

RESEARCH ARTICLE

A study of peak expiratory flow rate in poultry industry workers of India

Manpreet Kaur Taluja¹, Vidushi Gupta², Garima Sharma², Jaspreet Singh Arora³

¹Department of Physiology, Netaji Subhash Chandra Bose Medical College, Jabalpur, Madhya Pradesh, India, ²Department of Physiology, Dayanand Medical College, Ludhiana, Punjab, India, ³Department of Animal Biotechnology, Guru Angad Dev Veterinary Animal Sciences University, Ludhiana, Punjab, India

Correspondence to: Manpreet Kaur Taluja, E-mail: drmanpreet17@gmail.com

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ABSTRACT

Background: Routine exposure to poultry dust is an important source of indoor air pollution in poultry farms to which the poultry industry workers are exposed. Peak expiratory flow rate (PEFR) is helpful in detecting respiratory morbidity at an initial stage of its development. **Aims and Objectives:** The aims and objectives were to study and compare PEFR in poultry industry workers of India. **Materials and Methods:** PEFR was measured in 66 poultry industry workers and compared with demographically matched 66 healthy controls using an autospirometer. The data were analyzed using Student's *t*-test. **Results:** We found that the mean PEFR value was 5.86 ± 1.828 L/S in poultry industry workers and 8.36 ± 1.730 L/S in healthy controls. The difference was found to be highly statistically significant ($P = 0.000$). **Conclusion:** It was concluded that PEFR in poultry industry workers exposed to poultry dust is less than that of healthy controls.

KEY WORDS: Peak Expiratory Flow Rate; Poultry Dust; Poultry Industry Workers; Spirometry

INTRODUCTION

The incidence of occupational diseases is becoming alarming high day by day. The respiratory hazards caused depend on the type of pollutants to which the workers are exposed. The term occupational disease refers to any disease contracted as a result of an exposure to risk factors arising from work activity.^[1] Many pulmonary diseases arising out of workplace environment and the subsequent exposure to harmful substances are being recognized in the 21st century. Occupational respiratory diseases are usually caused by extended exposure to irritating or toxic substances that cause acute or chronic respiratory ailments. It poses a major health risk for people working in the poultry industry.^[2]

Poultry industry is growing at a fast rate in India. With poultry population showing an annual growth rate of 12.39%, this industry provides a good source of employment for the masses.^[3] Livestock and poultry farming have developed from small backyard farms to proper confinement buildings. There are many diversified types of businesses to poultry farming besides egg production, broiler production such as chick production, production of hatching eggs, and feed manufacture. By-products such as poultry manure can be used as an effective fertilizer in agro-farming. Almost all parts of poultry have one or the other kind of use. For example, fertile eggs are used in vaccine preparation, inedible eggs from hatchery as animal feed, and fertilizer albumen in pharmaceuticals preparations, paints, varnishes, and adhesives. Egg yolk is used in the manufacture of soap, paint, and shampoos and egg shell as a mineral mixture. Feathers are used in millinery goods and endocrine glands are used for the preparation of hormones. India's export of poultry products has increased exponentially during recent years.^[4]

Poultry farmers raise chickens and other fowls for meat and egg production purposes. They are responsible for the daily

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care of the birds. They are involved in distributing feeds to them, administering medications, cleaning the enclosures, and removing the dead or sick birds. They maintain proper ventilation and keep the facility in good working condition. The work environment is dirty and smelly. There is a production of high amount of dust arising during these work activities.^[5,6] Dust exposure in the workplace is an important occupational health problem for the poultry farm workers. In India, the exact magnitude of the problem is still not known.

A study conducted in poultry confinement buildings in Switzerland reported that the workers were exposed to very high levels of inhalable dust ($26 \pm 1.9 \text{ mg/m}^3$ dust level) and $6198 \pm 2.3 \text{ EU/m}^3$ of endotoxin concentration.^[7] The bacterial air contamination too was very high containing both Gram-positive and Gram-negative bacteria. Poultry dust is also high in protein content with an increased risk of respiratory sensitization.^[8] Chicken droppings contain excreted serum protein antigens.

Occupational asthma is an allergic reaction that can occur in some people when they are exposed to certain substances in the workplace, for example, grain, storage mites, and fungal spores.^[9] These substances are called respiratory sensitizers or “asthmagens” and form some of the constituents of poultry dust. They can cause a change in people’s airways, known as the “hypersensitive state.” Not everyone who becomes sensitized goes on to get asthma. However, once the lungs become hypersensitive, further exposure to the substance, even at quite low levels, may trigger an attack.^[10] Wheezing had been reported in one-third of Spanish poultry workers working inside confinement buildings; the cause of this was attributed to occupational asthma caused by storage mites.^[11] A study reported the role of northern fowl mite in occupation-related respiratory disease in poultry workers.^[12] Furthermore, the organic dust contains endotoxin (derived from the cell wall of gram-negative bacteria) which is capable of harming the airways by causing inflammation.^[13] The airways swell and tighten, and this causes the production of symptoms such as cough, wheezing, chest tightness, and breathlessness at or after work. Moreover, working in poultry dust environment can worsen the symptoms in people who already have asthma.

Pulmonary function tests (PFTs) are essential to assess pulmonary function status and respiratory efficiency. The knowledge of PFTs is a basic requirement to understand the respiratory physiology for all medical physiologists and clinicians.

