This article was published in the Brazilian Center for Health Studies' (Centro Brasileiro de Estudos de Saúde) scientific journal, Saúde em Debate, in June 2022. It is from volume 46, special issue number 2, on health, pesticides, and agroecology.

The English translation aims to inform international audiences about the contamination and health conditions of residents of three municipalities in the Juruena River Basin in the state of Mato Grosso, Brazil. The locale is one of the world's largest planters of agricultural commodities and pesticide users in volume.

Pesticide exposure, self-reported health conditions, and public health surveillance of municipalities in Mato Grosso, Brazil

Wanderlei Antonio Pignati,[1] Mariana Rosa Soares,[1] Stephanie Sommerfeld de Lara,[2] Franco Antonio Neri de Souza e Lima,[3] Nara Regina Fava,[1] Jackson Rogério Barbosa,[1] Mareia Leopoldina Montanari Corrêa[1]

DOI: 10.1590/0103-11042022E203

ABSTRACT
This study analyzed the sociodemographic profile and health conditions of the population living in Mato Grosso municipalities between 2016 and 2017. It is a quali-quantitative study on the population and self-reported health conditions. Adult residents were interviewed with a 172-question structured questionnaire over family and individual information. A total of 1,379 valid questionnaires were answered, covering 4,778 individuals. Most reported living in urban areas less than one km from plantations (98%), having low schooling (43%), an average income below three minimum wages (68%), and using agrochemicals for domestic use (71.8%). The most commonly cited morbidities were: respiratory problems, acute poisoning, psychological disorders, kidney diseases, and cancers. Underreporting of pesticide poisoning was identified in one in 77 cases in Campo Novo do Parecis and one in 20 cases in Campos de Júlio; 100% of the cases were underreported in Sapezal. Associations were found between sociodemographic variables and pesticide exposure and reported morbidities, considering the p-value=0.05 and a significance level of 95%. The increasing use of pesticides associated with political and economic scenarios that favored agribusiness interests demonstrated the need to develop public health surveillance strategies, underscoring the negative impacts of this production model on human and environmental health.

KEY WORDS Health status. Agrochemicals. Public Health Surveillance. Agro-industry

Introduction

Brazil allocates around 76% of its planted area to soybean, corn, sugarcane, and cotton for export.[1,2] Between 2010 and 2016, there was an annual percentage change of 4% in the planted area in the country and 5% in the consumption of pesticides. About 16.4% of the pesticides are highly and extremely hazardous to the environment.[3,4] Tax-exemption incentives for exporting primary goods, using transgenic grains, weakening environmental laws, and precarious control and inspection bodies exemplify how politics and the economy have helped Brazil use approximately one-fifth of all pesticides produced worldwide.[2]

Mato Grosso is the leading producer of soy, corn, cotton, sunflower, and cattle among all Brazilian states.[5,6] Those four commodities corresponded to 97% of the state's agricultural area in the 2017/2018 crop. Consequently, more than 222 million liters of pesticides were estimated to have been used on those plantations, the largest consumption in the country.[1] Campo Novo do Parecis, Campos de Júlio, and Sapezal[7] – municipalities among Brazil's highest pesticide use – use about 98% of their territory to produce commodities, averaging 15 to 20 liters of pesticides per hectare.[8] Each of these three municipalities used more pesticides than Ceará, Rondônia, Pará, and 12 other Brazilian states.[1]

Environmental damage and adverse effects on human health resulting from pesticide exposure are widely recognized in the scientific literature.[9,10] Therefore, investigating and discussing the impacts of pesticides on the environment and the health of workers and the populations of agricultural municipalities is fundamental, constituting one of the mechanisms for Public Health Surveillance (PHS).

The PHS is based on Law No. 8080/1990 and Law No. 8142/1990, which provide for community participation in managing the Brazilian Unified Health System (*Sistema Único de Saúde* – SUS), allowing the public more effective participation in health practices, from the planning, management, control, and evaluation of the popular and social opinion of health practices in the territory to aid in a socio-historical transformation to meet the needs of the public that must be answered in an intersectoral manner with government management.

Brazil has one of the world's best Health Information Systems (HIS), capable of recording injuries and diseases in the national territory. However, when it comes to injuries triggered by pesticide exposure, the magnitude of their impact on health is not apparent, as acute poisonings are underreported, and the causal nexus of chronic poisoning is difficult to establish. Those records are essential to subsidize potential intersectoral policies.[9]

When faced with this challenge, epidemiological studies of morbidity surveys are a viable alternative, used when existing information is insufficient due to underreporting, registration errors, and (above all) exogenous pesticide poisoning. The survey allowed for population-based information on public health conditions and risk and exposure factors. It is a confidential instrument the affected person used to report their morbidity within a specific period, not requiring clinical evaluation.[11-15]

This study is justified by the novelty of completing a morbidity survey on pesticide exposure in the populations of a few municipalities in Mato Grosso. It emerged from the hypothesis that the data collected by the

health systems and other sources have limitations for expressing the health status of these territories.

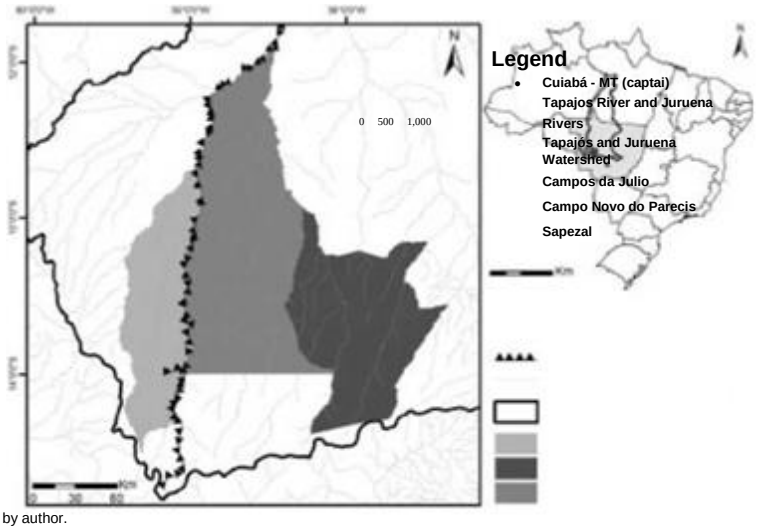
The objective was to analyze the resident population's socioeconomic and demographic profiles, health conditions, and pesticide exposure and compare them to official municipal data on Campo Novo do Parecis, Campos de Júlio, and Sapezal from 2016 to 2017 to help improve PHS actions.

Material and methods

This is a quali-quantitative, cross-sectional, population-based study of the municipalities of Campos de Júlio, Campo Novo do Parecis, and Sapezal between 2016 and 2017, which are part of the research 'Evaluation of occupational, environmental, and food contamination by pesticides in the Juruena Basin – Mato Grosso' from the Center for Environmental Studies and Occupational Health (NEAST), done at the Institute of Collective Health of the Federal University of Mato Grosso (ISC/UFMT) in partnership with the Mato Grosso State Public Ministry of Labor (MPT-MT)[1].

