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A COMPARATIVE STUDY TO ASSESS THE PULMONARY FUNCTION TEST (PFT) AMONG AGRICULTURAL WORKERS WHO SPRAYED PESTICIDE AND NON-AGRICULTURE WORKERS IN WARDHA DISTRICT IN CENTRAL INDIA.

Community Medicine

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ABSTRACT

Increase in the use of chemicals as pesticides can result in various health and environmental problems. Therefore this study was conducted to compare Pulmonary Function Test between pesticide spraying agriculture workers and non-agriculture workers. It was a cross-sectional study. Agricultural pesticide sprayers and non agricultural workers who visited Rural Health and Training Center (RHTC) were interviewed for history of exposure with pesticide and further Pulmonary function test was conducted and those with ailments were referred to AVBRH Hospital in Wardha. Result showed the mean FVC in the pesticide exposed agricultural workers was 2.74 ± 0.70 and the non-agricultural workers 2.94 ± 0.63. On applying t test the result was significant. It can be concluded that agricultural workers exposed regularly to pesticide were more prone to pulmonary diseases.

KEYWORDS

Pesticide, Agricultural workers, Pulmonary Function Test

INTRODUCTION:

Pesticide poisoning is a major public health problem in many developing countries .In developing world, pesticide poisoning causes more deaths than infectious diseases. Pesticide poisoning among farmers and occupational workers in developing countries is alarming. WHO estimated approximately 20,000 workers die from exposure every year, the majority in developing countries. The number of intoxications with organophosphates is estimated at some 3000,000 per year. [1] Pesticides are playing a pivotal role in meeting the food, cotton fiber and tobacco demand of escalating population and non agricultural workers of vector-borne diseases. However, most of the applied pesticides get dispersed in the environment and affects the health of un-protected agricultural and industrial workers. The three major routes of entry for pesticides include contamination of the skin, lungs and the gut. So the pesticides are very harmful for human health especially for farmers who are more in contact with them. [2]

The promotion of High Yielding Varieties that marked the green revolution has led to large scale use of chemicals as pesticides. Increase in the use of chemicals as pesticides can result in various health and environmental problems like pesticides poisoning of farmers and farm workers, cardiopulmonary, neurological and skin disorders, fetal deformities, miscarriages, lowering the sperm count of applicators, . Indian pesticide industry is the fourth largest in the world. Of the total market, around 75% is accounted by insecticides. At present, India is the largest producer of pesticides in Asia and ranks twelfth in the world for the use of pesticides with an annual production of 90,000 tones. [3]

From the above mentioned facts it is very clear that pesticides are very harmful for farmers. So they should be aware of using pesticides in agriculture and their adverse effects on health. Low education levels of the rural population, lack of information and training on pesticide safety, poor spraying technology, and inadequate personal protection during pesticide use have been reported to play a major role in the intoxication scenario. In general, knowledge of the main determinants of pesticide exposure in developing countries is often poor and also exposure situations may differ among countries. [4]

Aim

To compare Pulmonary Function Test between agricultural workers exposed to pesticide and non-agricultural workers.

Objective

To compare Pulmonary Function Test between agricultural workers exposed to pesticide and non-agricultural workers.

MATERIALS AND METHODS

Study population: Agricultural pesticide sprayers and non agricultural workers who visited to RHTC Deoli, Department of Community Medicine. The participants were interviewed for history of exposure with pesticide and further PFT was conducted with their permission on consent form.

Study Design and settings: It was a Cross Sectional Study, conducted from September 2015 to August 2016. Deoli is 15 km away from Wardha. This study was conducted in the field practice area of Rural and Health Training Centre in Deoli, under the Department of Community Medicine Jawaharlal Nehru Medical College (JNMC). Literature review indicated that the prevalence of respiratory morbidity was found to be 41.5% [5] in agricultural pesticide sprayers and 22.7% [6] in non agricultural workers.

$N = \{p_1(1\,p_1) + p_2(1\,p_2)\} \times [z\alpha + z\beta]^2 \div (p_1\,p_2)$

P_1 = Prevalence of respiratory morbidity among study group = 41.5%

P_2 = Prevalence of respiratory morbidity among study group = 22%

$q_1 = 1 - P_1 = 58.5\%$

$q_2 = 1 - P_2 = 78\%$

$Z\alpha$ = value of normal deviate at 5 % level

$Z\beta$ = value of the normal deviate at 5% level

D = Difference in the proportion = 0.26

N = 83 in each group.

