RESPIRATORY STATUS RELATED TO PESTICIDES EXPOSURE IN A RURAL AREA OF TRANSYLVANIA

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ABSTRACT. – Respiratory status related to pesticides exposure in a rural area of Transylvania. Respiratory disease is today an important clinical problem for agricultural workers. Several studies have reported increased risk of respiratory problems, such as asthma and chronic bronchitis, among agricultural workers. In order to determine the extent of the problems related to pesticide use, a study was performed on the rural population of Sâncraiu, Romania, during 2011. Out of the group of 100 subjects investigated on the basis of a questionnaire in the study that started in 2011, 27 subjects agreed to participate in the respiratory status assessment based on performing some respiratory functional tests by using a portable spirometer. For all the explored functional respiratory parameters there are differences between the group that apply pesticides and the group that do not apply pesticides, but they do not reach the limit of statistical significance. There is a special situation in the case of the predicted lung age that is with 4.59 years higher for those exposed to pesticides and smoking in relation to those not exposed thereupon there is no difference. In general the subjects prepare and apply pesticides and afterwards wash the utensils without using full protective equipment. The most commonly used applicators are those in the form of spray devices, especially for insecticides used on crops. In this context we consider that, as shown by the test results, the respiratory status of the subjects that use pesticides may be affected.

Keywords: pesticides exposure, respiratory disease, agricultural workers.

1. INTRODUCTION

Exposure to pesticides may result in acute and chronic health problems, including temporary acute effects like eye irritations and excessive salivation, as well as chronic diseases like cancer and reproductive and developmental disorders. (Yassi, A. et al. 2001, Abu Mourad 2005, Del Prado-Lu 2007, Miranda et al. 2002, Miranda et al. 2004) Nowadays the respiratory diseases are an important clinical problem concerning the agricultural workers. An increased risk of respiratory problems, such as asthma and chronic bronchitis among agricultural workers, has been reported by several studies. (Kimbell-Dunn et al.2001, Radon et al.2001) Exposure to pesticides in relation to the agricultural activities has been associated with an increased risk of respiratory symptoms. (Sprince et al. 2000). Agricultural workers are usually exposed to a wide range of different chemical substances. The contact with these substances occur during preparation, manipulating hoses,

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washing contaminated clothes and applying treatment to livestock and it is not restricted only to product application. (Neice et al. 2005). Due to the differences in the periods and levels of exposure, type of pesticides (regarding toxicity), mixtures or cocktails used in the field, and the geographic and meteorological characteristics of the agricultural areas where pesticides are applied, the risk assessment of pesticide impact upon human health is not an easy and particularly accurate process. (Bolognesi 2003, Pastor et al. 2003) Such differences refer mainly to the agricultural workers that prepare the mixtures in the field, the pesticide sprayers, and also the population that lives near the sprayed areas, pesticide storage facilities, greenhouses, or open fields. Therefore, it is expected that a higher risk arises from high exposure to a moderately toxic pesticide than from little exposure to a highly toxic pesticide taking into consideration that the risk upon the human health is a function of pesticide toxicity and exposure. It is still a subject of great scientific controversy whether the general population undergoes or not to the dietary pesticide residues exposure found in food and drinking water, consisting in a potential threat to human health. (Magkos et al. 2006)

Purpose: In order to determine the extent of the problems related to pesticide use, a study was performed on the rural population of Sâncraiu, Romania, during 2011 (Lovasz M.-E. and Gurzau E. 2011). This paper presents the results of the respiratory function examination in relation to pesticide use in a group of farmers enrolled in this study.

2. MATERIALS AND METHODS

Out of the group of 100 subjects investigated on the basis of a questionnaire in the study that started in 2011, 27 subjects agreed to participate in the respiratory status assessment based on performing some respiratory functional tests by using a portable spirometer (ML3535S MicroLoop). Two groups of subjects were investigated: those who use pesticides on crops, orchards and livestock and those who have never used pesticides. Data on lifestyle, personal pathologic history, and general information on the activities performed within the farm, types of pesticides used and their application methods, the protective equipment used, a history of personal pathologic history (respiratory symptoms) were reported on the basis of a questionnaire. Databases and their processing were performed using Excel software.

