Research Article
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The use of pesticides and the signs of poisoning in farmers of southern Brazil

Abstract

Since 2008, Brazil has been leading the world ranking of the largest consumer of pesticides in the world. This increasing the risk of poisoning and environmental contamination. This paper's objective is to analyze the use of Personal Protective Equipment (PPE) and the manifestation of signs and symptoms of acute and chronic intoxication in agricultural workers in southern Brazil. This is a field research carried out through semi-structured interviews with 142 family farmers who produce garlic and grapes. The results show that only 17.60% of farmers use all eight recommended PPE. Most participants (90.84%) claim to wear boots, gloves (75.35%) and pants (73.94%). Regarding acute symptoms, 31.69% reported headaches after the pesticide application, 28.16% eye irritation, and 23.94% weakness/fatigue/tiredness. Of the total, 38.02% reported depression, and 35.91% had systemic arterial hypertension. The data set indicates that farmers are exposed to risks due to exposure to pesticides and the inappropriate use of PPE. It is noticed that a high number of workers presented acute symptoms after the use of pesticides. Therefore, it is necessary to raise awareness among farmers about the risks of human and environmental exposure to these products.

Keywords: pesticides; health; intoxications

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Introduction

The use of pesticides has intensified in agriculture in recent decades, resulting in significant impacts on human and environmental health. Pesticides originated in the interim of the world wars, developed by companies producing and formulating chemical weapons. Afterwards, it started to be used progressively for expanding the agricultural market.[1] In Brazil, these inputs were quickly accepted, to the point that, since 2008, it has become the leading country in the world's ranking largest consumer of pesticides,[2] increasing the risk of poisoning and environmental contamination by these products.

In 2017, Bombardi published an extensive mapping of pesticide consumption in Brazil, demonstrating a growing use (many pesticides are banned in the European Community), the main agricultural products responsible for this consumption (soybeans, corn, and sugarcane alone consume 72% of the pesticides sold in the country) and the regional differences in this consumption (concentrated in the Midwest, Southeast, and South regions of Brazil). It also showed that pesticide consumption increased by 100% between 2000 and 2010 in the world, while in Brazil, this increase was 200%. Further, from 2012 to 2014 about 8.33 kg of pesticides were applied per hectare, with glyphosate being the most consumed in all Brazilian regions.[3] This study, together with the Abrasco Dossier,[2] served as a great warning about the seriousness of the use of pesticides in Brazil and the risks to human and environmental health they pose.

Pesticides are used to control or eliminate insects, larvae, weeds, and other pests that can affect crops.[1,4–6] However, its effects are not selective and generally affect flora and fauna.

Regarding humans, after inadequate exposure to pesticides, there may be intoxication. Effects can be classified into: i) acute effects, or those resulting from exposure to concentrations of one or more toxic agents capable of causing harm within 24 hours after exposure; and ii) chronic effects, or those resulting from continued exposure to relatively low doses of one or more products, which may appear weeks, months, years or generations after their use.[1,2]

Pesticides are classified based on their purpose, chemical group, and toxicity. Toxicity is the ability of a chemical to cause adverse effects in living organisms.

In 2019, there was a pesticide toxicological reclassification carried out by the National Health Surveillance Agency (Anvisa), through Resolution No. 2080,[7] according to the standards of the Globally Harmonized System of Classification and Labeling of Chemicals (GHS). As a result, only those that can cause death if in contact by oral, inhalation, and/or dermal routes are classified as extremely toxic.[8] This reclassification entails greater risks to the health of rural producers since they do not follow the indications according to the technical package leaflet, in addition to not using the personal protective equipment (PPE) required for application.[9] The non-use of equipment stems from the thermal discomfort they provide, the high costs they represent to farmers, in addition to the belief shared by many that these substances do not cause harm to health.

The situation is alarming in Brazil, considering the illiteracy in farmers.[10] It is also difficult for health professionals to make an adequate and quick diagnosis of acute poisoning, as well as to establish the causal link between the use of pesticides and chronic diseases such as cancer, depression, and Parkinson's disease, among others.

It is also important to point out that efforts have been made by various segments of society and by pesticide manufacturers to cover up the risks they pose to human and environmental health. However, more and more researchers worldwide have demonstrated the acute effects and chronic diseases resulting from contact with these substances.[2]

Considering the characteristics of pesticide use in Brazil and the fact that the southern region of Brazil is one of the regions that consume the most pesticides in the country, the present study aims to analyze the use of PPE and the manifestation of signs and symptoms of acute and chronic intoxication in agricultural workers from south of Brazil.

Answering this question can contribute to the search for evidence to clarify the relationship between pesticide exposure and the manifestation of signs and symptoms of acute and chronic intoxication. Data of this nature can be useful for public policies' development that protect farmers, and to assist the health system in defining forms of prevention, early diagnosis, and treatment of this fundamental professional category in providing food to the population.

