International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2013): 4.438

A Study on Effect of Inhaled Pesticides on Pulmonary Function Tests in Farmers

Dr. R.S. Khane[1], Bharti Arora[2]

Department of Physiology, B.K.L. Walawalkar Rural Medical College, Sawarde

Abstract: ***The present study was done to evaluate the effect of inhaled pesticides on the respiratory function of farmers in rural area of Kolhapur . It was done in 225 participants (Study group-150, Control group- 75) .Respiratory symptoms were noted in both the groups. Pulmonary Function Test was done using a Spirometer (RMS-HELIOS 702 by following standard protocols. It was found that respiratory symptoms like cough, dyspnoea, Wheeze, Sore throat, Haemoptosis were more common in study group as compare to control group. Also the parameters of Pulmonary Function Test viz, FVC, FEV_1, PEFR, MVV were significantly decreased (p < 0.0001) in study group as compare to control group. The present study demonstrated significant decline of various parameters of pulmonary functions test in farmers exposed to pesticides, which is indicator of adverse effects of inhaled pesticide on respiratory functions.***

Keywords: Pesticide, Farmers , Pulmonary Function Test, Respiratory symptoms

1. Introduction

India is an agricultural country and also a major producer and consumer of pesticides. It is the pesticides which has achieved a central place of agricultural practices in India and also a major contributory factor in green revolution of india. But the use of pesticides have credits in trerms of increased economic potential of farmersand so as of nation as well as debits as it has serious effects on health of mankind and his environment.

By their very design most of the pesticides are highly toxic [1,2]. Protection of workers against work related injuries and illness has over the years been an issue of great concern because safe working environment will promote the physical ,mental and social well being of workers at work paces resulting in effective work output. With no exception to this, farmers who are the backbone and the marrow of Indian agricultural economy are regularly exposed to pesticides in many ways and face greater threats ,from pesticides exposure including acute poisoning as well as long term-effects [3].

Pesticide applications can have unwanted health consequences by affecting no. of enzymes and physiological systems such as CNS, CVS, and Reproductive etc[4]. Several earlier studies have reported increased respiratory problems such as cough, asthama, chronic bronchitis among agricultural works. Earlier reports also showed that farmers get exposed through inhalation to the pesticides after spraying and cause acute irritant response in the lungs[5]. But relatively small no. studies have assessed the pulmonary function tests to study long term pesticide exposure on farmer's health[6,7,8].

Also in developing countries like india farmers get direct exposure of pesticides due to unsafe and non preventive work practices of pesticides spraying like improper handling of pesticids, poor housekeeping of pesticides, extensive pesticide usage as well as improper pesticide storage leading to increase respiratory dysfunction is reported in several studies of various pesticide exposed population[6,7]. However, there is a paucity of data of such reports in rural population of India which are at higher risk. Kolhapur is a district in western Maharashtra of India where majority of population are indulged in agriculture. So keeping all these facts in mind the present study do the assessment of respiratory function among farm workers occupationally exposed to pesticides.

Objectives

1) To assess the health status of agricultural workers occupationally exposed to pesticides.
2) **To find out the respiratory symptoms in study population.**
3) To study the pulmonary function test in study and control population
4) To compare and contrast pulmonary function test and respiratory symptoms in study and control group.

2. Methodology

This cross sectional study was undertaken among 150 farm workers directly exposed to pesticides compared with 75 controls to assess the respiratory illness, lung functions. The farmers were working in farms in the rural area of Kolhapur.

2.1 Study Population

Sample size- Total 225 subjects were included in the study.
Study group-n= 150
Control group-n=75

2.2 Data Collection

Subjects were selected on the basis of the results of a preliminary questionnaire specifically designed for this study. Subject from the control group were selected from the general population not directly exposed to the pesticides.

2.3 Selection Criteria

Farm workers occupationally exposed to the pesticides were randomly selected on the basis of inclusion and exclusion criteria.

Licensed Under Creative Commons Attribution CC BY

Inclusion criteria: farm workers (exposed subjects) included:
1. Male farm workers with age group of 18–60 yrs.
2. Male farm workers having at least six months previous experience in spraying operations in the field.

Exclusion criteria of male farm workers (exposed subjects) included:
1. Male farm workers less than 18 yrs of age and greater than 60 yrs.
2. Male farm workers with less than six months work experience.
3. Female subjects.