Study tool: A pretested questionnaire was prepared comprising of socio-demographic profile, work practices followed by agricultural pesticide sprayers, detail clinical history & physical examination & findings of Pulmonary Function Test. Pulmonary Function Test (PFT) of the participants were done by PC based spirometer (RMS Helios 401) following the protocol of the American Thoracic Society (ATS) [6].The individual were placed in a sitting position with their nose closed by their own hand. The procedure was repeated 4 times and the best maneuver was accepted.

The data were then compared with predicted values based on age, sex, height, and ethnic group and the following spirometric parameters were recorded for analysis, forced vital capacity (FVC) i.e. the volume of air in liters that could be maximally forcefully exhaled, forced expiratory volume at 1 s (FEV1) i.e. volume of air in liters that was forcefully exhaled for one second, the ratio of FEV1 to FVC (FEV1/FVC), expressed as percentage, forced expiratory at 25-75%

(FEF_{25-75}) which is the average expiration flow rate during the middle 50% of the FVC, and the peak expiratory flow rate (PEFR) the peak flow rate during expiration.

Miller's prediction quadrant [6] was used to classify the type of lung function deficits into three categories i.e. Restrictive type: FVC <80% of predicted value & FEV_1/FVC > 70%, of predicted value. Obstructive type: FVC>80% predicted value & FEV_1/FVC <70%predicted value Combined (Mixed) type: FVC <80% pre value & FEV1/FVC <70% predicted value.

Inclusion Criteria: Male agricultural pesticide sprayers, Male non Agriculture workers, Participants with same socio-economic status, Age group of between18-60 years, Agricultural pesticide exposed to exposed to pesticide more than 1 year, Participants who were willing to participate in the study.

Exclusion criteria: Chronic alcoholic patients, Chronic smokers, Diabetes patient, Cardiac Patients, Any Malignancy carrying patients, Chronic Renal Failure Patients, Chronic COPD patients, Participants below 18year and more than 60 year of age, Females, participants who were not willing to participate in the study.

Consent: After explaining the procedure in verbal and in written, the informed consent were obtained and data thus received were kept confidential.

Ethical Committee Approval: The study protocol was approved by Institutional Ethics Committee of Datta Meghe Institute of Medical Sciences (Deemed University). Necessary permission was taken from Physiology Department for spirometry.

Data collection: After building a rapport and ensuring confidentiality regarding the use of data for research purpose only. A pretested questionnaire was used for collection of the data. The data collection was done by a face to face interview; pulmonary function test was also carried out with referral to AVBRH hospital if needed for those found suffering from abnormal function test for further management.

Statistical Analysis: The data was entered into a computerized Excel (Microsoft Excel 2007) spreadsheet. Subsequently it was analyzed using SPSS (Statistical Package for Social Sciences) Version 16.0 Data were tabulated according to frequency distribution tables. Quantitative variables such as age, duration of working, Spirometric reading were summarized through mean, Standard Deviation etc.

RESULTS

Table 1: Duration of work experience in field (agricultural pesticide sprayers)

Duration of exposure to pesticides (in years)	Agricultural Pesticide Sprayers n=83 (%)
<2	6 (7.22%)
2-5	31 (37.34%)
>5	46 (55.42%)
Total	83 (100.00%)

Table 2: Distribution of agricultural pesticide sprayer

Agricultural Pesticide Sprayers	No of workers n = 83 (%)
Occasional Sprayer	39 (46.98%)
Regular Sprayer	44 (53.02%)

Table 3: Findings in PFT (Pulmonary Function Test) of the study participants

Participants	Pulmonary Function Test				Chi Square Test
	Normal (%)	Obstructive (%)	Restrictive (%)	Mixed (%)	
Agricultural Pesticide Sprayers n=83 (%)	42 (50.60%)	16 (19.27%)	19 (22.90%)	6 (7.23%)	P=0.007 (<0.05) $\chi2$= 12.714 Df=3 Significant
Non agricultural Workers n= 83 (%)	64 (77.10%)	8 (9.64%)	8 (9.64%)	3 (3.62%)	

Table 4: Relation between the Pulmonary Function Test and the Pesticides exposed Agricultural & Non Agricultural workers

