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PESTICIDE EXPOSURE AND RISK OF ACUTE LYMPHOBLASTIC LEUKEMIA IN CHILDREN FROM QUETZALTENANGO, GUATEMALA

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Abstract

Objective: Development of a case-control study linking pesticides used in Quetzaltenango, Guatemala with the risk of children from that region developing acute lymphoblastic leukemia (ALL).
Method: Retrospective study of cases and controls with a sample of 24 patients 0-14 years of age (years 2,000 to 2,009) in Unidad Nacional de Oncología Pediátrica UNOP, with an equal number of controls. The risk of exposure to pesticides was established using Odds Ratio OR and X_2.
Results: It was established that there is a 9.8 times higher risk of developing ALL in children exposed directly or indirectly to pesticides from agricultural activity ($p = 0.0025$). In addition, there is a 9.3 times higher risk of getting ALL from proximity to crops where pesticides are used ($p = 0.0094$). There is an 11.5 times higher risk of getting ALL when exposed to pesticide sprayed outside or inside the house ($p = 0.020$).
Conclusion: It was determined children exposed to pesticides are between 9 and 11 times more likely to develop ALL.

Key words: pesticide, lymphoblastic Leukemia, Guatemala

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Introduction

Acute lymphocytic leukemia ALL is the leading cancer affecting children between 0 and 14 years in Guatemala.[1] Patients treated between 2000-2009 are mainly from Guatemala City followed by the department of Quetzaltenango, where reported cases exceed expected cases, according to the average incidence of countries like Mexico, and the United States of America with an incidence of 3.2 cases per 100,000 habitants between 0 and 14 years,[2,3]. Taking into account that in Quetzaltenango there is an undercount, because many cases are undetected, the above suggests that there are risk factors that may be increasing cases of ALL in the region.

Most cases of cancer in children are referred from other hospitals, and these are diagnosed in large numbers as acute lymphocytic leukemia, also called acute lymphoblastic leukemia, which affects a higher percentage of children between 0 and 14, and mainly children between 0 and 5. Risk factors for developing acute lymphocytic leukemia are controversial and are still subject of study, some of the most frequently proposed are: exposure to hydrocarbons such as benzene, genetic factors, exposure to electromagnetic fields and exposure to some pesticides.[4, 5, 6]

The present study evaluated the exposure to pesticides in patients 0-14 years of age at UNOP, diagnosed with acute lymphocytic leukemia from the department of Quetzaltenango. The research was conducted using a case-control study, by interviewing mothers of patients in the hospital.

The study of cases and control had a universe of 37 patients who alive from the 67 reported by UNOP between 2000 and 2009. 24 patients were interviewed since they fitted the inclusion criteria, were not in palliative care and were not lost to follow-up. The same number of controls for interview was taken in the same communities of origin of the cases. The controls were selected according to the inclusion criteria randomly going to houses in the local map located in the community center health, post or convergence center in the district or jurisdiction of the Area Health Care of Quetzaltenango. The main objective of the study was to determine whether there was exposure to pesticides by patients diagnosed with ALL and whether this exposure was a risk factor for developing ALL.

It also sought to determine which could have been the pesticides they were exposed to.

It was determined through the interviews that the pesticides used in greater volume in villages and neighborhoods were atrazine and paraquat. This is because corn is grown extensively and these pesticides are used prior to its cultivation. In the case of the National Vector program of the Control Ministry of Public Health and Social Assistance, deltamethrin was used in both domestic and external environment.

Of the above, Atrazine is a herbicide used before sowing corn, which reports limited carcinogenic activity in humans and belongs to Group 2B of the International Agency for Research on Cancer, IARC, 7 and may be a factor risk for ALL in children between 0 and 14 years of age.

On the other hand, we have the pyrethroid deltamethrin used in households, which reported no carcinogenic activity in animals or humans. But the solvent used is diesel; a mixture of hydrocarbons, including benzene, Group 1 of the IARC classification8,21. It is used in spraying pumps inside and outside homes in Quetzaltenango. Most patients come from the counties of Coatepeque, Genova and Quetzaltenango, and their parents also have a history of being exposed to pesticides.

The study established that there is a statistically significant relationship to pesticide exposure, concluding that there is a 9.8 times higher risk of acquiring ALL to those exposed to pesticides from agricultural activity or through a close relative, such as a parent ($p = 0.0025$).

In addition, there is also a 9.3 times greater risk of getting ALL from exposure to pesticides because of living in close proximity to crops where pesticides are used ($p = 0.0094$). There is also an 11.5 times higher risk of getting ALL by those exposed to spraying outside or inside their home ($p = 0.020$)

Methods

The present study was conducted using information about patients diagnosed with ALL in Quetzaltenango, Guatemala between 2000 and 2009 in the National Pediatric Oncology Unit (UNOP). This is a hospital specialized on cancer in children. There was a pool of 67 patients and 37 of them being alive and 24 lost to follow-up in palliative care or excluded from the study because of having recently moved to Quetzaltenango.