Control subjects were randomly selected on the basis of inclusion and exclusion criteria.

Inclusion criteria of control subjects included

Male resident who did not handle pesticides and having similar socio economic status and age group of exposed subjects.

Exclusion criteria of control subjects include:
1. Male subjects with age group less than 18 yrs of age and greater than 60 yrs and those handling pesticides.
2. Female subjects

The criteria for the withdrawal of subjects: If study or control subject was not ready to participate in the study after giving detail explanation of the study, he was free to discontinue/withdraw at any stage of procedure *viz.*, collection of personal background information or during clinical procedures.

3. Procedure and Instruments

All the participants were subjected for routine general examination (pulse, BP, respiratory rate,pallor cyanosis, clubbing), anthropometric measurements which included height ,weight, chest circumference ,inform consent was taken from all the participants. The study was conducted after approval of institutional ethical committee.

Questionnaire

A preliminary questionnaire was designed to record the personal and occupational information along with pesticide exposure and respiratory health.

Clinical Examination

Clinical examination for respiratory health was done and the symptoms for respiratory illness were recorded in the questionnaire for every individual who had participated in this study. Ethical clearance was obtained from "Ethics Committee" All the documents including questionnaires and consent forms of all the participants were safely kept for data analysis.

Lung Function Tests

Lung function tests FEV_1 (Forced Expiratory Volume in 1 second), PEFR (Peak Expiratory Flow Rate) and FVC (Forced Vital Capacity) for pulmonary impairment of each subject (pesticide sprayers and control) were performed using a Spirometer (RMS-HELIOS 702 by following standard protocols . The purpose of the lung function test was to evaluate pulmonary impairments among study subjects. The volunteer performed the lung function test three times allowing for sufficient rest between repetitions. The best values for PEFR, FEV_1 and FVC from three tests for each subject were recorded. Results were interpreted with the predicted values of lung function parameters calculated by reference equation for Indian population. All data was analyzed statistically by decade age groups adjusting for smoking habits.

4. Observation and Results

The present study was done in 225 participants (study group-n=150 , Control group n= 75). The Mean age of participants of study group is 32.7±5.2 and that of control group 35.2 ± 4.1. The Mean weight of participants of study group is is 60.53 ±7.3 and their mean height is 152.8± 6.3. The Mean weight participants of control group is 62.81±5.5 and their mean height is 153.2 ± 6.12

Table no. 1 showed prevalence of various respiratory symptoms in study and control group. The respiratory symptoms were more common among the study group than control group .Overall prevalence of respiratory symptoms among study group 28.6% which is like statistically significant when compared with control group.

Table no. 2 showed that all the parameters of Pulmonary Function Test were significantly decreased ($p < 0.0001$) in study group as compare to control group.

5. Discussion

The literature review suggests that the results of majority of the studies are consistent with known respiratory irritant effects associated with significant decline in lung function parameters as well as serum cholinesterase activity due to pesticide exposure.

In the present study participants are engaged in farming occupation for 10-15 years on an average. This long term exposure to pesticides leads to the various adverse effects on their health. At the same time it is noteworthy that majority of study population was having unsafe exposure to pesticides. Also they were having very poor knowledge about the pesticide effects and use of personal protective equipment. Chitra GA et al done study of health status of south Indian farmers including both males and females exposed to pesticides. They used questionnaire to assess the health status of participants. It was found that as most of the participants are not using the personal protecting devices get direct exposure to the pesticides which in turn leads to serious health impairement[9] So, all these factors give a cumulative effect on the health of farmers.

In the present study , out of 150 farmers of study group 43 farmers showed the occurrence of various respiratory symptoms which is in agreement of other studies showing the presence of respiratory symptoms in pesticide exposed population [10,11,12]. It clearly indicates that farmers are at increased risk of developing respiratory symptoms than the control group. It is explained by some researchers that pesticides inhibit acetylcholine esterase that in the context of

Licensed Under Creative Commons Attribution CC BY

respiratory symptoms results in mucus hypersecretion and potentially, airway smooth muscle contraction (bronchospasm). These actions of pesticides results in dysponea, cough and other respiratory symptoms in pesticide exposed population [6, 9].

Most of the participants of the study showed decline in PFT parameters as detected by spirometry and are considered to be reliable indices of airflow limitation.