Pulmonary Function Test (PFT)	Pesticide Exposed Agricultural workers	Non - agricultural Workers	t test
FVC (L) Mean ± SD	2.74 ± 0.70	2.94 ± 0.63	t = ─2.393 p= 0.018 Significant
FEV1 (L) Mean ± SD	2.38 ± 0.74	2.58 ± 0.66	t = ─ 1.838 p= 0.068 Non-Significant
PEFR (L/S) Mean ± SD	5.78 ± 1.76	5.86 ± 1.72	t = ─ 0.296 p=0.767 Non-Significant

Table 5: Relation between PFT and Distribution of pesticide sprayers

Distribution of Exposure	Pulmonary Function Test				Chi Square Teat
	Normal (%)	Obstructive (%)	Restrictive (%)	Mixed (%)	
Occasional Sprayers n=39 (%)	22 (56.41%)	7 (17.94%)	8 (20.52%)	2 (5.13%)	$\chi2$=0.552 df =3 P=1.000 Non-Significant
Regular Sprayers n=44 (%)	20 (45.45%)	9 (20.45%)	11 (25.00%)	4 (9.10%)	

Table 6: Relation between the Pulmonary Function Test and Type of Pesticide Sprayer

Pulmonary Function Test (PFT)	Type of Pesticide Sprayers		t- test
	Occasional Pesticide Sprayer	Regular Pesticide Sprayer	
FVC(L) Mean ± SD	2.18 ± 0.69	2.73 ± 0.76	t = ─3.435 p =0.000 Significant
FEV1(L) Mean ± SD	2.48 ± 0.64	2.35 ± 0.78	t =0.824 p=0.413 Non Significant
PEFR(L/s) Mean ± SD	5.78 ± 1.65	6.10 ± 1.59	t = ─0.899 p=0.371 Non Significant

Table 7: Association between Duration of Exposure to pesticide and PFT

Duration of exposure to pesticide	Pulmonary Function Test (PFT)				Chi Square Test
	Normal (%)	Obstructive (%)	Restrictive (%)	Mixed (%)	
≤ 5YEARS n= 37 (%)	25 (65.56%)	7 (18.91%)	4 (10.81%)	1 (2.72%)	$\chi2$=9.950 df = 3 p= 0.024 Significant
> 5YEARS n=46 (%)	17 (36.95%)	9 (19.56%)	15 (32.66%)	5 (10.83%)	

Table 8: Relation between the Duration of exposure to pesticide and Pulmonary Function Test (PFT)

Pulmonary Function Test (PFT)	Duration of exposure		t-test
	≤ 5YEARS n= 37	> 5YEARS n=46	
FVC (L) Mean ± SD	2.86 ± 0.69	2.67± 0.706	t =1.179 p=0.242 Non-Significant
FEV1(L) Mean ± SD	2.53 ± 0.62	2.28 ± 0.77	t =1.601 p=0.113 Non-Significant
PEFR(L/s) Mean ± SD	6.15 ± 1.62	5.51 ± 1.92	t =1.616 p= 0.110 Non-Significant

DISCUSSION

Table 1 shows that 6(7.22%) of agricultural pesticide sprayers had the experience of spraying pesticide was less than 2 years, 31(37.34%) of agricultural pesticide sprayers had the experience of spraying pesticide was between 2-5 years.46 (55.42%) of agricultural pesticide sprayers had the experience of spraying pesticide was more than 5 years. Table 2 shows that the agricultural pesticide sprayers were divided into 2 groups according to their working type 39(46.98%) were occasional pesticide sprayer and 44(53.02%) were regular pesticide sprayer.

Table 3 shows that in **Agricultural pesticide sprayer** Normal PFT was 50.60% followed by the Obstructive lung disease 19.27%, restrictive lung disease 22.90%, and mixed lung disease 7.23% and in **Non agricultural workers** Normal PFT was 77.10%%, followed by the Obstructive lung disease 9.64%%, restrictive lung disease 9.64%, and mixed lung disease 3.62%. The result was significant on applying the Chi square test thus clearly indicating that agricultural workers had abnormal or deranged PFT.

Table 4 **s**hows that the mean FVC in the pesticide exposed agricultural workers was 2.74 ± 0.70 and the non-agricultural workers were 2.94 ± 0.63. On applying t test the result was significant. The mean FEV1 in the pesticide exposed agricultural workers was 2.38 ± 0.74 and the non-agricultural workers was 2.58 ± 0.66. On applying t test the result was non-significant. The mean PEFR in the pesticide exposed agricultural workers was 5.78 ± 1.76 and the non-agricultural workers was 5.86 ± 1.72. On applying t test the result was non-significant. Again it can be interpreted that the PFT parameters were affected in agricultural workers who were exposed to pesticides.