Peak expiratory flow rate (PEFR) (L/S) - It is the largest expiratory flow rate achieved with a maximally forced effort from a position of maximal inspiration^[14] The PEFR is an effort-dependent lung parameter emerging from the large airways within about 100–120 ms of the start of the forced expiration. It is an effective measure of effort-dependent airflow, and it indicates mainly the caliber of bronchi and

larger bronchioles^[15]. It is an important diagnostic and prognostic tool in lung function studies for identifying airflow limitations, its severity, and variations.^[16] PEFR does not detect small airways obstruction.^[17] It is a good indicator of bronchial hyperresponsiveness. Bronchoconstriction is one of the components in the pathophysiology of asthma.^[18]

There is a shortage of data on PEFR in poultry industry workers of India which highlights the need for research in this area. Hence, this study was done to record and compare the PEFR in poultry industry workers and healthy controls.

MATERIALS AND METHODS

The subjects included for the study were in the 18–60 years of age group and non-smokers. Subjects who were smokers, suffering from chronic chest diseases and with spine and rib cage deformities, were excluded from the study. Proper counseling of every subject was done, and after a written informed consent, initial interviews, and clinical examinations, 66 poultry industry workers were selected. All were male poultry workers. 66 healthy subjects from general population were selected as control group. They were demographically matched.

The subjects underwent spirometry procedure in standing posture, and all the precise techniques of performing lung function test were explained as per the ATS/ERS 2005 guidelines.^[19-21] PEFR was recorded in liters per second by computerized spirometer (Helios 701: Chandigarh) [Figure 1]. Permission of the study was taken from the Institutional Ethical Committee. All data were collected at the Physiology department, Dayanand Medical College and Hospital, Ludhiana, India.

Statistical Analysis

Statistical analysis was performed by Student’s *t*-test to compare the means of controls and cases (poultry industry workers). The data were statistically analyzed by IBM SPSS Statistics Version 20. Mean and standard deviation were computed.



Figure 1: Computerized spirometer (Helios 701:Chandigarh)

RESULTS

The mean age of the controls was 30.62 ± 1.39 years and the poultry industry workers was 32.62 ± 1.314 years. Table 1 shows mean PEFR (L/S) of the subjects. The mean PEFR of poultry industry workers (5.86 ± 1.828 L/S) was lower than that of controls (8.36 ± 1.730 L/S), and the difference was found to be highly statistically significant ($P = 0.000$). Table 2 shows a comparison of predicted and observed values of PEFR. None of the poultry workers used respiratory protective equipment during work.

DISCUSSION

The poultry workers in the present study showed a statistically significant decrease in PEFR ($P = 0.000$) indicating large airway obstruction. The other aspects of this study commendable to be bothered are that none of the poultry farm workers used respiratory protective measures during work. The scarce use of respiratory protective devices by workers may contribute to the negative effects on workers' health. The decrease in PEFR is probably due to hypertrophy of mucosal cells due to irritation by poultry dust, resulting in increased secretions of mucus and formation of mucosal plugs which causes obstruction to exhaled air.^[22] There is an accumulation of poultry dust particles in the air passages. Moreover, grain dust (a part of poultry dust) is also associated with mucus hypersecretion and obstructive airway disease.^[23]

Decreased lung function has been observed among swine and poultry workers in various international literature.^[24-26] Lutsky *et al.* reported that the employees in poultry employment are prone to develop occupational asthma.^[27] The workers working in swine barn environment had a lower PEFR due to airway hyperactivity.^[28] Even the Dutch veterinarians demonstrated a variable value of PEFR as they are also exposed to dust.^[29] The components of the poultry dust such as the endotoxin, mites, grain particles, and wood dust are

responsible for an increase in airway inflammation and enhanced sensitivity of the airways.^[30,31] The reason is the development of inflammatory changes in the epithelial lining of the lung parenchyma.^[32]

The strength of the study is that lung function parameter by spirometry has been recorded in poultry industry workers, but the dust levels and control methods in poultry houses and environmental study of the poultry confinement buildings would have given a better correlation of the amount of poultry dust that these workers are exposed.

CONCLUSION

The present study re-emphasize the need for minimizing health hazard in poultry industry workers. We suggest that a regular medical surveillance including pulmonary function tests should be done in poultry industry workers. This preliminary screening allows early recognition of respiratory disorder so that the sensitive poultry worker can be removed from that area of workplace before chronic impairment develops.

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Table 1: PEFR (L/S) of subjects in controls ($n=66$) and cases (poultry workers) ($n=66$)

Parameter	Controls	Poultry industry workers (cases)	P value
PEFR (L/S)	8.36 ± 1.730	$5.86 \pm 1.828^*$	0.000*

Values expressed as mean $\pm$ SD, * $P < 0.05$ statistically significant.
PEFR: Peak expiratory flow rate, SD: Standard deviation

Table 2: Comparison of PEFR with the predicted value

Parameter	Poultry industry workers		% predicted
	Predicted value	Observed value	
	Mean $\pm$ SD	Mean $\pm$ SD	Mean $\pm$ SD
PEFR (L/S)	8.73 ± 0.768	5.817 ± 1.792	66.98 ± 21.78

PEFR: Peak expiratory flow rate, SD: Standard deviation

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