Materials and methods

This is a field research which was carried out through semi-structured interviews with 142 family farmers that produce garlic and grapes in a municipality in Serra Gaúcha/RS/Brazil, which stands out as the largest national producer of garlic. Field research seeks to describe and explore phenomena in natural settings. The purpose of a field researcher is to approach the people studied (in this case, farmers) in order to understand a problem or situation (the use of pesticides) from their natural setting.[11]

The municipality of São Marcos is located in the Brazilian Serra Gaúcha, on the upper slope of the Northeast region of the state of Rio Grande do Sul (Figure 1). São Marcos, with a subtropical climate, is located 166.1km from the capital Porto Alegre. It lies at an altitude of 746 meters, in a total area of 256.25 km², of which 16.44km² are urban areas. The estimated population is 21,449 inhabitants.[12] Its location can be seen in the following figure.

Figure 1 Location of the municipality of São Marcos in RS.

The interviews were carried out by trained researchers through a script applied directly to the farmers who agreed to participate in the study and who signed the Free and Informed Consent Form (TCLE), according to the precepts of Resolution 466/2012 of the National Health Council.

The sampling unit was defined according to the universe of farmers present in the rural area of the São Marcos. Considering that there are 4000 farmers and a significance level of 95%, p=005, the sampling unit of farmers is 351 [13]. This is, therefore, partial data, which is part of the Project "The use of pesticides in family farming and its implications for the health of farmers and environmental health" approved by the Research Ethics Committee under number 17010519.1.0000.5341.

For data processing, the statistical program Statistical Package for Social Sciences (SPSS) (version 21.0) was used, with partial data treated by descriptive statistics.

Results

The results are organized into two subsections. The first contains characterization data of the farmers, and the second, data regarding the use of Personal Protective Equipment and the main acute and chronic effects presented by the farmers that make up the sample.

Characterization of the study's farmers

In Table 1 there is the characterization data of the farmers in terms of gender, age group, schooling, and time working in agriculture.

The results show that most of the sample (54% of the farmers) are female, with schooling up to elementary school (66.9% with up to eight years of education) and working time equal to or greater than forty years (Table 1).

Table 1 Characterization of farmers

Sociodemographic variables		Absolute frequency	Relative frequency
Sex	Feminine	77	54%
	Male	65	46%
Age group	19-24	6	4,22%
	25-29	2	1,40%
	30-34	2	1,40%
	35-39	9	6,35%
	40-44	11	7,75%
	45-49	12	8,45%
	50-54	19	13,40%
	55-59	25	17,60%
	60-64	24	16,90%
	65-69	14	9,85%
	70-74	11	7,75%
	75-79	5	3,53%
	80-84	2	1,40%
Education	Incomplete primary education	12	8,45%
	Complete primary education	95	66,9%
	Incomplete high school	9	6,35%
	Complete high school	23	16,20%
	Cimplete higher education	2	1,40%
	Did not answer	1	0,8%
Working Time in years	0-9	9	6,33%
	10-19	10	7,05%
	20-29	23	16,20%
	30-39	23	16,20%
	40-49	34	23,95%
	50-59	25	17,60%
	60-69	15	10,56%
	70-79	3	2,11%

The use of PPE and the prevalence of acute and chronic damage

Table 2 below presents the number and type of PPE used by farmers and the acute and chronic damage they perceive or present after use.

The data show that only 17.60% of farmers use all eight recommended PPE for this activity. Most participants (90.84%) wear boots, followed by gloves (75.35%) and pants (73.94%). Only 32.39% of farmers use a face shield. Regarding acute symptoms, 31.69% reported headaches after the pesticide application, 28.16% eye irritation, and 23.94% weakness/fatigue/tiredness. Of all rural

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workers, 38.02% reported having depression and 35.91% systemic arterial hypertension, as shown in the table below.