Chakraborty S et al, [6] in 2009 a similar study was conducted on "pesticide exposed agricultural workers", found restrictive lung disease in 28.7% agricultural workers compared to 15.2% non agricultural workers, followed by obstructive lung diseases in 17.0% agricultural workers compared to 6.6% non agricultural workers, mixed lung disease in 3.2% of agricultural workers compared with 0.9% of non agricultural workers Chi square test was significant. According to this study prevalence of lung function deficit was much greater in regular sprayers 57.5% than in occasional sprayers and the Chi square test was significant.

Table 5 **s**hows that in **Occasional sprayers** Normal PFT was 56.41% followed by the obstructive lung disease 17.94% restrictive lung disease 20.52% and mixed lung disease 5.13% and in **Regular Sprayers** Normal PFT was 45.45% followed by the Obstructive lung disease 20.54%, restrictive lung disease 25.00% and mixed lung disease 9.10%. The result was non-significant on applying the Chi square test.

Table 6 shows that the mean FVC in the Occasional Pesticide Sprayer was 2.18 ± 0.69 and in the Regular Pesticide Sprayer it was 2.73 ± 0.76. On applying t test the result was significant. The mean FEV1 in the Occasional Pesticide Sprayer was 2.48 ± 0.64 and the Regular Pesticide Sprayer was 2.35 ± 0.64. On applying t test the result was non-significant. The mean PEFR in the Occasional Pesticide Sprayer was 5.78 ± 1.76 and the Regular Pesticide Sprayer was 6.10 ± 1.59. On applying t test the result was non-significant. The parameters in the regular pesticide sprayers were found reduced.

Table 7 **s**hows that in **≤ 5 years exposure to pesticide** normal PFT was 65.56% followed by the obstructive lung disease 18.91%, restrictive lung disease 10.81%, and mixed lung disease 2.72%, in **> 5 years exposure to pesticide,** normal PFT was 36.95% followed by the obstructive lung disease 19.56%, restrictive lung disease 32.66% and mixed lung disease 10.83%. The result was significant on applying the Chi square test.

Table 8 **s**how that the mean FVC in the ≤ 5YEARS duration of pesticide exposure was 2.18 ± 0.69 and > 5YEARS duration of pesticide exposure was 2.73 ± 0.76. On applying t test the result was significant. The mean FEV1 in the ≤ 5YEARS duration of pesticide exposure was 2.48 ± 0.64 and > 5YEARS duration of pesticide exposure was 2.35 ± 0.64. On applying t test the result was non-significant. The mean PEFR in the ≤ 5YEARS duration of pesticide exposure was 5.78 ± 1.76 and > 5YEARS duration of pesticide exposure was 6.10 ± 1.59. On applying t test the result was non-significant.

In the present study it was found that Mean ±SD of FVC (L) was significant while, FEV1 (L), PEFR (L/s) was non- significant. In the present study the relation of PFT between the occupational and regular pesticide exposure was significant in FVC, while the result was non-significant in FEV1, & PEFR.

Chakraborty S et al, [6] also found that the result between agricultural workers and non agricultural workers group was found to be significant after comparing the Mean ±SD of FVC, FEV1, and PEFR. It was also observed that the Mean FVC, FEV_1, FEV_1/FVC, FEF_{25-75} was decreased because of exposure to pesticide and dust for long duration.

CONCLUSION

Study concludes importance of proper protective measures; highlighting the basic protective measures during pesticide spraying, as their nonobservance was found to be associated with abnormal lung function test. Regular agricultural pesticide workers were more prone to pulmonary defects as finding suggest but participants were still unaware about adverse effect on their health.

Recommendation

Need to have intensive information, education and communication (IEC) especially to create awareness among the pesticide sprayers on the importance and continuous use of personal protective measures during the working hours, about the sign and symptoms of accidental and acute poisoning and the preventive care which will improve the quality of life.

Selection of appropriate pesticides and their handling and use as per the label are the most important steps for safe use of chemical pesticides. For this, the Government needs to develop mechanisms for enforcing the regulations for the overall management and use of pesticides, adopting FAO guidelines with adequate education and training.

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