the chemicals daily. Children can be more exposed to pesticides because they play on ground and their hands and mouth are in contact with potential contaminated surface. Those who are occupationally exposed to pesticides during their manufacture, formulation and application constitute the high risk population group (Cavel et al. 1995, Alvenja 2007).

Some of the pesticides are carcinogenic in nature. Carcinogens are chemicals that can initiate and promote cancer. The carcinogenic pesticides are of two groups, carcinogens and potential carcinogens. Organophosphates and organochlorine pesticides are identified as carcinogenic pesticides (Waddela et al. 2001, US-EPA 2002, US-Publication 2002).

It is stated that the exposure to the normal cell initiated the genetic changes which produce pre-neoplastic lesion known as promotion. Promotion stage of the cell is converted into cancer cell forming malignant tumour in the conversion stage and this finally changes into progression stage known as clinical cancer (Magee 1973, Curtis et al. 1987).

The aim of this study is to investigate the relationship between exposures of carcinogenic pesticides and occurrence of cancer in the agricultural region of Barpeta district, Assam.

METHODS

Study design: A case-control study of cancer among the pesticide exposure in agricultural workers was designed in Barpeta district. The area was selected randomly from the register maintained by pesticide shops. The study was conducted in ten selected centres from October 2008 to January 2010. These centres included the villages of Mazdia, Chenga, Nagaon, Sarthebari, Jania, Mandia, Baghbar, Palhazi, Kayakuchi and Kalgachia. The total area was 1.622 sq. kilometre, which represents 50% of the area of the entire district. The farmers are divided as 8.6% big, 80% marginal and 12.36% landless farmers.

Cases: All the cancer cases of pesticide applicators in Barpeta district were taken into consideration. One hundred histologically confirmed cases were collected from the villagers of selected centres with the help of Gaonburha and Asha-karmi of the area. Description of the study population is given in Table 1. The data recorded from personal interview with the patients and verified their medical reports. Out of 100 patients throat cancer, lung cancer, liver cancer, leukaemia, stomach cancer, oral cancer, breast cancer, skin cancer, bone cancer, brain cancer and sex organ cancer were recorded, which were recognized by Dr. B. Baruah Cancer Institute and Tata-Memorial Cancer Institute, West Bengal Medical College, Siliguri, and Christian Medical College, Vallore.

Controls: The workers which were involved incomparable physical work such as building construction and free from the area of pesticides were considered as control. The control group comprised from the same diet, habitat and living economic status. All of them were cancer free patients. Cases were divided into groups with the 5 years and were matched according to age and sex. Out of 100 controls 62 were exposed and 38 were unexposed.

Questionnaires: A standard questionnaire was employed in a field based case-control study according to National Cancer Institute, U.S.A . The questionnaire included six different sections, demographics, occupation, pesticide exposure, agricultural practice, family history and medical history along with smoking habit.

The information included type of crop, duration of farming, surface area of the farm, characteristics of the adjacent field, and crop infestations. The farmers were asked to provide commercial names of pesticides, number of applications per year, total years of use and type of appliances. A list of the most common brand names was provided for their help. The use of personal protective equipments (cloths, masks, boots, etc.) and the use of equipments, storage safety from kitchen and children were also investigated. In addition, information on certain habits such as changing cloths and bath completely before entering house, smoking and eating during application time and accidents was also collected.

In the family history section, all types of cancers and family proximity (first, second and third degree relatives) were recorded. Medical history was recorded from their recognized medical reports. Smoking habit and alcohol consumption was also recorded in the study.

Statistical analysis: Standard statistical procedures were carried out using multiple logistic regression analysis. Data were evaluated for completeness before statistical analysis. Descriptive stastical analysis was conducted for each variable including frequency ranges, median values for both the cases and controls. The Chi-square test was used to analyse qualitative data. Agricultural occupations were grouped together as exposure (farmer, fish-farmer, agricultural labour, animal breeder) and compared to the group of other occupations (teacher, businessman, public servant, unemployed, etc.) as non-exposed. Backward conditional logistic regression analysis was used to control for confounders. Each histological group was analysed separately. To asses the dose-response relationship between exposure and disease, Chi-square test for trend was used. Smoking during application, age and sex were confounders.

All control subjects were included in the statistical analysis of each histological group. The analysis was conducted separately for the 9th histological groups; 1. throat cancer, 2. lung cancer, 3. liver cancer, 4. leukemia cancer, 5. stomach cancer, 6. oral cancer, 7. breast cancer, 8. skin cancer, 9. others. Differences were considered statistically significant when the two tailed p-value was ≤ 0.05.

RESULTS

One hundred (100) historically confirmed cancer cases were detected from the year 2008-2010. 100 sex and age matched controls were included in the study. Pesticide exposure was independently associated with different types of cancer in the region; lung cancer (OR = 1.138, 0.790-1.48, P = 0.769), throat cancer (OR = 1.426, 0.564-3.78, P = 0.735), leukemia (OR = 1.167, 0.261-5.909, P = 0.056), stomach cancer (OR = 1.069, 0.281-4.385, P = 1.00). Pesticide exposure was strongly associated with cancer after controlling smoking and family history. Smoking during pesticide application was strongly associated with throat cancer (OR = 1.636, 0.396-8.826, P = 0.745), lung cancer (OR = 2.306, 0.976-5.512, P = 0.056), liver cancer (1.023, 0.220-4.883, P = 1.0), oral cancer (OR = 0.818, 0.124-5.403, P = 1.0), etc.

