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Research Article

Common Mental Disorders and Exposure to Pesticides: A Cross-Sectional Study with Rural Community in Brazil

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Abstract

Introduction: Pesticides exposure has been a relevant source of association to common mental disorders (CMD) development. Rural population are the most likely to develop common mental disorders when it refers to pesticides contamination and poisoning. The neurotoxicity from those pesticides shows a severe damage to mental health.

Objectives: To evaluate the prevalence of common mental disorders linked to pesticides exposure.

Methods: A transversal retrospective and descriptive epidemiologic research was made in a rural area of Jataí, a city in the state of Goiás, Brazil, in the period of 2018 to 2020. The study population consisted of 43 farmers in contact with pesticides, whose children attended 3 rural schools in that area. Data were collected by individual interviews conducted by trained researchers using a patterned questionnaire in addition to SRQ-20.

Results: The prevalence of CMD in these rural families of the southwest from Goiás was 32,5%. It exhibits predominance for female sex (n = 27, 62,79%) and rural zone residency (88,37%). Majority number of interviewed reported a low educational stage, completed, at most, high school.

Discussion: The vulnerability of the rural families exposed to pesticides has an intimate relationship with the following risk factors: high toxicity of agricultural inputs; low education stage; lack of specialized guidance on the use of pesticides; exposure level; absolute number of past intoxications; lack of action by public policies to promote, prevent and treat the health of at-risk populations.

Recommendations: The chronic intoxications, subnotification, the difficulty of characterized and symptoms related to grievances are other issues that should be better analyzed and empirically tested to assess the impact of pesticides on populations. We hope that the results of this research can contribute to the analysis and reflection of the proposed theme, as well as the promotion of effective mental health strategies for rural populations.

Keywords: *Pesticides; Common Mental Disorders; Neurotoxic; Mental Health; Epidemiological Study; Rural Population*

Introduction

The implications involving exposure to pesticides have been one of the major concerns of epidemiological studies in view of the impacts on human health. The abusive and indiscriminate use of pesticides in Brazilian agriculture is identified as a risk factor for the health

of populations [1-4]. Brazil is one of the largest consumers and producers of pesticides worldwide [5]. About 28% of the agrochemicals used in the country contain substances that are not authorized for commercialization and consumption [6,7].

Exposure to pesticides has been shown to be an impacting variable in the association of the development of common mental disorders. The population that lives and works in rural areas is the public most prone to the development of common mental disorders, when associated with the factor of contamination and intoxication by insecticides, pesticides or other pesticides. Evidence points to reports of neuropsychiatric disorders in rural populations [3,8,9]. The most common mental disorders linked to pesticide poisoning are one of the main causes of disability and morbidity in the population [8,10].

The neurotoxic capacity of pesticides reflects serious damage to mental health. Mental disorders that are characterized as common mental disorders (CMD) are those that exclude psychotic symptoms and include depressive, anxious and somatoform symptoms [8]. The prevalence of common mental disorders in rural populations can be considered from complaints of depressive symptoms, anxiety, insomnia, headache, irritability, memory deficit and lack of concentration [11].

The symptoms of CMDs imply a condition of psychological distress with the possibility of a great biopsychosocial and socioeconomic impact. Population-based studies carried out in countries in Latin America, Africa and India have a prevalence of 30% to 50% of CMD. The World Health Organization (WHO) highlights the Self Reporting Questionnaire (SRQ-20), as a screening tool for the identification of suspected cases of CMD. The SRQ-20 has been validated in Brazil, and although it is not a diagnostic tool, it has a screening capacity to detect relevant psychological distress, with high sensitivity (83%) and specificity (80%) [12].

In view of the concern with the mental health of rural populations exposed to pesticides, the present study was carried out in an agricultural region, in the southwest of the state of Goiás, Brazil, with the objective of assessing the prevalence of common mental disorders associated with exposure to pesticides, through the SRQ-20. This investigation emerged from the analysis of practical activities developed in Primary Care services in the region, in which the question was raised about the high rate of neuropsychiatric diseases (depression, anxiety, insomnia, changes in sensitivity and others) in rural workers.

Methods

This is a descriptive and retrospective cross-sectional epidemiological study, carried out in the rural area of the city of Jataí, state of Goiás, Brazil, in the period from 2018 to 2020. The southwestern state of Goiás has livestock and agriculture as its main economic activity, highlighting large-scale monoculture areas of crops such as soybeans, corn and sorghum. The population of this research was composed of 43 rural workers exposed to pesticides, who have children enrolled in three rural schools in the municipality of Jataí-Goiás. The selection of these schools took place through a partnership with the Municipal Education Secretariat of Jataí.