The pulmonary function was tested using a spirometer which according to sex, age, height and weight calculates the theoretical value (predicted) of the respiratory functions. The parameters evaluated by the device for respiratory function testing are: FEV_1-Forced Expiratory Volume in 1 second, FVC–Forced Vital Capacity, FEV_1/FVC–The ratio of FEV_1 to FVC expressed as percentage, FEF-25, FEF-50 and FEF-75-The usual intervals are 25%, 50% and 75% of FVC, PEF-Peak expiratory flow, MVV-Maximum voluntary ventilation, FET-Forced Expiratory Time and an estimation of “lungs age”.

The estimations of the associations between pesticide exposure and pulmonary function were performed using Excel software. In the statistical processing Student's t test was used for differences between averages, „χ^2 test" (Pearson Chi-square test) for frequencies and P-value≤0,05 was determined for the level of significance.

3. RESULTS

Out of the 27 subjects 15 were female and 12 male, aged between 22 and 68 years old, the average age being 44.72 years with a standard deviation of 12.49. Most respondents (93%) were aged between 30-70 years old, the most active period from the professional point of view.

In addition to the demographic and identification information contained in the questionnaire there is also information about the lifestyle of the subjects in study. Regarding smoking, from the 22 subjects exposed to pesticides, 45.5% declared that they had a history of smoking and 27.3% still smoke. Cigarette consumption for smokers was an average of a pack a day. 31% of smokers declared that they have smoked less than 5 years, 31% between 5 and 10 years, 15% 10-20 years and 23% have smoked more than 20 years. The group of subjects who did not report the use of pesticides is not currently smoking, one single subject declared previous smoking.

The personal pathological history reported by the subjects enrolled in this phase of the study consisted of respiratory diseases (9 subjects), cardiovascular diseases (7 subjects) and nervous system diseases (1 subject).

According to the questionnaire, in Sâncraiu area the activity in farms is mainly non-mechanized. Manual harvesting of crops has been reported in a significant percentage of 93%, leading to an increased risk of pesticide contamination by dermal contact.

When asked whether during their lifetime they have prepared or personally applied pesticides, 81.5% of the respondents answered YES. Most (26%) declared that they applied pesticides for more than 30 years. 22.2% stated the use of pesticides between 11-20 years, 18.5% between 6-10 years, 11.1% between 21-30 years and 3.7% less than one year.

Farming and livestock in the area represent important activities for the respondents. Preparation and application of pesticides were part of the common activity. The pesticide application process takes place, according to respondents' statements, utmost 5 days each year.

Regarding the pesticides application method, 21 subjects out of a total of 22 who use pesticides, use a spraying device with back tank, 2 subjects use a manual-handled spraying device and 2 subjects pour the powdered-form substance on animals. Of the total of 22 applicators, 7 subjects repair themselves the spraying and preparation equipment, without specialized help.

The most common types of pesticides used in Sâncraiu are the insecticides for crops (18 subjects out of 22 who use pesticides), pesticides for weed control (10 subjects) and insecticides for animals (10 subjects), and lastly insecticides for

pets (2 subjects).

All 22 respondents who use pesticides declared that the pesticides they use are purchased in liquid form, but 13 subjects purchase them also in powdered form.

In Sâncraiu locality the most common pesticides used are Calypso and Decis, listed in Group III - moderately toxic - and belong to the classes of neonicotinoid insecticides, and pyrethroids, respectively, with thiacloprid and deltamethrin as active substances.

After questionnaire processing there were identified subjects whose various symptoms relate to the pesticide use, as shown in Table 1.

Table 1. ***Symptoms related to pesticides use***

		Symptoms						
	frequency	**tired**	**headache/ dizziness**	**nausea and vomiting**	**skin irritations**	**eye irritations**	**chest discomfort**	**nervous/de pressed**
No. persons	**never/ seldom**	21	20	21	19	20	20	21
	sometimes	0	1	0	2	2	0	0
	frequently	1	1	1	1	0	2	1

The agricultural activity can become dangerous in many ways, thus the use of protective equipment is required. The personal protective equipment does not prevent accidents, but may prevent or reduce injury or even death.