Each patient caregiver, parent or relative was provided with a questionnaire on agricultural activity to fill out. They were asked if they had personally prepared or used the

pesticide spray mixture. If possible, they were asked about the brand, main use, type of spray equipment used, and the annual number and duration of application. Questions on crops close to home and spraying close to their homes were asked. The questionnaire also included questions on the use of pesticides on farms, with animals, grain, hay or straw, or to clear paths and patios. The interviewer was trained on pesticides and their use on agricultural well as all pesticides in the country. Bias of multiple interviewers was removed by having only one interviewer.

The communities selected for control were located in the same proportion and location provided by the cases. Controls were randomly selected by numbering houses in the map of the community and interviewing its inhabitants using the same questionnaire.

SOFTWARE:

Odds ratios (ORs) and their 95% CI and X_2. were estimated All analyses were conducted using EpiData version 3.0 .

Results

(Table 1 and Table 2).

Discussion

Guatemala is a Central American country with significant agricultural production, especially in rural areas such as the Department of Quetzaltenango.

Like the rest of the country's western area, economic activity is based on the production of traditional crops such as corn and beans as well as nontraditional crops such as potatoes and lettuce. For this important activity in the country, there is a trend in the increase in imports of pesticides. For example, in less than a decade imports increased from 4.1 thousand tons in 1994 to 11.3 in 2002, representing an increase of 275%. [9]

The small producers have historically supplied the local markets, although some have begun to export nontraditional products. However, most peasants produce for self-consumption, depending greatly on access to land, with an array of fertilizers and insecticides, and with low productivity. [10]

This high dependence on chemicals has led to a series of consequences in environmental pollution as there are more cases of poisoning, complications in various diseases, cancer incidences and deaths from misuse of these substances. The misuse of these chemicals stems from little or no education regarding their risks by the peasants, which leads to unsafe handling.

In the etiology of cancer, particularly acute lymphocytic leukemia-ALL, there is great correlation to environmental risk factors. This association is reported in more than 40 articles, reviews and meta-analysis, which assess the use of pesticides as one of the major risk factors. [11,12,13,14,15,16,16,17,18,19,22]

The present study focused on linking through case-control pesticide use with ALL, but in addition the study sought to identify pesticides that are commonly used by the peasants. Guatemala is cooperating in the Stockholm (2,004), Rotterdam (1998) and Basel (1989) agreements, whose purpose is the adequate use of chemicals in pest control, making sure that they do not pose a risk to human health and to the environment. [20]

Table No. 1 contains pesticides reported by the controls, which include Endosulfan. This is evidence that the regulations for its use by the state are not met; because it is categorized as Class I, extremely toxic by the Environmental Protection Agency (EPA).

Table No. 2 show results of the case-control study reported an OR of 9.8, indicating a significant risk to pesticide use. The controls were selected from the same communities. The use of pesticides in control reported sites was not uniform for the community, and non-farming activities were found in greater proportion.

An OR of 9.31 represents a significant risk of ALL by proximity to crops, pesticide use in houses where periodic spraying takes place less than 15 meters away. In the field it was observed that nearby crops within 15 m of houses were located in different parts of the communities and not in all its extension because there is urban growth.

An OR 11.5 for spraying inside or outside the homes, accounted for the largest risk factor study. 95% of reported cases have been subject to fumigation inside or close to their homes, by the vector control program of the Ministry of Public

Health and Welfare. Field surveys determined that spraying inside and outside the homes has been repeated in those places where there are problems with dengue and malaria vectors, but there is homogeneity in the spraying of communities. This study selected the controls in the same communities as the cases at random. Further field work showed Deltamethrin pesticide use in combination with diesel as a solvent.

The limitations of the study were patients lost to follow-up, lack of data related to pesticide use and exposure, and palliative ill patients who were excluded from the study because of ethical considerations. However, it was possible to interview a significant number of patients within the inclusion criteria.

In conclusion, despite the limitations of the study, the results show a statistically significant risk of developing ALL because of the use of pesticides as well as for proximity to crops with pesticides, especially, the risk of ALL by exposure to pesticides for vector control inside and outside homes.

However, the risk to pesticides used for vector control as Deltamethrin must be studied experimentally because of its combination with diesel as a solvent and the high risk demonstrated in this study.

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Table 1

Classification	Pesticides	Crops
Insecticides	Endosulfan	Corn
Insecticides	Permethrin	Potato
Fungicides	Dithiocarbamate propineb	Corn, bean, potato
Herbicides	Bipyridyl	Corn, potato, lettuce
Herbicides	Linuron	Corn
Herbicides	Atrazine	Corn

The pesticides are used in accord of the experience of the farmer

Table 2

	Used of pesticides	Housing in agricultural area within 15 meters of a crop pesticide use	Spraying in/out home
OR (95% IC)	9,8 (2,39-39,14)	9,31 (1,94-48,72)	11,5 (1,6-101,2)
X2	9.1	6.75	4.9
P=	0.0025	0.0094	0.02

The 58 % of de cases used at least one pesticide, which could not be identified due to the low level of education of the farmers, 92% of cases reported living near a corn field, where the main pesticide used is Atrazine (IARC 2B), 50% cases reported indicate pesticide spraying outside and inside their homes with pesticides used for vector control and diesel as the vehicle.