The fieldwork was carried out through health promotion actions in schools, followed by the application of questionnaires in the target population. The target population included pesticide applicators, weeds, harvesters, plantation goers and members of the population in the area of influence who have or do not have contact (direct or indirect) with pesticides. Data were collected through individual interviews, conducted through trained researchers. Sociodemographic data were collected using a standard questionnaire applied in conjunction with the SRQ-20.

The Self-Reporting Questionnaire (SRQ-20 and SRQ-4) as a method of obtaining data characteristic of common mental disorders, is a questionnaire validated in several countries [13,14], including Brazil [15-17]. It has been widely used to assess CMD, and is recommended by WHO especially for its ease of use and low cost. It consists of 20 questions, proposed by Hardin [18], and assesses non-psychotic symptoms, such as insomnia, fatigue, irritability, forgetfulness, difficulty concentrating and somatic complaints. However, it does not provide a specific diagnosis, serving only as a screening. Each negative answer has a value of zero and each affirmative, 1 point [17,19,20]. The

cut-off point can vary considerably from 5/6 to 10/11, depending on the cultural context in which it is applied [17] and sex. For the current study, the cut-off value was 9. Studies based on SRQ 20 have demonstrated good sensitivity and specificity performance in a specific population, although there are different cut-off points/interpretations adopted by the different authors who use it [21]. The 4 additional items (SRQ-4), designed to detect psychotic conditions, were based on the items in the Foulds Symptom Sign Inventory [22]. A score greater than or equal to one, in this case, already identifies a psychotic illness.

In the statistical analysis, the prevalence of CMD was estimated from the cutoff point, defined according to the number of positive responses to symptoms. Individuals were classified as suspected cases of CMD when they had nine or more positive items. The data obtained were tabulated using the Statistical Package Social Sciences (SPSS), version 17. All variables were analyzed in a descriptive manner. In the univariate analysis, qualitative variables were presented with distribution of absolute (n) and relative (%) frequencies and quantitative variables, such as mean values, standard deviations, maximum and minimum values. It was divided into a control group and cases according to the result of the SQR20> = 8, leading to n of 29 controls and 14 cases.

The study was approved by the Ethics Committee of the Federal University of Goiás, under opinion No. 78045417.6.0000.5083. Participants were informed of ethical commitments and voluntarily signed an informed consent form. Participants who presented severe symptoms of mental suffering or who spontaneously requested psychological support were welcomed and then instructed to seek appropriate care in the public mental health service.

Results

The SRQ-20 questionnaire was completed by 43 rural workers. There was a preponderance of females (n = 27, 62.79%) and a predominance of residence in rural areas (88.37%). Most respondents had a low level of education, having completed high school at most. The family income of the sample points to an average of 2 to 3 minimum wages, being the control group, with the highest index of employability and the highest income. It is also evident in the control group, a high statistic for the participants who combine work and study (Table 1).

	Control		**Case**	
	Frequency	**%**	**Frequency**	**%**
Sex	**n = 29**		**n = 14**	
Male	11	37,9	5	35,7
Female	18	62,1	9	64,3
Race	**n = 29**		**n = 13**	**%**
Undeclared	1	3,4	-	-
White	7	24,1	4	30,8
Brown	16	55,2	7	53,8
Therefore	5	17,2	2	15,4
Yellow	-	-	-	-
Education	**n = 29**	%	**n = 13**	**%**
Illiterate	1	3,4	1	7,7
1st degree incomplete	4	13,8	6	46,2
1st degree complete	2	6,9	1	7,7
2nd degree incomplete	12	41,4	5	38,5
2nd degree complete	2	6,9	-	-
Incomplete higher education	2	6,9	-	-
Complete higher education	6	20,7	-	-

Rural zone	**n = 29**	%	**n = 14**	%
Yes	25	86,2	13	92,9
No	4	13,8	1	7,1
Work activity	**n = 13**	**%**	**n = 8**	**%**
Exclusive School	2	15,4	3	37,5
Productive work in the family unit	3	23,1	2	25,0
Extra-family productive work	-	-	1	12,5
Study and work	8	61,5	2	25,0
Don't study	-	-	-	-
Labor market	**n = 28**	%	**n = 13**	**%**
Unemployed	5	17,9	6	46,2
Employee with portfolio	4	14,3	1	7,7
Unregistered employee	10	35,7	4	30,8
Self-employed	2	7,1	-	-
Public server	2	7,1	-	-
Retiree	1	3,6	1	7,7
Cooperative	2	7,1	-	-
Others	2	7,1	1	7,7
Family income	**n = 27**	%	**n = 12**	**%**
1 minimum wage	3	11,1	-	-
2 to 3 minimum wages	13	48,1	10	83,3
4 to 5 minimum wages	6	22,2	1	8,3
More than 5 minimum wages	5	18,5	1	8,3

Table 1: *Sociodemographic data of the study participants.*

Source: Data collected in the survey.