The study site comprises the municipalities of the Mato Grosso Cerrado in the western region of the state, comprising the watershed of the Juruena, Tapajós, and Amazonas Rivers. *(Figure 1).* The 2010 Census recorded populations of 5,154 in Campos de Júlio, 27,577 in Campo Novo do Parecis, and 18,094 in Sapezal, totaling 50,825 inhabitants.[16]

Figure 1. Location of the studied municipalities in the Juruena River basin: (a) Campos de Júlio, (b) Sapezal, and (c) Campo Novo do Parecis, Mato Grosso, Brazil



Source: Elaborated by author.

[1] Translator's note: Original research name in Portuguese–(*Avaliação da contaminação ocupacional, ambiental e em alimentos por agrotóxicos na Bacia do Juruena* - MT)

NEAST–Núcleo de Estudos em Ambientais e Saúde do Trabalho

ISC/UFMT–Instituto de Saúde Coletiva da Universidade Federal de Mato Grosso

MPT-MT–Ministério Público do Trabalho de Mato Grosso

A population formula was developed as a participatory research instrument to reveal the magnitude of pesticide exposure morbidities.

The team of interviewers initially consisted of community health agents (*agente comunitário de saúde* or ACS, in Portuguese), endemic agents (*agentes de endemias* or AE, in Portuguese) from the sampled municipalities. However, not all municipalities were keen on their health agents collecting data as interviewers. Thus, the interviews were conducted by students from the collective health, medicine, and graduate degree courses in collective health at UFMT. The interviewers participated in training workshops on the topic before using the questionnaire.

It contained 172 questions in two analysis modules: per family (yes/no), per individual in the families (yes/no), and how many times it occurred in specific cases. The variables were: demographic (gender, age, and household zoning), socioeconomic (education, family income, occupation, source of water supply), aspects related to pesticides (distance from the house to the farm and to the place of storage or distribution, use in the home and garden, direct contact at work), and health conditions (13 reported morbidities: hypertension, diabetes, cancer, malformations, kidney disease, miscarriage, respiratory diseases, neurological diseases, psychological disorders, suicide, suicide attempt, acute poisoning, and low weight).

Before establishing the final version, a pre-test was run in an urban and rural area of two Family Health Units in a nearby municipality, Diamantino (MT), which has similarities in the agricultural production profile.

A probabilistic random sampling was designed so the data would represent the relevant characteristics of each municipality, using a 95% confidence interval, a sampling error of 5%, and a prevalence of 50%, per the number of households from the 2010-2016 Census. Stratified sampling was carried out for each municipality by census sector and gender ratio. The questionnaire was used at every third house on each sampled street.

All adult residents, guardians, or heads of households in each randomly selected household were interviewed, and they answered the form for all family members. The inclusion criterion for the study was the consent of all adults to participate in the research. Anyone who lost the form or refused was excluded.

The blind questionnaire was prepared, the data obtained were double-entered, and the variables were validated in the Epi Info™ 7 software (Centers for Disease Control and Prevention, Atlanta, United States). Descriptive analyses, tables, and graphs were generated using Microsoft® Excel® 2010 software. The Chi-square association analysis was performed using the Stata® 14 statistician software.

The Research Ethics Committee of the Hospital Universitário Júlio Müller approved the study under Opinion No. 2092601 of February 11, 2015, and the recommendations of Resolution No. 466/2012 were respected.

Results

A total of 1,378 questionnaires were answered, corresponding to the families interviewed: 630 in Campos de Júlio, 415 in Campo Novo do Parecis, and 333 in Sapezal, covering 4,751 individuals (1,998 from Campos de Júlio, 1,552 from Campo Novo do Parecis, and 1,201 from Sapezal). The results were presented according to the group of variables.

Sociodemographic information

Demographic information showed that more than 91% of the families interviewed lived in the urban area of these municipalities. Of these, 1,212 families' (87.9%) water was supplied from the municipal public network, 160 families

(11.6%) used artesian wells, non-artesian wells, and others. That information can be seen in *Table 1*.

Table 1. Socioeconomic and demographic information per family and individuals residing in the municipalities of Campos de Júlio, Campo Novo do Parecis, and Sapezal (2016 and 2017)

	Campos de Júlio		Campo Novo do Parecis		Sapezal		Total
	Families n = 631	Individuals n = 1,998	Families n = 415	Individuals n = 1,552	Families n = 333	Individuals n = 1,201	
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	
Gender							
Female		966 (48.3%)		754 (48.6%)		582 (48.5%)	2,302 (48.0%)
Male		940 (47.0%)		746 (48.1%)		618 (51.5%)	2,304 (48.5%)
Left blank		92 (4.6%)		52 (3.4%)		1 (0.1%)	145 (3.1%)
Age group							
<9 years		320 (16.0%)		232 (14.9%)		205 (17.1%)	757 (15.9%)
10 to 19 years		279 (14.0%)		235 (15.1%)		179 (14.9%)	693 (14.6%)
20 to 49 years		828 (41.4%)		576 (37.1%)		543 (45.2%)	1,947 (41.0%)
50 to 69 years		278 (13.9%)		179 (11.5%)		134 (11.2%)	591 (12.4%)
>70 years		46 (2.3%)		45 (2.9%)		17 (1.4%)	108 (2.3%)
Left blank		247 (12.4%)		285 (18.4%)		123 (10.2%)	655 (13.8%)
Education							
Illiterate		37 (1.9%)		46 (3.0%)		41 (3.4%)	124 (2.6%)
Didn't finish elementary school		807 (40.4%)		691 (44.5%)		562 (46.8%)	2,060 (43.4%)
Finished middle school		124 (6.2%)		120 (7.7%)		80 (6.7%)	324 (6.8%)
Didn't finish high school		261 (13.1%)		162 (10.4%)		140 (11.7%)	563 (11.9%)
Graduated high school		347 (17.4%)		250 (16.1%)		217 (18.1%)	814 (17.1%)
Didn't finish/still in college		73 (3.7%)		76 (4.9%)		46 (3.8%)	195 (4.1%)
Graduated college		168 (8.4%)		90 (5.8%)		59 (4.9%)	317 (6.7%)
Left blank		181 (9.1%)		117 (7.5%)		56 (4.7%)	354 (7.5%)
Family income (BRL)							
<1 thousand	174 (27.6%)		57 (13.7%)		41 (12.3%)		272 (19.7%)
1 to 3 thousand	236 (37.4%)		245 (59.0%)		185 (55.6%)		666 (48.3%)
3 to 5 thousand	67 (10.6%)		79 (19.0%)		76 (22.8%)		222 (16.1%)
5 to 15 thousand	31 (4.9%)		21 (5.1%)		23 (6.9%)		75 (5.4%)
>15 thousand	4 (0.6%)		4 (1.0%)		0		8 (0.6%)
Left blank	119 (18.9%)		9 (2.2%)		8 (2.4%)		136 (9.9%)
Residential zone							
Urban	600 (95.1%)		378 (91.1%)		298 (89.5%)		1,276 (92.5%)
Rural	31 (4.9%)		32 (7.7%)		35 (10.5%)		98 (7.1%)
Left blank	-		5 (1.2%)		-		5 (0.4%)
Water supply							
Public network	582 (92.2%)		352 (84.4%)		278 (83.5%)		1,212 (87.9%)
Wells and streams	47 (7.4%)		60 (14.5%)		53 (15.9%)		160 (11.6%)
Left blank	2 (0.3%)		3 (0.7%)		2 (0.6%)		7 (0.5%)

Source: Elaborated by author.