The present study showed that the Pulmonary Function Test parameters viz. FVC, FEV1, PEFR, MVV was decreased in farmers exposed to pesticides as compared to control. These derangement in PFT parameters may be due to more duration of working daily and that too again for longer duration (10-15 yrs) as well as continuous unsafe exposure to pesticides.

Similar findings were observed in Chakraborty S et al [6], studies done in South Korean farmers, farmers of Ethiopia[11].They found statistically significant decrease in FVC, FEV_1, PEFR, and MVV

The decline in lung function parameter could be explained with the association between pesticides agents to influence the immunological and neutrophilic inflammatory response [5].

In our study as the participants were all non smokers. So the deranged parameters of PFT are not related to the smoking habit. Also, the animal experiments demonstrated that the epithelial hyperplasia, thickening of the alveolar capillary membrane leads to derangement of alveoli and neuromuscular changes in respiratory muscles[13, 14]. Pesticides get absorbed very slowly through the stomach, intestine and skin but more quickly through the lungs leading to impairment of lung function following exposure. So it indicates that exposure of farmers to pesticides through inhalation deserve particular attention.[15]

Also the study group did not use any protective measures while spraying. So in addition to pesticide inhalation a dermal route of exposure, could be associated with pesticide exposure. But it was reported that the absorption is rapid when exposure occurs via inhalation and pesticides mainly OP compounds reach systemic circulation bypassing the liver where they metabolized.[16]

Studies demonstrated that pesticide exposure causes increase airway resistance ,increase closing volume and reversible reduction of FVC. These findings are in aggrement with the findings of our study as well as other Indian studies[17]. Also the present study underlines certain physiological dysfunctioning effects of respiratory system which are constantly observed in other studies of occupationally exposed farmers to pesticides.

The data generated in the present study suggests that the chronic exposure to the pesticides account for substantial pulmonary function impairment which merits attention as of the individuals are likely to remain asymptomatic till significant lung damage results.

Farmers are regularly exposed to high levels of pesticides leading to serious health impacts. Workers lack adequate information to protect themselves from pesticides. Thus, the present study demonstrated decreased pulmonary functions in farmers exposed to pesticides, which is similar to findings by previous studies.

6. Summary and Conclusion

While exploring the respiratory status of farmers exposed to inhaled pesticides, the present study considered the subjects having same socioeconomic, demographic profile. Regarding the knowledge about the use of pesticide and use of personal protective equipment working in the farms , it showed very poor response. Majority of participants are working in the farms for more than 10 years. This unsafe exposure for longer duration resulted in decrement in lung function parameters studied by spirometry with increment in respiratory symptoms as compared to control group. Also farm workers have very little or no control over factors that lead to their pesticide related illness such as unsafe exposure to pesticide sprayed area, early re- entry into pesticide treated areas and being present in the treated area at the time of pesticide application as well.

7. Suggestions

It can be suggested that due emphasis should be given on the adaptation of protective measures among the farmers. Also periodic monitoring of pulmonary function test is suggested for early detection of lung disease.

8. Acknowledgement

The authors duly acknowledge the ICMR for providing permission and financial assistance for conducting the study under ICMR- STS Grant 2014.

References

[1] Ntzani EE, Chondrogiorgi M, Ntritsos G, Evangelou E, Tzoulaki I Literature review on epidemiological studies linking exposure to pesticides and health effects. EFSA supporting publication 2013:EN-497, 159 pp.
[2] Kaiser Jamil, G. Prabhavathy Das ,Abjal Pasha Shaik, Sunita S. Dharmi and Sudha Murthy Epidemiological studies of pesticide exposed individuals and their clinical implications CURRENT SCIENCE, FEB 2007; 340 VOL. 92, NO. 3.
[3] M Balali-Mood , K Balali-Mood , M Moodi , B Balali-Mood Health Aspects of Organophosphorous Pesticides in AsianCountries, Iranian J Publ Health, , Oct 2012;Vol. 41, No.10, pp. 1-14 .
[4] K. R. Dey, P. Choudhury and B. K. Dutta Impact of pesticide use on the health of farmers: A study in Barak valley, Assam (India) J. Environ. Chem. Ecotoxicol; November, 2013(Vol. 5(10), pp. 269-277.
[5] Mohd. Fareed, Manoj Kumar Pathak, Vipin Bihari, Ritul Kamal, Anup Kumar Srivastava, and Chandrasekharan Nair Kesavachandran Adverse Respiratory Health and Hematological Alterations among Agricultural Workers Occupationally Exposed to