The prevalence of CMD in this group of rural workers in the southwest of Goiás was 32.5% (Table 2). Considering the cutoff point of the SRQ ≥ 9, a positive screening for CMD was found in 14 of the 43 participants, with 6 individuals having scores equal to or greater than 12 (Table 2).

Instrument	**Control (n = 29)**				**Cases (n = 14)**			
	Min.	**Max.**	**Med.**	**DP**	**Min.**	**Max.**	**Med.**	**DP**
SRQ20	0	7,00	3,68	2,46	8,00	15,00	10,50	2,53
SRQ4	0	3,00	0,79	0,97	1,00	4,00	2,57	0,85

Table 2: *Application of the self-reporting questionnaire (SRQ).*

Source: Data collected in the survey.

Min: Minimum; Max: Max; Méd.: Medium.

Alcoholism and medication use were less frequent in the control group. Regarding psychiatric comorbidities, the study group points to a prevalence of 28.6%, also showing a higher frequency of medication use. As for leisure activities, no type of activity was restricted, considering any action that generated pleasure, relaxation and well-being. The data tend to match up in the positive and negative responses, being a good marker of progress for conditioning a healthy life according to the biopsychosocial model (Table 3).

The quality of the water that arrives at the home of the evaluated participants corroborates for surveillance in relation to indirect contamination, pointed out as the most common method of exposure to pesticides. In view of this, there was a difference of 14% more than those interviewed in the study group, as they did not have properly treated water (Table 3).

Regarding the type of exposure to pesticides (direct or indirect), there was a higher reported rate of indirect exposure in the control group compared to the study group (53.65% - 21.4%), suggesting the possibility of contamination unconscious. Taking into account that the participants of both groups are residents of the same small region with a greater report of indirect contact due to water contamination in rivers and streams provided to all equally (Table 3).

	Control		**Case**	
		%		**%**
Smoking	**n = 29**		**n = 14**	
No	19	65,5	10	71,4
Yes	7	24,1	3	21,4
Previous and ceased	3	10,3	1	7,1
Ethylism	**n = 29**		**n = 14**	
No	14	48,3	6	42,9
yes	15	51,7	8	57,1
Comorbidities	**n = 29**		**n = 20**	
No comorbidities	25	86,2	5	35,7
Psychiatric	1	3,4	4	28,6
HAS	-	-	4	28,5
Pulmonary	1	3,4	1	7,1
DLPDM	-	-	1	7,1
Atropias	1	3,4	1	7,1
Neoplasias	1	3,4	-	-
Osteoarticular	-	-	1	7,1
Gastrointestinal	-	-	3	21,4
Medicines	**n = 29**		**n = 22**	
No medicine	24	82,8	5	35,7
Psychoactive	-	-	3	21,4
Antihypertensive drugs	-	-	4	28,6
Antidyslipidemics	-	-	2	14,3
NSAID pain reliever	2	6,9	2	14,3
Gastrointestinal	-	-	3	21,4
Hormonal	2	6,9	3	21,4

Corticoids	1	3,4	-	-
Leisure	**n = 29**		**n = 14**	
No	15	51,7	6	42,9
Yes	14	48,3	8	57,1
Potable water	**n = 28**		**n = 14**	
No	16	57,1	10	71,4
Yes	12	42,9	4	28,6
Contact with pesticides	**n = 28**		**n = 14**	
Denies contact	6	21,4	7	50,0
Indirect	15	53,6	3	21,4
Reports Direct Contact	6	21,4	3	21,4
Past	1	3,6	1	7,1

Table 3: *Frequency of other risk factors in the exposure to pesticides.*

Source: Data collected in the survey.

Regarding the time of exposure to pesticides, a longer period was observed, both minimum and maximum of pesticides and cigarettes (nicotine and others), when compared to the study group in relation to control. The minimum exposure time? the study group in relation to pesticides is twice as much as in the control group. The maximum time, in this case, there is a difference of gain, of the order of 30% in relation to the control group for the group under study. Finally, the average that suggests a higher general assessment for each group still shows a difference of almost 2 times greater than the group under study (Table 4).