The individuals showed an equal gender information distribution pattern with 48.2% for both genders. The socioeconomic variables showed that the 20-to-49 age group was the largest, above 41% of the individuals among the municipalities, indicating an economically active population. The under-nine population was the second largest with 16%.

The individual education levels indicated that 44% did not finish elementary school, 17% completed high school, and 2.7% were illiterate. Half of the families (50.6%) lived with a monthly income from BRL 1,000 to BRL 3,000. Most respondents reported an average household income of up to three times the minimum wage.

For occupations *(Table 2),* on average, 37.1% of the interviewees fell into an excluded class; 13.1% were classified as equipment operators, machine operators, and assemblers. Machine operators predominated with 57% of individuals; drivers were at 23.3%, and 16% of them were truck drivers. Operators, mechanics, and other artisans covered 9.3% of the individuals, and the mechanics' occupation was highlighted in this class with 31% of individuals. Farmers and agricultural workers made up 5.8% of the individuals, with the occupation of farmer and farmhand predominating in 56.8% of the individuals in this class, and 14.3% reported being pesticide dispensers and applicators (agricultural applicator).

Table 2. Occupation classifications of respondents over 18 years old in Campos de Júlio, Campo Novo do Parecis, and Sapezal - (MT, 2016 to 2017)

Brazil's National Code of Economic Activity (*Código Nacional de Atividade Econômica* – CNAE) Occupation	**Campos de Júlio** **Individuals n = 1,124 n (%)**	**Campo Novo do Parecis** **Individuals n = 815 n (%)**	**Sapezal** **Individuals n = 699 n (%)**	**Three-City Average (%)**
Excluded Classification	415 (36.9%)	288 (35.3%)	273 (39.1%)	37.1%
Unemployed	41 (3.6%)	48 (5.9%)	41 (5.9%)	5.1%
Equipment operators, machine operators, and assemblers	142 (12.6%)	112 (13.7%)	91 (13.0%)	13.1%
Truck driver	14 (9.9%)	19 (17.0%)	19 (20.9%)	16%
Driver	44 (31.0%)	24 (21.4%)	16 (17.6%)	23.3%
Agricultural machinery operator	78 (54.9%)	62 (55.4%)	55 (60.4%)	56.9%
Others	6 (4.2%)	7 (6.3%)	1 (1.1%)	3.8%
Service providers and Shop Salespersons and Demonstrators	136 (12.1%)	126 (15.5%)	56 (8.0%)	11.8%
Operators, mechanics, and other craftsmen	92 (8.2%)	70 (8.6%)	78 (11.2%)	9.3%
Mechanic	27 (29.3%)	22 (31.4%)	25 (32.1%)	31%
Others	65 (70.7%)	48 (68.8%)	53 (67.9%)	69%
Retired	66 (5.9%)	52 (6.4%)	31 (4.4%)	5.5%
Farmers and agricultural workers	75 (6.7%)	40 (4.9%)	41 (5.9%)	5.8%
Farmer and farmhand	48 (64.0%)	28 (70.0%)	15 (36.6%)	56.8%
Pesticides dispenser and applicator	10 (13.3%)	5 (12.5%)	7 (17.1%)	14.3%
Others	17 (22.7%)	7 (17.5%)	19 (46.3%)	28.8%
Mid-level technicians and professionals	41 (3.6%)	16 (2.0%)	16 (2.3%)	2.6%
Scientific and intellectual professionals	56 (5.0%)	25 (3.1%)	24 (3.4%)	3.8%
Others (Office workers, armed forces, executive and legislative branches, and other answers)	60 (5.3%)	38 (4.7%)	48 (6.9%)	5.6%

Source: Elaborated by author.

Information on lifestyle habits and pesticide exposure

Pesticide exposure *(Table 3)*, indirectly evaluated by the variable length of residence in the city, showed that, on average, 27% of individuals had resided there from one to five years; 26% from 11 to 20 years; and 19% from six to ten years.

In Campos de Júlio, 27% of the families lived less than 300 meters away from the plantation; 26%, more than one kilometer; 24%, between 300 meters to one kilometer. In Campo Novo do Parecis, 31% of the families lived more than one kilometer from the plantation, 25% lived less than 90 meters, and 25% between 300 meters to one kilometer. In Sapezal, half of the families (50%) lived more than one kilometer from the plantation.

For distance from the house to pesticide dealers, 40% of the households in Campos de Júlio, 63% in Campo Novo do Parecis, and 72% in Sapezal were located more than one kilometer away.

Table 3. Variables of pesticide exposure and lifestyle habits reported by family and individuals from the municipalities of Campos de Júlio, Campo Novo do Parecis, and Sapezal (MT, 2016 to 2017)

	Campos de Júlio		Campo Novo do Parecis		Sapezal		
	Families	**Individuals**	**Families**	**Individuals**	**Families**	**Individuals**	
	n = 631	**n = 1,998**	**n = 415**	**n = 1,552**	**n = 333**	**n = 1,201**	
	n (%)	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**Total**
Time residing in the city							
< 1 year		165 (8.3%)		120 (7.7%)		148 (12.3%)	433 (9.1%)
1 to 5 years		567 (28.4%)		403 (26.0%)		310 (25.8%)	1,280 (26.9%)
6 to 10 years		333 (16.7%)		268 (17.3%)		270 (22.5%)	871 (18.3%)
11 to 20 years		449 (22.5%)		427 (27.5%)		327 (27.2%)	1,203 (25.3%)
21 to 50 years		179 (9.0%)		175 (11.3%)		84 (7.0%)	438 (9.2%)
Left blank		305 (15.3%)		159 (10.2%)		62 (5.2%)	526 (11.1%)
Distance between home and plantation							
<90 m	170 (26.9%)		107 (25.8%)		32 (9.6%)		309 (22.4%)
90 to 300 m	124 (19.7%)		68 (16.4%)		46 (13.8%)		238 (17.3%)
300 m 1 km	151 (23.9%)		104 (25.1%)		88 (26.4%)		343 (24.9%)
>1 km	163 (25.8%)		128 (30.8%)		163 (48.9%)		454 (32.9%)
Left blank	23 (3.6%)		8 (1.9%)		4 (1.2%)		35 (2.5%)
Distance between home and pesticide dealers							
<90 m	94 (14.9%)		32 (7.7%)		12 (3.6%)		138 (10.0%)
90 to 300 m	73 (11.6%)		23 (5.5%)		33 (9.9%)		129 (9.4%)
300 m 1 km	162 (25.7%)		79 (19.0%)		39 (11.7%)		280 (20.3%)
>1 km	253 (40.1%)		263 (63.4%)		239 (71.8%)		755 (54.7%)
Left blank	49 (7.8%)		18 (4.3%)		10 (3.0%)		77 (5.6%)
Distance between the house and collection warehouses for empty pesticide containers							
<90 m	59 (9.4%)		16 (3.9%)		4 (1.2%)		79 (5.7%)
90 to 300 m	27 (4.3%)		7 (1.7%)		14 (4.2%)		48 (3.5%)
300 m 1 km	68 (10.8%)		19 (4.6%)		15 (4.5%)		102 (7.4%)
>1 km	436 (69.1%)		345 (83.1%)		288 (86.5%)		1,069 (77.5%)
Left blank	41 (6.5%)		28 (6.7%)		12 (3.6%)		81 (5.9%)