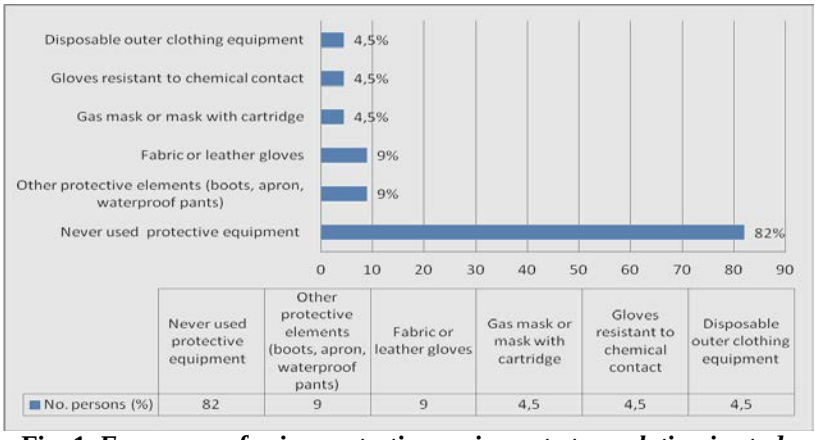

Fig. 1. ***Frequency of using protective equipment at population in study***

As shown in the figure above (Fig.1), 82% of all the subjects that use pesticides in agriculture have never used protective equipment, this being due to the lack of education regarding the use of pesticides. Gloves and face masks are very important in preventing poisoning with pesticides but are used in a small percentage.

Spirometry is the most common form of lung function testing, consisting in measuring volumes (quantities) and/or the flow rate (flow) of air that can be inspired and expired, being extremely important for the general health status screening of the respiratory tract.

The results of these examinations have revealed the following. The ratio between the achieved and the theoretical values of respiratory functions for the entire group examined are presented in Table 2.

Table 2. ***Actual and theoretical values for FEV1 and FVC of the group in study***

Total examined		Realized (L)	Predicted (L)	% Predicted	Significance of difference between realized and predicted	
					t	p
FEV1	mean	3,10	3,18	97,04	-0,41	0,68
	st.dev.	0,82	0,68	13,24		
FVC	mean	3,88	3,80	102,00	0,30	0,77
	st.dev.	1,01	0,86	13,00		

As observed, there are no significant differences between the theoretical and actual values. The forced vital capacity (FVC) determined in the investigated sample was 3.88 L ± 1.01, which represents 102% of the theoretical calculated values. The average forced expiratory volume in one second (FEV1) was 3.10 L ± 0.82, i.e. 97.04% of the theoretical value.

The forced expiratory flow during some fixed intervals (FEF 25-75%) show significant differences from theoretical values. For FEF 25% there are no significant differences between the determined and theoretical values, instead for FEF 50% and 75% the difference is highly significant (p=0.002). Other respiratory function parameters showed no significant differences between the determined and calculated theoretical values.

A next stage of the study was to evaluate the differences between the respiratory functions in the group that apply pesticides in relation to the group that do not apply pesticides.

Table 3. ***Respiratory samples values (FEV1, FVC) for those who apply pesticides and those who do not apply pesticides***

			Realized (L)	Predicted (L)	% Predicted	Significance of difference between the group that apply pesticides and the group that do not apply pesticides			
						t	p	χ^2	p
FEV1	**apply pesticides**	mean	3,08	3,18	96,55	-0,30	0,77	0,10	0,75
		st.dev.	0,83	0,73	12,73				
	not apply pesticides	mean	3,20	3,19	99,20				
		st.dev.	0,86	0,43	16,77				
FVC	**apply pesticides**	mean	3,89	3,83	101,55	0,24	0,82	0,34	0,56
		st.dev.	1,08	0,93	12,65				
	not apply pesticides	mean	3,80	3,67	104,0				
		st.dev.	0,71	0,46	15,87				

As shown in Table 3 and Figure 2, there are differences between the group exposed to pesticides and the not-exposed one, but they do not reach the significant

value for averages, also the Chi-square$_{(\chi 2)}$ tests do not show significant differences in terms of the determined percentage from the calculated theoretical one.

Also, the other parameters do not show significant differences neither as averages nor as frequencies.