Licensed Under Creative Commons Attribution CC BY

Organophosphate Pesticides: A Cross-Sectional Study in North India , PLoS One. 2013; 8(7): e69755.
[6] Chakraborty S, Mukherjee S, Roychoudhury S, Siddique S, Lahiri T, Ray MR.Chronic exposures to cholinesterase-inhibiting pesticides adversely affect respiratory health of agricultural workers in India. J Occup Health. 2009;51(6):488-97.
[7] Chandrasekharan Nair Kesavachandran, Subhodh Kumar Rastogi, Neeraj Mathur, Mohammad Kaleem Javed Siddiqui et al Health Status Among Pesticide Applicators at a Mango Plantation in India Journal of Pesticide Safety Education 2006 vol. 8 ; 1-9.
[8] Eun Shil Cha, Yun Keun Lee, Eun Kyeong Moon, Yong Bae Kim, Yong-Jin Lee, Woo Chul Jeong et al Paraquat application and respiratory health effects among South Korean farmers. Occup Environ Med 2012 Jun 2; 69(6):398-403.
[9] Chitra GA, Muraleedharan VR, Swaminathan T, Veeraraghavan D Use of pesticides and its impact on health of farmers in South India; International journal of occupational and environmental health 12:3 pg 228-33.
[10] Hernández AF, Casado I, Pena G, Gil F, Villanueva E, Pla A Low level of exposure to pesticides leads to lung dysfunction in occupationally exposed subjects. Inhalation toxicology 2008 Jul; 20:9 pg 839-49.
[11] Mekonnen Y, Agonafir T.Lung function and respiratory symptoms of pesticide sprayers in state farms of Ethiopia. Ethiop Med J. 2004 Oct; 42(4):261-6
[12] Hoppin JA, Umbach DM, London SJ, et al .Pesticide use and adult-onset asthma among male farmers in the Agricultural Health Study. Eur Respir J 2009; 34: 1296–1303.
[13] Fieten KB, Kromhout H, Heederik D, van Wendel de Joode B Pesticide exposure and respiratory health of indigenous women in Costa Rica , American journal of epidemiology 2009; 169:12 pg 1500-6.
[14] Pathak MK, Fareed M, Srivastava AK, Pangtey BS, Bihari V, et al. Seasonal variations in cholinesterase activity, nerve conduction velocity and lung function among sprayers exposed to mixture of pesticides. Environ Sci Pollut Res 2013; 11356
[15] Insecticide Factsheet, Pyrethrins/Pyrethrum Journal of pesticide reform/Spring 2002 vol. 22 vol. 14-20
[16] Peiris –John RJ, Ruberu DK, WickremasingheAR, Vander-Hoek W. Low –level exposure to organophosphate pesticides leads to restrictive lung dysfunction. Respir Med 2005;99:1319-24.
[17] Fareed M, Pathak MK, Bihari V, Reddy MMK, Patel DK, et al. Haematological and biochemical alterations in sprayers occupationally exposed to mixture of pesticides at a mango plantation in Lucknow, India. Toxicological & Environmental Chemistry 2010 ; 92(10): 1919–1928.

Table 1: Prevalence of respiratory symptoms in study and control group

Respiratory symptoms	*Study Group (n=150)*	*Control Group (n=75)*
Dyspnoea	40 (33.3%)	3 (4%)
Cough-Dry	30 (20%)	7 (9.3%)
Wet	12 (8%)	0 (0%)
Wheeze	23 (15.2%)	0 (0%)
Sore throat	11 (7.2%)	3 (4%)
Haemoptosis	2 (1.3%)	0 (0%)

Table 2: Comparison of PFT parameters in study and control group

PFT parameters	Study group	Control group	T-Value	Level of Significance
FVC(lit)	2.40+0.31	3.52 (±0.59)	18.68	P < 0.0001
FEV1(lit)	2.37+0.57	3.45 (±0.55)	11.68	P < 0.0001
PEFR(lit/min)	5.74+1.23	6.28 (±1.5)	2.88	P < 0.0001
MVV	69.13+10.1	81.3 (±11.5)	8.10	P < 0.0001

FVC - forced Vital Capacity ,FEV1 - Forced expiratory Volume1,PEFR - Peak Expiratory Flow Rate,MVV - Maximum Voluntary Ventilation

Licensed Under Creative Commons Attribution CC BY