Table 3. (cont'd)

	Campos de Júlio		Campo Novo do Parecis		Sapezal		
	Families n = 631 n (%)	**Individuals n = 1,998 n (%)**	**Families n = 415 n (%)**	**Individuals n = 1,552 n (%)**	**Families n = 333 n (%)**	**Individuals n = 1,201 n (%)**	**Total**
Use pesticides at home							
Yes	473 (75.0%)		288 (69.4%)		229 (68.8%)		990 (71.8%)
No	156 (24.7%)		127 (30.6%)		102 (30.6%)		385 (27.9%)
Left blank	2 (0.3%)				2 (0.6%)		4 (0.3%)
Has contact with pesticides							
Yes		393 (19.7%)		385 (24.8%)		315 (26.2%)	1,093 (23.0%)
No		1,514 (75.8%)		1,134 (73.1%)		865 (72.0%)	3,513 (73.9%)
Left blank		91 (4.6%)		33 (2.1%)		21 (1.7%)	145 (3.1%)
Which activity puts you in contact with pesticides?							
At home, in the garden and/or backyard	158 (7.9%)		169 (10.9%)		147 (12.2%)	474 (10.0%)	
Job		191 (9.6%)		162 (10.4%)		145 (12.1%)	498 (10.5%)
Left blank		135 (6.8%)		54 (3.5%)		23 (1.9%)	212 (4.5%)
No direct contact	1,514 (75.8%)		1,134 (73.1%)		865 (72.0%)	3,513 (73.9%)	

Source: Elaborated by author.

Seventy-one point eight percent (71.8%) of the families said they used pesticides at home, the interviewees' main form of direct contact, followed by the 'contact at work' category. Insect and weed control in vegetable gardens and gardening were among the most cited uses. The most used products were: 'Barragem' (Pyrethrin); 'Mata Mato' '(Substituted Glycine); 'Baygon' (Organophosphate), 'K-Otrine' (Pyrethroid).

Health conditions mentioned

Of the 4,751 individuals interviewed, 60.4% reported morbidities, with 524 (11%) cases of respiratory disease (bronchitis, asthma, allergic rhinitis, sinusitis, and difficulty breathing); 504 (10.6%) reported hypertension; 421 (8.9%) acute pesticide poisoning (inhalation and ocular routes the most cited, predominantly occurring in the workplace).

Among the 335 (7.1%) psychological disorders, the most cited were anxiety, depression, bipolarity, hyperactivity, schizophrenia, and autism; 289 (6.1%) cases of kidney problems (kidney stone, kidney cyst, pyelonephritis, kidney failure); 63 (1.3%) cases of neoplasms (breast, thyroid, skin, mouth, pharynx, prostate, bone, uterus, brain, leukemia, and lymphomas), and 30 (0.6%) cases of malformations (gastroschisis, tongue-tie, malformation of the foot bone, anotia, and heart murmur). There were also 38 (0.8%) cases of attempted suicide and 15 (0.2%) cases of suicide.

The exogenous pesticide poisoning rate was calculated by comparing the data from this study and exogenous pesticide poisoning data from Brazil's Notifiable Diseases Information System (*Sistema de Informação de Agravos de Notificação* – SINAN). A rate of 886 cases per 10,000 inhabitants was observed for self-reported information and sample population. The rate was 34 cases per 10,000 inhabitants when calculating the same information with official SINAN data. By calculating the ratio, we can infer that the underreported pesticide-poisoning rate in the cities studied was one reported case for every 26 underreported cases.

When broken down by municipality, it was observed that Campos de Júlio had a ratio of one reported case to 20 underreported, Campo Novo do Parecis had one to every 77 underreported cases, and 100% of the cases in Sapezal were underreported. There were zero registered cases of exogenous pesticide poisoning for three in Sapezal; the interviewees reported 115 cases.

Association of sociodemographic variables and self-reported morbidities

When compared with distance, living between 90 and 300 meters from the plantation was associated with a prevalence of 32.8% (p=0.001) of respiratory problems, 33.4% (p=0.001) of acute poisonings, 23.9% (p=0.001) of psychological problems, 9.6% (p=0.001) of cancer prevalence, 3.8% (p=0.040) of neurological problems, 3.6% (p=0.001) of prevalence of fetal malformation, and 1.3% (p=0.006) for suicide *(Table* 4).

Most of the interviewees mentioned living in urban areas. However, 98% of respondents reported living less than 500 meters from the plantations, of which 22.4% lived between 10 and 90 meters, and 17.3% lived between 90 and 300 meters.

Table 4. Prevalence ratio by the chi-square test of sociodemographic variables and reported morbidity, Campo Novo do Parecis, Campos de Júlio, Sapezal (MT, 2016 to 2017)

	Self-Reported Morbidity																			
	Respiratory		Acute Poisoning		Psychological		Kidney		Miscarriage		Low weight		Cancer		Suicide		Malformation		Neurological	
	%	p-value	%	p-value	%	p-value	%	p-value	%	p-value	%	p-value	%	p-value	%	p-value	%	p-value	%	p-value
Distance from the plantation																				
<10 to 90 m	27.1	0.001	23.7	0.001	17.5	0.001	15	0.001	5.4	0.556	9.8	0.001	6.1	0.001	0.9	0.006	1.3	0.001	1.4	0.040
90 to 300 m	32.8		33.4		23.9		22.2		4.8		10.4		9.6		1.2		3.6		3.8	
300 m to >1 km	28.2		19.9		21.7		22.3		5.1		13.2		7.1		1.3		3.2		2.2	
Zone																				
Urban	28.7	0.554	22.3	0.001	20.8	0.001	20.8	0.014	5.2	0.751	12.6	0.005	7.5	0.017	1.2	0.129	2.8	0.192	2.2	0.131
Rural	27.2		32.2		20.9		15		4.7		7.3		3.5		0		4.1		0.9	
Family income (BRL)																				
≤3 thousand	70.6	0.002	22.1	0.002	18.9	0.001	18.6	0.001	5.4	0.380	11.5	0.001	6.9	0.283	1.4	0.250	2.8	0.102	2.6	0.001
3 to 5 thousand	20.8		25.1		27.2		21.4		4.1		12.4		7.1		1.2		3.7		0.7	
5 to >15 thousand	8		28.7		32.5		35.7		4.9		21		9.3		0		1.8		5.1	
>15 thousand	0.6		0		9		18.1		0		0		0		0		9		0	
Use pesticides at home.																				
Yes	29.6	0.061	24.5	0.001	23.4	0.001	23.5	0.000	5.6	0.008	11.9	0.604	7.6	0.212	1.5	0.002	2.9	0.416	2.8	0.001
No	26.8		18.9		14.7		12.7		4		12.7		6.2		0.3		2.3		0.8	
Residential water																				
Public network	88.4	0.032	22.6	0.01	20.8	0.069	20.2	0.069	5.2	0.616	12.5	0.074	7.7	0.001	1.3	0.125	3.2	0.025	2.2	0.85
Artesian well	11.1		27.5		22.4		21.6		4.1		9		1.5		0		0.7		2.7	
Non-artesian well	0		15.8		21		21.5		5.2		15.8		21		0		0		0	
Streams	0.1		0		0		0		14.2		0		0		0		0		0	

Table 4. (cont'd)

	Self-Reported Morbidity																			
	Respiratory		Acute Poisoning		Psychological		Kidney		Miscarriage		Low weight		Cancer		Suicide		Malformation		Neurological	
	%	p-value	%	p-value	%	p-value	%	p-value	%	p-value	%	p-value	%	p-value	%	p-value	%	p-value	%	p-value
Residing time (years)																				
0 to 5	28.5	0.198	23.4	0.079	23.4	0.286	22.5	0.179	4.3	0.292	15.4	0.004	7.8	0.000	0.2	0.000	3.1	0.001	1.1	0.001
6 to 10	30.6		24.1		22.7		21		5		13.6		11.3		0		4.7		2.7	
11 to 30	30.8		22.9		20.6		19.5		5.8		11.1		5.3		2.2		1.9		1.7	
>30	26.1		28.8		21.9		18.4		4.5		10.6		8.2		0		5.7		4.6	

Source: Elaborated by author.