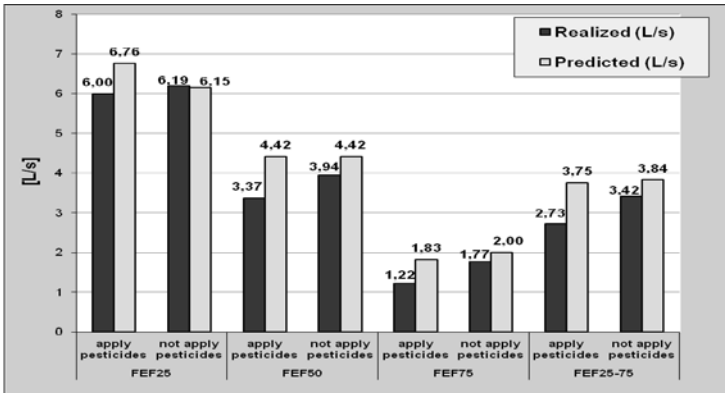

Fig. 2. ***Forced expiratory flow during some fixed intervals (25-75%) in the group that apply pesticides and the group that do not apply pesticides***

For FEF 25-75% it is observed that the differences between the determined and theoretical values are higher for the subjects exposed to pesticides (Fig. 2.).

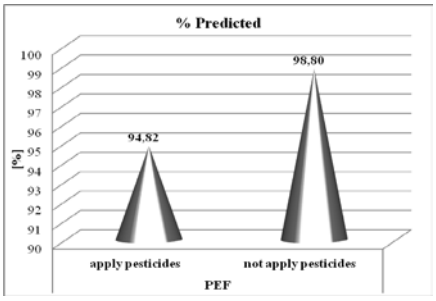

Fig. 3. ***Percentage values determined from the theoretical calculated values of PEF for those that apply pesticides and those that do not apply pesticides***

Fig.3 shows the difference between the percentage values determined from the theoretical calculated values of PEF for those that apply pesticides and those that do not apply pesticides.

Table 4. ***Respiratory samples values (MVV, FET 25-75%) and the significance of differences in averages for those that apply pesticides and those that do not apply pesticides***

		MVV (ind)	FET 25-75	Significance of differences in averages (MVV)		Significance of differences in averages (FET 25-75)	
				t	p	t	p
apply pesticides	mean	115,3	0,76	-0,30	0,78	0,38	0,72
	st.dev.	31,03	0,26				
not apply pesticides	mean	120,0	0,69				
	st.dev.	32,12	0,43				

As shown in Table 4 between the average values of MVV and FET 25-75% for those who apply pesticides and those who do not apply pesticides there are differences but they do not reach the significance threshold.

Table 5. ***Average values of lung age and the actual age and the significance of differences***

		Lung Age	Actual age	Significance of differences between the actual age and the lung age	
				t	p
apply pesticides	mean	51,5	46,91	-1,84	0,08
	st.dev.	16,1	11,15		
not apply pesticides	mean	34,4	35,07	0,14	0,90
	st.dev.	23,8	14,76		

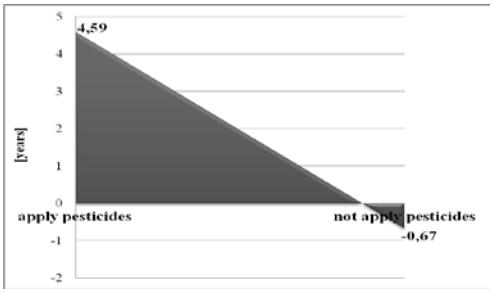

Fig. 4. ***Difference between the actual age and the estimated lung age in terms of exposure to pesticides***

As shown in Fig.4 for the group exposed to pesticides there is a big difference between the actual age and the age estimated by the spirometry device (4.59 years), close to the limit of significance (p=0.08) compared to the not-exposed group thereupon there is almost no difference.

4. CONCLUSIONS

Overall, for the group examined there are no significant differences between the tested pulmonary function values and the predicted ones in terms of age, sex, height and weight, except for the FEV 50% and 75% parameters, for which it is possible to consider a degree of bronchial obstruction. For all the explored functional respiratory parameters there are differences between the group that apply pesticides and the group that do not apply pesticides, but they do not reach the limit of statistical significance. There is a special situation in the case of the predicted lung age that is with 4.59 years higher for those exposed to pesticides and smoking in relation to those not exposed thereupon there is no difference.

The most widely used pesticides in the community under study belong to the groups of neonicotinoid and pyrethroid insecticides with moderate toxicity. In general the subjects prepare and apply pesticides and afterwards wash the utensils without using full protective equipment. The most commonly used applicators are those in the form of spray devices, especially for insecticides used on crops. In this context we consider that, as shown by the test results, the respiratory status of the subjects that use pesticides may be affected.

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