Table 2 The use of PPE and the prevalence of acute and chronic damage

Variables		Absolute frequency	Relative frequency
Number of PPE used	-	3	2,11%
	1	8	5,65%
	2	16	11,26%
	3	17	11,97%
	4	15	10,58%
	5	24	16,90%
	6	16	11,26%
	7	18	12,67%
	8	25	17,60%
Types of PPE used	Boots	129	90,84 %
	Gloves	107	75,35%
	Pants	105	73,94%
	Respirator	92	64,78%
	Coat	91	64,08%
	Arabic cap	68	47,88%
	Apron	59	41,54%
	Face Visor	46	32,39%
	Others	62	43,66%
Acute damage	Headache	45	31,69%
	Eye irritation	40	28,16%
	Weakness/fatigue/ tiredness	34	23,94%
	Cramps/Muscle Spasms	25	17,60%
	visual changes	24	16,90%
	vertigo/dizziness	22	15,49%
	Itch	22	15,49%
	hypersecretion	15	10,56%
	Abdominal cramps/pain	13	9,15%
	Tachycardia	10	7,04%
	nausea	10	7,04%
	Mouth and nose sores	8	5,63%
	vomiting	8	5,63%
	Diarrhea	7	4,92%
	breathing difficulty	7	4,92%
	Change in body temperature	3	2,11%
	Others	7	4,92%
Chronic damage	Depression	54	38,02%
	High pressure	51	35,91%
	Liver problems	16	11,26%
	Cancer	15	10,56%
	Decreased sensitivity	14	9,85%
	Asthma/ bronchitis/ emphysema	13	9,15%
	Diabetes	11	7,74%
	Chronic anemia	7	4,92%
	Seizures	6	4,22%
	Renal insufficiency	6	4,22%
	Birth defects	3	2,11%
	Parkinson	1	0,70%
	Alzheimer	-	
	Others	21	14,78%

Discussion

This study was carried out with family farmers, which may explain the fact that the female and male genders are in very close numbers, with 54% women and 46% men. Studies carried out with workers in non-family agriculture indicate a greater predominance of men.[14,15] Low schooling can be considered a risk factor, considering that pesticide package inserts contain technical language and that few farmers receive adequate guidance when purchasing inputs.[10,16] The lack of adequate environmental education for farmers and unequal access to education has been evidenced by other authors in Brazil[10] and abroad.[17]

Brazilian legislation requires the use of eight personal protective pieces of equipment during the handling of pesticides, which includes the preparation of the syrup, the application, and the harvesting of agricultural products. In the study, only 17.6% of workers claim to use all the equipment, which may increase the risk of acute or chronic poisoning.[18–20] Most farmers claim to wear boots, an Arab cap, and an apron. However, the equipment observed in loco corresponds to improvised clothing, such as caps and aprons, without adequate waterproofing. This is risky behavior, justifiable by the historically produced culture that pesticides are not harmful to health, the inadequacy of equipment in relation to the climate, and the costs of acquiring them. Thus, public policies that provide equipment and facilitate access to education programs are essential for changing behavior.

Among the symptoms most cited by farmers are headache, eye irritation, weakness and fatigue, dizziness, and visual changes, in addition to vomiting and diarrhea, which are sufficiently recognized as related to pesticide exposure.[2,21,22]

These acute symptoms are related to changes in the acetylcholinesterase enzyme caused by organophosphates and carbamates, resulting in cholinergic effects in the body. To confirm intoxication by substances, such as carbamates and organophosphates, we performed the acetylcholinesterase test, which determined the plasma levels in red blood cells of enzymes responsible for the hydrolysis of acetylcholine, namely acetylcholinesterase (AChE) and butyrylcholinesterase (BChE).[23] In Brazil, organophosphates are the ones that most cause poisoning.[24,25] Even if these signs and symptoms are not exclusively produced by pesticides, World Health Organization recommends to consider a probable intoxication if three or more of these symptoms appear after pesticide exposure, and, therefore, be properly diagnosed in health services.[26] According to the National Report on Health Surveillance of Populations Exposed to Pesticides,[27] notification of exogenous intoxication by pesticides is mandatory and must be realized at the moment of suspicion or confirmation. Despite the legislation being clear, the Ministry of Health recognizes that for every reported case of intoxication, another fifty go unnoticed, which gives the problem the status of a, public health problem. The proper diagnosis and treatment of acute poisoning in farmers is still a problem for the health services in Brazil, which points to the need for changes in the training processes and permanent education of these professionals.If the diagnosis and treatment of acute poisoning cases in farmers are considered an obstacle to health services, it increases when dealing with chronic damage. Although studies have shown the relationship between chronic exposure to pesticides and depression, cancer, Parkinson's disease, Alzheimer's, reproductive and endocrine problems, pulmonary fibrosis, hepatotoxicity, and dermatitis, among others,[2–5,28–30] few services adequately investigate the relationship between these diseases and exposure to pesticides.

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Thus, new studies must be carried out in different regions and countries, so that the data set can increase the number of evidence that is capable of proving these relationships.

Conclusion

The data set indicates that farmers are exposed to risks due to the inappropriate use of PPE. It is noticed that a high number of workers presented acute symptoms after the use of pesticides. Therefore, it is necessary to raise awareness among farmers about the risks of human and environmental exposure to these products. Health professional are able to identify, analyze and implement measures that minimize risks to this population, based on their professional practice. This can favor the improvement of the quality of life of farmers.

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Informed consent statement: Consent was obtained from all subjects involved in the study.

Conflicts of interest

The authors declare no conflict of interest.

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