As for the place of residence, associations were found between living in rural areas and acute poisoning with a prevalence ratio of 32.2% (p=0.001) and psychological disorders with a ratio of 20.8% (p=0.001). For residents in urban areas, associations were found for kidney problems, 20.8% (p=0.014); low birth weight, 12.6% (p=0.005); and cancer, 7.5% (p=0.017).

As for family income, an association was found among those who reported a family income of less than BRL 3,000, with a prevalence of 70.6% (p=0.002) for families who reported respiratory problems. Families that reported income above BRL 5 thousand showed an association of cases of acute poisoning with a prevalence of 28.7% (p=0.002); psychological disorders, 32.5% (p=0.001); kidney problems, 35.7% (p=0.001); and neurological problems, 5.1% (p=0.001).

Regarding the household use of pesticides, associations were found with a prevalence ratio for acute poisoning, 24.5% (p=0.001); kidney problems, 23.5% (p=0.001); psychological problems, 23.4% (p=0.001); miscarriages, 5.6% (p=0.008); neurological problems, 2.8% (p=0.001); and suicide, 1.5% (p=0.002).

Regarding the sources of supply for residential water use, an association was found between public water supply and a prevalence of 88.4% (p=0.032) of respiratory problems, and for cases of malformation, 3.2% (p=0.025). With artesian wells, the association was found for families who reported having acute poisoning with a prevalence of 27.5% (p=0.001), and for those who reported a water supply coming from a non-artesian well, an association was found for cancer with a prevalence of 21% (p=0.001).

A residing time from zero to five years was associated with 15.4% (p=0.004) of low birth weight; six to 10 years was associated with a prevalence of 11.3% (p=0.001) for cancer cases, and from 11 to 30 years, a significant association was found for families who reported suicide with a prevalence ratio of 2.2% (p=0.001). For a residing time more than 30 years, an association was found with a prevalence ratio of 4.6% (p=0.001) for neurological problems and 5.7% (p=0.001) for malformation.

Discussion

The common characteristics of these municipalities are that transgenic monocultures smother their urban area, and they have frequent use of pesticides and chemical fertilizers[1,17] and little or no vegetation to contain the drifts resulting from applying these compounds,[8] which are sprayed less than 500 meters from the dwellings.

Beserra[18] identified that pesticide residues in the same municipalities of the present study were found in 61% of samples from artesian

wells and in 75% of rainwater samples from rural and urban schools in the three municipalities. The agricultural pesticides found in the rain were metolachlor, atrazine, trifluralin, malathion, and metribuzin, and metolachlor and atrazine were found in the artesian wells of schools.[19] Regarding the gender ratio of those interviewed, according to the 2017 Agricultural Census, about 18% of rural producers are women. Maria Claudia Peres Moura Luna[20] mentions that, although the number of women working is smaller, it is evident that mortality among women was higher than that estimated among men in every category of potential associated factors when evaluating the difference between gender and the proportional mortality due to acute occupational pesticide poisoning in Brazilian agriculture. Still, domestic activities such as washing the clothes of family members who work directly with pesticides are also another route of exposure.[21]

The predominance in the economically active age groups is explained by the investment in crop commodities in the state of Mato Grosso, where there is a higher proportion of men between 20 and 30 looking for work.[22] The low level of education found in the study may indicate greater vulnerability to risks in terms of technical information, reading pesticide labels, using Personal Protective Equipment (PPE), and recognizing illness risks.[23] Schooling acts as a protective factor in this sense since individuals with a high school education are 57% less likely to be poisoned by pesticides.[24]

Although these municipalities have high per-capita Gross Domestic Product (GDP) values, household income does not follow these data, thanks to a high informality rate and low education.[25] Similar results were found in studies in the Northeast with workers in irrigated fruit-farming,[26,27] and in tobacco-producing municipalities in the South.[28,29]

Life habits and exposure to pesticides that arise from the proximity of homes and cities to the crops are often associated with situations of general malaise, especially in times of spraying;[30] Residents living near corn and cotton plantations have twice as many acute poisonings.[31]

A study conducted by Lara[32] showed that occupational poisoning occurred primarily with agricultural and public health pesticides, and of the 141 municipalities in Mato Grosso, 83 reported occupational poisoning by agricultural pesticides; and of the 54 municipalities characterized as an area of high agricultural production, 14 remained silent for 10 years.

The underreporting of the sentinel event of exogenous pesticide poisonings corroborates the findings of other studies in this and other agribusiness regions.[7-10, 26-29] They showed the difficulties of health surveillance teams to act,[9,10] the intervention of agribusiness managers, and the low demand for health services of those poisoned,[7,9,10,17] because they fear reprisals and consequent loss of employment if the notifications of poisonings were work-related (above all) or from the 'pesticide clouds' that hover over the cities after aerial spraying crops.[17,30]

Mato Grosso Decree No. 1.651/2013[33] (the state legislation on pesticides) establishes a minimum distance of terrestrial spraying of 90 meters; and the Ministry of Agriculture, Livestock, and Supply's (MAPA) Normative Instruction No. 02/2008[34] regulates a minimum distance of 500 meters for aerial spraying in populated regions, environmental preservation areas, and water sources.

Thus, because the city is surrounded by crops, residing in the urban area of these municipalities does not mean being less exposed to pesticides, in which there is no compliance with the minimum spraying distances, showing the state's permissiveness through non-action and lack of (or insufficient) supervision,[10] normalizing and establishing illegality and naturalizing the inevitability of spraying and harm.

The use of agricultural pesticides for domestic purposes was reported by 72% of respondents. The highest use recorded was for the glyphosate herbicide known as 'Mata Mato' or *'Roundup'* for urban 'chemical weeding', and

for insecticides with a base of cypermethrin, deltamethrin, and neonicotinoids to control domestic pests. The domestic use of pesticides increases environmental exposure and the risk of poisoning by accidental or provoked ingestion.[35]

Several national and international studies relate pesticide exposure to the illness profile described in this study, such as the association between pesticide exposure and acute poisonings;[14,32,36] hypertension;[37-39] cancer;[39-44] malformations;[45,46] respiratory diseases;[31,47] and neurological and psychiatric illnesses and associated infirmities, such as suicide, suicide-attempt, and social distress.[48,50]

Several studies have found that health problems are related to the largest-producing municipalities and regions in Mato Grosso, which, consequently, use more pesticides[1,7,8] and point to the incidences of acute poisonings, cancers, and malformations,[1,10,30] contamination of breast milk by pesticide residues,[51] and contamination in rainwater, the water supply, and food.[7,8,52]

Self-reported health conditions are important data sources that allow part of the health situation of a territory from the perception of families to be seen. The results present a scenario of illness related to the characteristics of the agribusiness production model, evidencing the underreporting of a significant sentinel event, exogenous pesticide poisoning, and associations between environmental and occupational exposure to pesticides and different illnesses reported by respondents.