The mean smoking burden was 5.57 times higher in the study group. In contrast, alcohol abuse in a general average among the participants in each group focused on a slight difference of 41% more in the control group in relation to the cases (Table 4).

	Control			**Case**		
	Pesticide (n = 6)	**Cigarette (n = 21)**	**Alcohol (n = 21)**	**Pesticide (n = 3)**	**Cigarette (n = 14)**	**Alcohol (n = 09)**
Minimum	12	0	0	24	0	0
Maximum	180	12,00	61,19	240	42,00	15,65
Average	66,0	0,58	4,78	128,0	3,29	3,43
DP	63,38	2,61	13,36	108,22	11,15	5,79

Table 4: *Time of contact with chemical agents [pesticide (months), cigarette (smoking load) and alcohol (grams/week)].*

Source: Data collected in the survey.

With regard to past intoxications, 88.5% of the control population had negative responses, while in the study group, only 69.2% presented "no" as an answer. Although, only 11.5% of the responses were positive in the control group (adding the answers yes to those of multiple past intoxications), in the study group, 30.8% did; there is an increase in past intoxications within the study group. An Odds ratio of 3.4 among the groups studied, shows that people with past intoxication are about 3.4 times more likely to evolve with a common mental disorder when compared to a person who is not intoxicated (Table 5).

	Control		Case	
		%		%
Past intoxications	**n = 26**		**n = 13**	
No	23	88,5	9	69,2
Yes	1	3,8	4	30,8
Multiple	2	7,7	-	-
Type of activity	**n = 29**		**n = 10**	
Denies contact	5	18,5	1	10,0
Agriculture	18	66,7	8	80,0
Livestock	23	11,1	1	10,0
Desensitization service	2	7,4	-	-
Domestic service	2	7,4	-	-
Industry	-	-	-	-
Public service/endemic agent	-	-	-	-
Other	-	-	-	-

***Table 5**: Past intoxications and contact characteristics with pesticides.*

Source: Data collected in the survey.

Discussion

The prevalence of common mental disorders in rural populations exposed to pesticides shows significant concerns regarding mental health. This population presents itself as a group vulnerable to contamination, intoxications and a variety of health comorbidities [3,7].

In this study, common mental disorder was found in 32.5% of rural workers and a prevalence of psychotic illness of 100% (n = 14/14) in the study group, while 51.7% (n = 15/29) in the control group, considering the variable SRQ4> = 1. In addition, the number of symptoms in the study group was substantially higher, leading to an average of points 3.2 times greater in relation to the control. Comparing the data obtained with other studies, in the municipality of Candelária-RS, a positive SRQ-20 was identified for 17% of tobacco growers who dedicated themselves to planting tobacco in smallholdings [20]. Another study with rural workers in Rio Grande do Sul (southern region of Brazil), showed that about 48% of the sample had the occurrence of common mental disorders. This data had a significant relationship between working time in agriculture and exposure to pesticides [11]. In a survey conducted in the state of Ceará (northeastern region of Brazil), the prevalence of common mental disorders was 33.3% in a group of workers exposed to pesticides [8]. The three values showed a significant difference, the present study being closer to that of research in the state of Ceará [8].

The tendency observed predominantly in studies was the majority of rural female workers in the control group (62.1%) and in the study group (64.3%). One study described the percentage of 85.2% of men [23], according to other analyzes: 68% [24] and 83% [25]. Notwithstanding another study [26] reported a percentage closer to that found in the current job: 63% of rural workers were female.

In line with the results obtained in this study, other studies have associated low education and prevalence of CMD [27,28]. Previous investigations have associated the low level of education to the difficulty of understanding labels, handling and understanding the need for protection with PPE's [22,25]. In this sense, less educated individuals may experience greater exposure to pesticides. Thus, the current study found that approximately 83% of respondents have a low level of education. Other studies have also shown similar results, pointing

to about 32% of 157 rural workers with just over 8 years of study [29]. In another study, an average age of 5.8 years of study was identified, with 55.8% not having completed elementary school [27].