Table 1: Description of the study population.

		Cases		Control	
Sex	Male	83	83%	92	92%
	Female	17	17%	08	08%
Agricultural Occupation	Yes	75	75%	72	72%
	No	25	25%	28	28%
Pesticide Exposure	Yes	65	65%	62	62%
	No	35	35%	38	38%
Smoking	Yes	67	67%	55	55%
	No	33	33%	45	45%

Table 2: Logistic regression analysis of smoking during application of pesticides, cancer cases and histological groups.

	Smoking during application		Non smoking during application		OR	95% CI	P-trend
Throat cancer	33	73.80%	11	25.19%	1.636	0.336-8.826	0.745
Lung cancer	6	66.66%	3	33.33%	2.306	0.979-5.512	0.056
Leukaemia	4	44.40%	5	55.55%	0.655	0.137-3.035	1.03
Stomach cancer/ alimentary tract cancer	7	46.66%	8	53.33%	0.716	0.213-2.390	0.744
Oral cancer	3	50%	3	50%	0.818	0.124-5.403	1.0
Breast cancer	0	-	3	100%	0.273	0.011-3.106	0.503
Skin cancer	2	66.66%	1	33.33%	1.636	0.111-46.627	0.10
Liver cancer	5	55.55%	4	44.40%	1.023	0.220-4.883	1.0
Others	2	66.66%	2	66.66%	0.818	0.078-8.569	1.0
Controls	55	55%	45	45%	Ref	Ref	Ref

$p \leq 0.05$

Table 3: Logistic regression analysis of occupational status and cancer cases and histological groups.

Types of cancer	Agricultural Occupation	Other Occupation	OR	95%CL	P-trend
Control	72	28	Ref		
Throat cancer	33	9	1.436	0.564-3.678	0.846
Lung cancer	9	2	1.75	0.320-12.581	0.735
Liver cancer	9	3	1.167	0.261-5.909	0.01
leukemia	9	2	1.75	0.320-12.58	0.735
Stomach cancer	11	4	1.069	0.281-4.385	0.01
Oral Cancer	4	2	0.778	0.113-6.516	0.01
Breast Cancer	2	1	0.998	0.052-22.377	0.01
Skin Cancer	2	1	0.389	0.037-4.105	0.869

$P < 0.05$ indicate risk factor

Overall 100 cases (65 pesticide exposed and 35 non-exposed) and 100 controls (62 pesticide exposed and 38 non-exposed) were collected. The characteristics of the study population, including sex, agricultural occupation, pesticide exposure and smoking habit are presented.

As shown in Tables 2 and 3, univariate analysis revealed statistically significant associations between exposure to pesticides. A dose response effect was observed for almost all histological groups and was statistically significant for all cases.

For all cases, eating during application was a very common habit. Using logistic regression analysis, pesticide exposure was found to be independently associated with all cases after controlling for the following confounders, age, sex, smoking and family history. Smoking during pesticide application was strongly associated with throat cancer (OR = 1.636, 0.396-8.82, p = 0.745), lung cancer (OR = 2.306, 0.976-5.512, p = 0.056), liver cancer (OR = 1.023, 0.220-4.883, p = 1.0), etc.

DISCUSSION

Our study has substantial information regarding occurrence of cancer in Barpeta district. Statistically significant associations have been found between pesticide exposure and all cases, after controlling for confounder factors. It was determined that agricultural occupation was associated with throat and lung cancer. This type of study was reported earlier by Nordstrom et al. (1998) and Cavel et al. (1996).

Barpeta is mainly agricultural based district of lower Assam. The farmers supply various vegetables and fishes to the main towns (particularly in Guwahati city) of Assam daily. For that reason they use huge amount of pesticides, vitamins and hormones on crops for their economic profit. Since, the workers are directly exposed to the variety of pesticides for longer period, particularly the illiterate farmers, unknown about the nature of the pesticides, which effected them easily. The results are supported by Cavel et al. (1995), Hardell et al. (2002) and Kokova et al. (2011).

The important result from this study is that smoking and eating during pesticide application were associated with all cases. Most of the farmers used tea and breakfast in the field and they had the habit of tobacco, bidi and beetle nut chewing during pesticide application.

Pesticides are purchased in commercial form and diluted prior to use. The mixing and loading process is not suitable for farmers. They do not use any mask and gloves during the process. 98% of the farmers work in the field without agricultural training and protective measures. Some farmers used lemon juice to get rid of toxicity after applying pesticides. Their pesticide storage is not appropriate, they store it in their living room also.

The present study is field based study. So, it has several limitations. Data collection from different villages and personal interviews with the patients were a hard tusk. Cases were histological confirmed, but controls were not examined. On the other hand there was no laboratory confirmation of exposure status.

CONCLUSIONS

The cause of cancer is multifactorial. Cancers were associated with pesticide exposure after controlling for confounders. Smoking and eating during pesticide application were identified as modifying factors increasing the risk of cancers. The poor pesticide work practices identified during this study. Proper training and educational campaigns are essential for handling pesticides.

Abbreviations used: C L = Confidence interval, OR = Odds ratio, SD = Standard deviation.

ACKNOWLEDGEMENT

We are thankful to all the patients who participated in the study and the villagers, Gaonburah, and Asha-workers those gave information about patients. We are also grateful to our college authority, which gave permission to conduct this study.

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