In this context, the survey becomes an instrument for making pesticide-exposure problems in agricultural territories visible with the participation of the population and the potential to trigger local actions to reduce pesticide use and approach agroecological transition as another way of production, from the perspective of Participatory and Public Surveillance and strengthening public health surveillance of populations exposed to pesticides (*Vigilância em Saúde das Populações Expostas aos Agrotóxicos* – VSPEA), whose guidelines are not included in municipal management planning agendas.

Final considerations

This study described that most families primarily comprise individuals between 20 and 49 who did not finish elementary school and have an income from BRL 1,000 to BRL 3,000, in an excluded classification, working as machine operators or mechanics and in agriculture. They live less than 500 meters from plantations and handle herbicides in their homes. It was identified that there are 26 underreported cases for each case of exogenous pesticide poisoning in the three studied municipalities, with underreported ratios ranging from 1 to 20 in Campos de Júlio to 100% of the cases being unreported in Sapezal.

The historic increase in registrations of formulated products, the disruption of public inspection policies, and the attempts to make more use and types of pesticides more flexible in Brazil through Bill No. 6299/2002 rekindle the importance of implementing social participation, such as territorial and participatory surveillance, focusing on surveillance of development profiles, through the PHS.

From the data produced by this study, the strategies that can be used to implement this surveillance, the struggle movements, collection of environmental rights already provided for in laws, civil society organization, recognition of negative impacts, forums to fight against the effects of pesticides, and a permanent campaign against pesticides and for life have proved to be effective strategies for denouncing the impacts of pesticides and announcing the agroecological transition as a means to transform the production model.

The formal instances of people's representation in these territories have been transmuted to fit economic interests, not expressing the health-based needs to foster and stimulate a healthy environment of life, existence, and permanence. Therefore, the PHS

and techniques such as self-reported health conditions surveys are necessary to foster Healthy and Sustainable Territories (*Territórios Saudáveis e Sustentáveis*, or TSS in Portuguese).

Further studies are recommended to interpret these processes, which are seen as substantial as the residents of these places are affected by the development model, generating environmental contamination and health problems that remain unseen in the official records of the SUS information systems. The social determinations of these conditions are aggravated when these health needs are not investigated, either by silencing the people's demands for health or by the impossibility of governmental investigation when the state is inefficient, sometimes silent, in surveillance actions.

Collaborators

Pignati WA (0000-0001-9178-6843)* participated in all article writing stages. Soares MR (0000-0002-0417-2614)*, Lara SS (0000-0001-7996-1629)*, Lima FANS (0000-0001-5677-2390)*, and Fava NR (0000-0002-8499-5310)* participated in writing, reviewing, discussing and revising the end of the article. Barbosa JR (0000-0003-2762-3665)* and Corrêa MLM (0000-0001-7812-0182)* collaborated in reviewing the article and reading the final version of the article. All authors approved the final version. ■

References

1. Pignati WA, Lima FANS, Lara SS, et al. Distribuição espacial do uso de agrotóxicos no Brasil: uma ferramenta para a Vigilância em Saúde. Ciênc. Saúde Colet. 2017 [accessed on 2020 Jul 2]; 22(10):3281-93. Available at: https://www.scielo.br/i/csc/a/grr-nnBRDimtcBhm6CLprQvN/abstract/?lang=pt.

2. Bombardi LM. Agrotóxicos e agronegócio: arcaico e moderno se fundem no campo brasileiro. In: Merlino T, Mendonça ML, organizadores. Direitos humanos no Brasil 2012: relatório da Rede Social de Justiça e Direitos Humanos. São Paulo: Rede Social de Justiça e Direitos Humanos; 2012. p. 75-86.

3. Companhia Nacional de Abastecimento. Acompanhamento da safra brasileira de grãos Safra 2019/20. Décimo levantamento, 2020 [accessed on 2020 Jul 10]; Jul:7(10). Available at: https://www.conab.gov.br/info-agro/safras/graos/boletim-da-safra-de-graos.

*Orcid (Open Researcher and Contributor ID).

4. Moraes RF. Agrotóxicos no Brasil: padrões de uso, política da Regulação e prevenção da captura regulatória. Texto para Discussão n° 250. Brasília, DF: Instituto de Pesquisa Econômica Aplicada; 2019. 84 p. [accessed on 2022 Feb 3], Available at: http://repositorio.ipea.gov.br/bitstream/11058/9371/l/td 2506. pdf.

5. Instituto Brasileiro de Geografia e Estatística - Sistema IBGE de Recuperação Automática. Produção Agrícola Municipal. 2017. [accessed on 2020 Jul 2]. Available at: https://sidra.ibge.gov.br/pesquisa/pam/ tabelas.

6. Instituto Brasileiro de Geografia e Estatística - Sistema IBGE de Recuperação Automática. Produção Agrícola Municipal. 2018. [accessed on 2020 Jun 10]. Available at: https://sidra.ibge.gov.br/pesquisa/ pam/tabelas.

7. Oliveira LK, Pignati WA, Pignatti MG, et al. Processo sócio-sanitário-ambiental da poluição por agrotóxicos na bacia dos rios Juruena, Tapajós e Amazonas em Mato Grosso, Brasil. Saúde e Soc. 2018 [accessed on 2020 Jul 4]; 27(2):573-87. Available at: https://www.scielo.br/i/sausoc/a/RkzmB8BHSHZqyixnKK8xv-PL/abstract/?lang=pt.

8. Corrêa MLM, Pignati WA, Pignatti MG, et al. Alimento ou mercadoria? Indicadores de autossuficiência alimentar em territórios do agronegócio, Mato Grosso, Brasil. Saúde debate. 2019 [accessed on 2020 Jul 16]; 43(123):1070-83. Available at: https://www.scielo.br/i/sdeb/a/pcPNxVk4pjxVzxmRxCMnPVL/ ?lang=pt.

9. Nasrala Neto E, Lacaz FAC, Pignati WA. Vigilância em saúde e agronegócio: os impactos dos agrotóxicos na saúde e no ambiente. Perigo à vista! Ciênc. Saúde Colet. 2014 [accessed on 2020 Aug 3]; 19(12):4709-4718. Available at: http://dx.doi.org/10.1590/1413-812320141912.03172013.

10. Correa MLM, Pignati WA, Pignatti MG, et al. Agrotóxicos, Saúde e Ambiente: ação estratégica e políticas públicas em territórios do agronegócio. Rev Polít. Públicas. 2020 [accessed on 2020 Jul 16]; 24(1):11-27. Available at: http://dx.doi.org/10.18764/2178-2865.v24nlpll-27.