A key factor for increasing CMD is the level of exposure to pesticides. According to a study with rural workers in Rio Grande do Sul [30], 62.2% of the interviewees had mental disorders due to exposure to pesticides. Other comorbidities pointed to circulatory problems (about 50%), dermatological changes (45%), respiratory complications (41%) and gastric disorders (36%) [30]. In addition, in another survey of 102 rural workers in Nova Friburgo (Rio de Janeiro), 29 (28.5%) were diagnosed with neurobehavioral syndrome and neuropsychiatric disorders associated with exposure and chronic use of organophosphates [31]. One of the consequences of exposure to pesticides may be related to changes in the mechanism of production of neurotransmitters and thyroid hormones, which can generate behavioral and emotional changes [3].

In the current analysis, the average time of individual exposure to pesticides was 66 months in the control group and 128 months in the study group. In Brazil, other studies have found a value of 16.0 years [24] and an average between 17.4 to 15.5 years [27]. In North Carolina and Iowa (USA) the average time was 14 and 15 years, respectively [32].

Not only is the handling of pesticides related to increased exposure and risk of exogenous intoxication. In a study involving 753 individuals residing in the state of Mato Grosso (central-western region of Brazil), it was found that acute poisoning in that region was more prevalent among participants with incomplete high school and residents close to the crops [33]. This fact was associated with spraying the area, with a tractor or manually, which would contaminate breast milk, water, air and food consumed [34]. Another study [35] found that 67.2% of the rural workers interviewed lived close to the workplace. Thus, the population close to non-organic plantations is more exposed to contamination by pesticides.

A study with a large number of participants found that individuals who reported pesticide poisoning were twice as likely to be depressed. In this investigation, a significantly higher risk of depression was observed in individuals with more than 2 pesticide poisonings [36]. Other studies have also shown this relationship [37,38]. The same studies found a greater chance of depression among those individuals submitted to an episode of high contamination by pesticides and those exposed for a long time, but without episodes of intoxication. In the current work, however, most individuals stated that they had not suffered previous acute intoxications. However, one flaw of the study was that it did not differentiate between self-diagnosis and the diagnosis made by a health professional.

An important risk factor in the exposure to pesticides refers to the absence of specialized technical guidance, lack of actions for education and health promotion, lack of inspection and applicability of laws [7]. There are several ways to deal with agriculture and farming, use and exposure to the analyzed products, in addition to different types and functionalities, there is still a clinical difference in the analysis of a possible intoxication. In this study, more than 77% of both groups (cases and control) reported contact with pesticides, with the highest prevalence in both groups in the area of agriculture. There was no contact through industries or public service/endemic agents and only the control group reported contact through the pest control service or domestic services.

Conclusion

This study describes the high prevalence of common mental disorders in rural populations, taking into account exposure to pesticides. The SRQ-20, used as an instrument to ascertain symptoms of relevant psychological distress, represents an important tool in the identification of CMD. The recognition of symptoms is essential for planning prevention and health promotion actions for these populations.

It is evident and emerging the need for a health action plan for rural populations exposed to pesticides. The development of Brazilian agriculture portrays the retaliation and neglect of human health subordinated to variations in the financial market in relation to agri-

cultural production methods and the ways of survival of biomes. The abuse of pesticides, environmental degradation and the increased incidence of health problems, are at the mercy of the qualitative and quantitative incentives of an economy.

One of the major challenges to public policies and to the surveillance and inspection bodies is the assessment and institution of effective measures in relation to the toxicological risks of pesticides on human health. Chronic intoxications, underreporting, difficulty in characterizing and associating symptoms with diseases are other issues that must be properly analyzed and empirically tested to assess the impact of pesticides on populations.

It was found that the vulnerability of the rural population exposed to pesticides has an intimate relationship with the following risk factors: high toxicity of agricultural inputs; inappropriate and / or absent use of PPE; low education level; lack of specialized guidance on the use of pesticides; lack of action by public policies to promote, prevent and treat the health of at-risk populations.

Recommendations

We hope that the results of this research can contribute to the analysis and reflection of the proposed theme, as well as the promotion of effective mental health strategies for rural populations.

Collaborators

TRLZ, MLMJ, WADN, LRD, VRA and EMP worked on the design and writing of the text, bibliographic review; TRLZ, MLMJ, WADN, LRD, VRA, CVW and FMO in the writing of the text and in the fieldwork; EMP, EFMV and FMO when designing the study and writing the text; EFMV, WADN, LRD, VRA, FMO and PSB in structuring the questionnaire, database and statistical analysis; WADN, LRD, VRA, FMO and PSB participated in the data analysis.

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Conflict of Interest

We declare that there is no conflict of interest.

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Volume 3 Issue 8 August 2021