11. Viacava F. Informações em saúde: a importância dos inquéritos populacionais. Ciênc. Saúde Colet. 2002 [accessed on 2020 Jul 15]; 7(4):607-621. Available at: http://dx.doi.org/10.159Q/S1413- 81232002000400002.

12. Viacava F, Dachs N, Travassos C. Os inquéritos domiciliares e o Sistema Nacional de Informações em Saúde. Ciênc. Saúde Colet. 2006 [accessed on 2020 Jul 6]; ll(4):863-869. Available at: http://dx.doi.org/10.1590/S1413-81232006000400002.

13. Gold M, Franks P, Erickson P. Assessing the health of the nation. The predictive validity of a preference-based measure and self-rated health. Med Care. 1996 [accessed on 2020 Jul 12]; 34(2):163-177. Available at: https://pubmd.ncbi.nlm.nih.gov/8632690/.

14. Molarius A, Janson S. Self-rated health, chronic diseases, and symptoms among middle-aged and elderly men and women. J Clin Epidemiol. 2002 [accessed on 2020 Jul 9]; 55(4):364-370. Available at: https://pubmed.ncbi.nlm.nih.gov/11927204/.

15. Theme Filha MM, Szwarcwald CL, Souza Junior PRB. Medidas de morbidade referida e interrelações com dimensões de saúde. Rev. Saúde Pública. 2008 [accessed on 2020 Aug 12]; 42(1):73-81. Available at: https://doi.org/10.1590/S0034-89102008000100010.

16. Instituto Brasileiro de Geografia e Estatística. Censo Demográfico; 2010. [accessed on 2020 Jul 2]. Available at: https://www.ibg.gov.br/estatisticas/sociais/populacao/9662-censo-demografico-JOlO. html?=&t=resultados.

17. Carneiro FF, Augusto LGS, Rigotto RM, et al. Dossiê ABRASCO: um alerta sobre os impactos dos agrotóxicos na saúde. Rio de Janeiro; São Paulo: EPSJV; Expressão Popular, 2015.

18. Beserra L. Agrotóxicos, vulnerabilidades socioambientais e saúde: uma avaliação participativa em municípios da bacia do rio Juruena, Mato Grosso, [dissertação]. Cuiabá: Universidade Federal de Mato Grosso; 2017.140 p. [accessed on 2020 Jul 2]. Available at: https://wwl.ufmt.br/ppgsc/aruuivos/7482ecled28ff2985ffdceea860bfl23.pdf.

19. Instituto Brasileiro de Geografia e Estatística. Censo agropecuário 2017. Resultados Preliminares. [accessed on 2020 Jul 2]. Available at: https://censos.ibge.gov.br/agro/2017/templates/censo_agro/resultadosagro/index.html.

20. Luna MCPM. Gênero e mortalidade proporcional por intoxicações ocupacionais agudas por agrotóxicos na agropecuária no Brasil. [dissertação]. Bahia: Universidade Federal da Bahia; 2016. 74 p. [accessed on 2020 Jul 2]. Available at: https://repositorio.ufba.br/ri/bitstream/ri/21658/l/Dissertacao.%20Maria%20Claudia%20Peres.%202016.pdf.

21. Abreu PHB, Alonzo HGA. Trabalho rural e riscos à saúde: uma revisão sobre o "uso seguro" de agrotóxicos no Brasil. Ciênc. Saúde Colet. 2014 [accessed on 2020 Jul 4]; 19(10):4197-4208. Available at: http://dx.doi.org/10.1590/1413-812320141910.09342014.

22. Camargo KCM. Dinâmica demográfica e transformação econômica recente no Mato Grosso. [dissertação]. Campinas: Universidade Estadual de Campinas; 2017.173 p. Available at: http://repositorio.unicamp.br/ispui/bitstream/REPOSIP/322669/1/Camargo. KellyCristinaDeMoraes_M.pdf.

23. Bedor CNG. Estudo do potencial carcinogênico dos agrotóxicos empregados na fruticultura e sua implicação para a vigilância da saúde. [tese]. Recife: Fundação Oswaldo Cruz, Centro de Pesquisa Aggeu Magalhães; 2008.115 p. [accessed on 2020 Jul 10]. Available at: https://www.arca.fiocruz.br/bitstream/icict/3907/2/000014.pdf.

24. Soares WL, Freitas EAV, Coutinho JAG. Trabalho rural e saúde: intoxicações por agrotóxicos no município de Teresópolis - RJ. Rev. Econ. Sociol. Rural. 2005 [accessed on 2020 Jul 11]; 43(4):685-701. Available at: https://www.scielo.br/j/resr/a/BH3JMPF7LzWwRrfkLgfB3CM/?lang=pt.

25. Barbosa Filho FH, Moura RL. Evolução recente da informalidade no Brasil: uma análise segundo características da oferta e demanda de trabalho. São Paulo: FGV; IBRE; 2012. [accessed on 2020 Jul 11]. Available at: http://hdl.handle.net/10438/11679.

26. Santana CM, Costa AR, Nunes RMP, et al. Exposição ocupacional de trabalhadores rurais a agrotóxicos. Cad. saúde colet. 2016 [accessed on 2020 Jul 12]; 24(3):301-307. Available at: http://dx.doi. org/10.1590/1414-462x201600030199.

27. Rigotto RM, Vasconcelos DP, Rocha MM. Uso de agrotóxicos no Brasil e problemas para a saúde pública. Cad. Saúde Pública. 2014 [accessed on 2020 13]; 30(7):1-3. Available at: http://dx.doi. org/10.1590/0102-311XPE020714.

28. Murakami Y, Pinto NF, Albuquerque GSC, et al. Intoxicação crônica por agrotóxicos em fumicultores. Saúde debate. 2017 [accessed on 2020 Jul 13]; 41(113):563-576. Available at: http://dx.doi.org/10.1590/0103- 1104201711317.

29. Riquinho DL, Hennington EA. Cultivo do tabaco no sul do Brasil: doença da folha verde e outros agravos à saúde. Ciênc. Saúde Colet. 2014 [accessed on 2020 Jul 13]; 19(12):4797-4808. Available at: http://dx.doi.org/10.1590/1413812320141912.19372013.

30. Pignati WA, Machado JMH, Cabral JF. Acidente rural ampliado: o caso das "chuvas" de agrotóxicos sobre a cidade de Lucas do Rio Verde - MT. Ciênc. Saúde Colet. 2007 [accessed on 2020 Jul 14]; 12(1):105-114. Available at: http://dx.doi.org/10.1590/S1413-81232007000100014.

31. Silva DO, Ferreira MJM, Silva SA, et al. Exposição aos agrotóxicos e intoxicações agudas em região de intensa produção agrícola em Mato Grosso, Brasil, 2013. Epidemiol. Serv. Saúde. 2019 [accessed on 2020 Jul 14]; 8(3):1-12. Available at: https://www.scielo.

32. Lara SS. Intoxicação aguda por agrotóxicos: um estudo do registro nas regiões agrícolas do agronegócio. [dissertação]. Cuiabá: Universidade Federal de Mato Grosso; 2018. 110 p. [accessed on 2020 jul 17]. Available at: https://www1.ufmt.br/ppgsc/arquivos/f42e-f56cae3a3cf56fda8884acefc457.pdf.

33. Mato Grosso. Decreto nº 1.651, de 11 de março de 2013. Regulamenta a Lei nº 8588 de 27 de novembro de 2006, dispõe sobre o uso, produção, comércio, armazenamento, transporte, aplicação, destino final de embalagens vazias e resíduos e fiscalização de agrotóxicos, seus componentes e afins no estado de Mato Grosso e dá outras providências. Diário Oficial do Estado de Mato Grosso. 11 Mar 2013.

34. Brasil. Ministério da Agricultura, Pecuária e Abastecimento. Instrução Normativa nº 2, de 3 de janeiro de 2008. Diário Oficial da União. 8 Jan 2008.

35. Rebelo FM, Caldas ED, Heliodoro VO, et al. Intoxicação por agrotóxicos no Distrito Federal, Brasil, de 2004 a 2007 – análise da notificação ao Centro de Informação e Assistência Toxicológica. Ciênc. Saúde Colet. 2011 [accessed on 2020 jul 16]; 16(8):3493-3502. Available at: http://dx.doi.org/10.1590/S1413-81232011000900017.

36. Yao J, Zhang J, Tai W, et al. High-Dose Paraquat In-duces Human Bronchial 16HBE Cell Death and Ag-gravates Acute Lung Intoxication in Mice by Regula-ting Keap1/p65/Nrf2 Signal Pathway. Inflammation. 2019 [accessed on 2020 jul 20]; 42(2):471-484. Available at: https://www.ncbi.nlm.nih.gov/pmc/arti-cles/PMC6449493/.

37. Ledda C, Fiore M, Santarelli L, et al. Gestational Hypertension and Organophosphorus Pesticide Expo-sure: A Cross-Sectional Study. Biomed Res Int. 2015. [accessed on 2020 jul 20]. Available at: https://doi.org/10.1155/2015/280891.

38. Suarez-Lopez JR, Hong V, McDonald KN, et al. Home proximity to flower plantations and higher systolic blood pressure among children. Int J Hyg Environ Health. 2018 [accessed on 2020 jul 20]; 221(8):1077-1084. Available at: https://pubmed.ncbi.nlm.nih.gov/30131222/.

39. Chaguri JL, Godinho AF, Horta DF, et al. Exposure to fipronil elevates systolic blood pressure and dis-turbs related biomarkers in plasma of rats. Environ Toxicol Pharmacol. 2016 [accessed on 2020 jul 21]; (42):63-68. Available at: http://dx.doi.org/10.1016/j.etap.2015.12.020.

40. Curvo HRM, Pignati WA, Pignatti MG. Morbimortalidade por câncer infantojuvenil associada ao uso agrícola de agrotóxicos no Estado de Mato Grosso, Brasil. Cad. saúde colet. 2013 [accessed on 2020 jul 22]; 21(1):10-17. Available at: http://dx.doi.org/10.1590/S1414-462X2013000100003.

41. Cunha MLON. Mortalidade por neoplasias e a utilização de pesticidas no estado de Mato Grosso no período de 1998 a 2006. [dissertation]. São Paulo: Universidade de São Paulo; 2010. [accessed on 2020 jul 22]. Available at: https://www.fcmsantacasasp.edu.br/wp-content/uploads/dissertacoes-e-teses/MP-saude-coletiva/2010/2010-Maria-Luiza-Ortiz--Nunes-da-Cunha.pdf.

42. Boccolini PMM, Asmus CIRF, Chrisman JR, et al. Mortalidade por câncer de estômago em agriculto-res: resultados de estudo caso-controle baseado em certificado óbito. Cad. saúde colet. 2014 [accessed on 2020 jul 24]; 22(1):86-92. Available at: http://dx.doi.org/10.1590/1414-462X201400010013.

43. Costa VIB, Mello MSC, Friedrich K. Exposição ambiental e ocupacional a agrotóxicos e o linfoma não Hodgkin. Rev. Saúde debate. 2017 [accessed on 2020 jul 24]; 41(112):49-62. Available at: http://dx.doi.org/10.1590/0103-1104201711205.

44. Silva JFS, Silva AMC, Luz LL, et al. Correlação entre produção agrícola, variáveis clínicas-demográficas e

câncer de próstata: um estudo ecológico. Ciênc. Saúde Colet. 2015 [accessed on 2020 jul 25]; 20(9):2805-2812. Available at: http://dx.doi.org/10.1590/1413-81232015209.00582015.

45. Dutra LS, Ferreira AP. Associação entre malformações congênitas e a utilização de agrotóxicos em monoculturas no Paraná, Brasil. Saúde debate. 2017 [accessed on 2020 jul 25]; 41 (esp2): 241-253. Available at: http://dx.doi.org/10.1590/0103-11042017s220.

46. Oliveira NP, Moi GP, Santos MA, et al. Malformações congênitas em municípios de grande utilização de agrotóxicos em Mato Grosso, Brasil. Ciênc. Saúde Colet. 2014 [accessed on 2020 jul 24]; 19(10):423-4130. Available at: https://www.scielo.br/j/csc/a/LBxRGXzfFpQwXrqqDVDY3Fj/?lang=pt.

47. Fávero KAS. Pulverização de agrotóxicos nas lavouras em Lucas do Rio Verde-MT e os agravos respiratórios em crianças menores de 5 anos de idade no período de 2004 a 2009. [dissertation]. [Cuiabá]: Universidade Federal de Mato Grosso; 2011.

48. Castro BVP. Sofrimento social de trabalhadores ru-rais assentados na contracorrente do agronegócio no Vale do Juruena – MT. [dissertation]. Cuiabá: Universidade Federal de Mato Grosso; 2017. 110 p. Available at: https://www1.ufmt.br/ppgsc/arquivos/1b2a7b268bec828c957da92e7cbec775.pdf.

49. Costa VLS. Aspectos socioeconômicos, culturais e ambientais presentes no suicídio de trabalhadores e trabalhadoras inseridos no Agronegócio. [dissertation]. Cuiabá: Universidade Federal de Mato Grosso; 2018. 117 p. [accessed on 2020 jul 27]. Available at: https://www1.ufmt.br/ppgsc/arquivos/36f629098cbecbcea322143f91ae884f.pdf.

50. Mostafalou S, Abdollahi M. Pesticides: an update of human exposure and toxicity. Arch Toxicol. 2017 [accessed on 2020 jul 29]; 91(2):549-599. Available at: https://pubmed.ncbi.nlm.nih.gov/27722929/.

51. Palma DCA, Lourencetti C, Uecker ME, et al. Simultaneous Determination of Different Classes of Pesticides in Breast Milk by Solid-Phase Dispersion and GC/ECD. J. Braz. Chem. Soc. 2014 [accessed on 2020 jul 29]; 25(8):1419-1430. Available at: https://www.scielo.br/j/jbchs/a/v7xxwGKqT3SmWFGdMsSnvkg/?lang=en.

52. Moreira JC, Peres F, Simões AC, et al. Contaminação de águas superficiais e de chuva por agrotóxicos em uma região do estado do Mato Grosso. Ciênc. Saúde Colet. 2012 [accessed on 2020 jul 30]; 17 (6):1557-1568. Available at: http://dx.doi.org/10.1590/S1413-81232012000600019.

Submitted on 09/20/2020

Approved on 07/13/2021

Conflict of interest: none

Financial support: none